

**CITY OF EVANSTON**

**SPECIFICATIONS AND BID DOCUMENTS**  
**Construction Bid with Subcontractors**

**BID NUMBER: 25-05**

**For**

**Water Plant 4160V Electrical System Reliability Project**

**Dated: Thursday, February 13<sup>th</sup>, 2025**

**IEPA LOAN NO. L17-6577**



**BID DUE DATE:** 2:00 P.M., Tuesday, April 8<sup>th</sup>, 2025

**VIRTUAL BID OPENING** 2:15 P.M., Tuesday, April 8<sup>th</sup>, 2025  
**Google Meet ID:**  
[meet.google.com/erk-vjyw-pza](https://meet.google.com/erk-vjyw-pza)  
**Phone Numbers:**  
(US) [+1 617-675-4444](tel:+16176754444)  
PIN: 491 020 418 0044#

**MANDATORY PRE-BID MEETING TIME, DATE PLACE:** 11:00 A.M., Friday, February 21<sup>st</sup>, 2025  
Evanston Water Utility  
555 Lincoln Street, Evanston, Illinois 60201

For security reasons, all parties interested in attending the mandatory pre-bid meeting must submit the Non-Disclosure Agreement (see Section 00-52-10) and a list of employee names that will be attending the meeting to Paul Moyano at [pmoyano@cityofevanston.org](mailto:pmoyano@cityofevanston.org) by close of business Wednesday, February 19<sup>th</sup>, 2025 in order to attend.

**BID BOND:** 5% of Contract Amount

**PERFORMANCE/MATERIAL & LABOR PAYMENT BOND:** 100% of Contract Amount

**CONTRACT PERIOD:** 1170 Days

**ELECTRONIC BID SUBMITTAL:**

Bid responses will only be accepted electronically via E-bidding through DemandStar ([WWW.DEMANDSTAR.COM](http://WWW.DEMANDSTAR.COM))

**It is highly recommended that new DemandStar users complete the account setup process prior to project due date/time.**

(NOT USED)

**CITY OF EVANSTON**  
**Water Plant 4160V Electrical System Reliability Project**  
**PROJECT MANUAL**

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END OF SECTION

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SECTION 00 11 13  
NOTICE TO BIDDERS

Bids will be received by the City's Purchasing Office until 2:00 P.M. local time Tuesday, April 8, 2025 and will be publicly opened and read aloud virtually via Google Meets at 2:15 P.M. Interested parties can use the following link: [meet.google.com/erk-vjyw-pza](https://meet.google.com/erk-vjyw-pza) or join by phone 617-675-4444 PIN: 491 020 418 0044# to access the virtual bid opening. Responses will only be accepted electronically via E-bidding through DemandStar ([www.demandstar.com](http://www.demandstar.com)). Although registration is required, vendors can download solicitations and upload responses for free. Bids shall cover the following:

**Water Plant 4160V Electrical System Reliability Project**  
**Bid Number: 25-05**

Work on this project at the existing Evanston Water Plant includes electrical equipment replacement, miscellaneous electrical improvements, renovation and extension of the existing Garage 4, replacement of garage access ramps and retaining wall, and associated structural, electrical, civil, and mechanical works.

A **mandatory pre-bid meeting** will be held at the Evanston Water Treatment Plant, 555 Lincoln Street, Evanston, IL 60201 at 11:00 A.M. on Friday, February 21, 2025 **For security reasons, all parties interested in attending the mandatory pre-bid meeting must submit the Non-Disclosure Agreement (see Section 00-52-10) and a list of employee names that will be attending the meeting to Paul Moyano at [pmoyano@cityofevanston.org](mailto:pmoyano@cityofevanston.org) by close of business February 19, 2025 in order to attend. Only pre-registered attendees will be allowed to enter the facility for the meeting.** The drawing set included with the bid documents is heavily redacted for security. A full un-redacted drawing set will be provided to bidders who attend the mandatory pre-bid meeting.

The above item shall conform to the Invitation for Bids on file in the Purchasing Office. Parties interested in submitting a bid should contact the Purchasing Office to receive a copy of the bid or see the City's website at: [www.cityofevanston.org/business/bids-proposals/](http://www.cityofevanston.org/business/bids-proposals/) or DemandStar at: [www.demandstar.com](http://www.demandstar.com).

The City of Evanston (the City) in accordance with the laws of the State of Illinois, hereby notifies all Bidders that it will affirmatively ensure that the contract(s) entered into pursuant to this Notice will be awarded to the successful Bidders without discrimination on the ground of race, color, religion, sex, age, sexual orientation, marital status, disability, familial status or national origin. The State of Illinois requires under Public Works contracts that the general prevailing rate of wages in this locality be paid for each craft or type of worker hereunder. This requirement is in accordance with The Prevailing Wage Act (820 ILCS 130) as amended. The City of Evanston reserves the right to reject any or all submittals or to accept the submittal(s) deemed most advantageous to the City.

Each Bidder shall be required to submit with their bid a disclosure of ownership interest statement form in accordance with the provisions of City Code Section 1-18-1 *et seq.* Failure

to submit such information will result in the disqualification of such bid.

Any contract or contracts awarded under this invitation for bids are expected to be funded in part by a loan from the Illinois Environmental Protection Agency (Illinois EPA). Neither the State of Illinois nor any of its departments, agencies, or employees is or will be a party to this invitation for bids or any resulting contract. The procurement will be subject to regulations contained in the Procedures for Issuing Loans from the Public Water Supply Loan Program (35 IAC Part 662), the Davis-Bacon Act (40 USC 276a through 276a-5) as defined by the United States Department of Labor, the Employment of Illinois Workers on Public Works Act (30 ILCS 570), Illinois Works Jobs Program Act Apprenticeship Initiative (30 ILCS 559/20-1), DBE Policy per 40 CFR Part 33 as amended, and the federal "Build America, Buy America Act" requirements contained in the Infrastructure Investment and Jobs Act, Pub. L. No. 117-58.

This procurement is also subject to the City's policy regarding the increased use of disadvantaged business enterprises (DBEs). The City's policy requires all Bidders to undertake specified affirmative efforts at least sixteen (16) days prior to bid opening. The policy is contained in the specifications. Bidders are also required to comply with the President's Executive Order No. 11246, as amended. The requirements for bidders and contractors under this order are explained in 41 CFR 60-4.

Linda Thomas  
Purchasing Specialist

SECTION 00 21 00  
INSTRUCTIONS TO BIDDERS

**1. ON-LINE NOTIFICATION OF SOLICITATIONS**

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The City is utilizing Demandstar.com ([www.demandstar.com](http://www.demandstar.com)) for on-line notification purposes only for sealed bids when it is anticipated that the amount of the resulting contract will be in excess of its formal bid limit of \$25,000, such as this requirement. Interested Bidders are required to submit a sealed bid to the City by the date/time indicated for this requirement on the forms provided by the City.

**2. SUBMISSION OF BIDS**

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- A. The City of Evanston will no longer accept hard copy paper submittals for any solicitation. Responses will only be accepted electronically via E-bidding through DemandStar ([WWW.DEMANDSTAR.COM](http://WWW.DEMANDSTAR.COM)). Although registration is required, vendors can download solicitations and upload bid responses for free. **Please refer to attached DemandStar E-bidding documents.**
- B. ANY BIDS RECEIVED AFTER THE TIME AND DATE SPECIFIED FOR THE RECEIPT OF BIDS WILL NOT BE ACCEPTED. It is the sole responsibility of the Bidder to ensure that his or her bid is delivered by the stated bid opening time. THE CITY IS NOT RESPONSIBLE FOR INCOMPLETE UPLOADED SUBMITTALS.
- C. Bids will be opened on the date and time stated.
- D. Any Bidder may withdraw his or her bid by letter or with proper identification by personally securing his or her bid at any time prior to the stated bid opening time. No telephone request for withdrawal of bids will be honored.

**3. PREPARATION OF BIDS**

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The Bidder must prepare the bid on the attached bid forms. Unless otherwise stated, all blank spaces on the bid form or pages must be filled in. Either a unit price, lump sum price, or a "no-bid", as the case may be, must be stated for each and every item and must be either typed in or written in ink.

**4. SIGNING OF BIDS**

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- A. Bids which are signed for a partnership should be signed in the firm's name by all partners, or in the firm's name by Attorney-in-Fact. If signed by Attorney-in-Fact, there should be attached to the bid a Power of Attorney evidencing authority to sign the bid, dated the same date as the bid and executed by all partners of the firm.
- B. Bids which are signed for a corporation should have the correct corporate name thereon and signature of an authorized officer of the corporation manually written

below the corporate name following words "By: \_\_\_\_\_". title of office held by the person signing for corporation, which shall appear below signature of an officer.

- C. Bids which are signed by an individual doing business under a fictitious name should be signed in the name of the individual "doing business as. \_\_\_\_\_."
- D. The name of each person signing the bid shall be typed or printed below his or her signature.

## **5. CONSIDERATION OF BIDS**

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The Purchasing Specialist shall represent and act for the City in all matters pertaining to this bid and the contract in conjunction therewith.

## **6. WITHDRAWAL OF BIDS**

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Bidders may withdraw or cancel their bids at any time prior to the advertised bid opening time. After the bid opening time, no bid shall be withdrawn or canceled for a period of sixty (60) calendar days. When contract approval is required by another agency, such as the Federal Government or the State of Illinois, no bid shall be withdrawn or canceled for a period of one hundred twenty (120) calendar days.

## **7. ERRORS IN BIDS**

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Bidders are cautioned to verify their bids before submission. Negligence on the part of the respondent in preparing the bid confers no right for withdrawal or modification of the bid after it has been opened. In case of error in the extension of prices in the bid, unit prices will govern.

## **8. ADDENDA**

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- A. Any and all changes to the specifications/plans are valid only if they are included by written addendum to all Bidders. Each Bidder must acknowledge receipt of any addenda by indicating on the Bid form. Each Bidder, by acknowledging receipt of any addenda, is responsible for the contents of the addenda and any changes to the bid therein. Failure to acknowledge any addenda may cause the bid to be rejected.
- B. Addenda information is available over the internet at: [City of Evanston Notices to Bidders](#) or [www.demandstar.com](http://www.demandstar.com), or by contacting the Purchasing Office.

## **9. RESERVED RIGHTS**

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The City of Evanston reserves the right at any time and for any reason to cancel his or her solicitation, to accept or reject any or all bids or any portion thereof, or to accept an alternate response. The City reserves the right to waive any immaterial defect in any response. The City may seek clarification from any respondent at any time, and failure to respond within a reasonable time period, or as otherwise directed, will be cause for rejection.

## **10. AWARD**

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It is the intent of the City to award a contract to the lowest responsive and responsible Bidder meeting specifications. Award will be based on the following factors (where applicable): (a) adherence to all conditions and requirements of the bid specifications; (b) price; and (c) qualifications of the Bidder, including past performance, financial responsibility, general reputation, experience, service capabilities, and facilities.

The City may make such investigations as deemed necessary to determine the ability of the Bidder to perform the Work, and the Bidder shall furnish to the City all such information and data for this purpose as the City may request. The City reserves the right to reject any Bid if the evidence submitted by, or investigation of, such Bidder fails to satisfy the City that such Bidder is properly qualified to carry out the obligations of the Agreement and to complete the Work contemplated therein.

## **11. INTERPRETATION OR CORRECTION OF BIDDING DOCUMENTS**

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Bidders shall promptly notify the City of any ambiguity, inconsistency, or error that they discover upon examination of the bidding documents. Interpretations, corrections, and changes will be made by addendum. Each Bidder shall ascertain prior to submitting a bid that all addenda have been received and are acknowledged in the bid.

## **12. INCONSISTENCIES AND OMISSIONS**

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These specifications and the accompanying plans, if any, are intended to include all information necessary for the work contemplated. If, by inadvertence or otherwise, the plans or specifications omit some information necessary for that purpose, the contractor shall, nevertheless, be required to perform such work at no additional cost to the City so that the project may be completed according to the true intent and purpose of the plans and specifications.

## **13. CONDITIONS**

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Bidders are advised to become familiar with all conditions, instructions, and specifications governing his or her bid. Once the award has been made, failure to have read all the conditions, instructions and specifications of this contract shall not permit the Bidder to amend contract or to request additional compensation.

## **14. VERIFICATIONS OF DATA**

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- A. It is understood and agreed that the unit quantities given in these specifications are approximate only, and the contractor shall verify these quantities before bidding as no claim shall be made against the City on, or account of, any excess or deficiency in the same.
- B. The contractor shall have visited the premises and determined for itself, by actual observation, boring, test holes, or other means, the nature of all soil and water conditions (both above and below ground in the line of work) that may be

encountered in all construction work under this contract. The cost of all such inspection, borings, etc. shall be borne by the contractor, and no allowance will be made for the failure of the contractor to estimate correctly the difficulties attending the execution of the work.

## **15. SPECIFICATIONS**

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Reference to brand names and numbers is meant to be descriptive, not restrictive, unless otherwise specified. Bids on equivalent items will be considered, provided the Bidder clearly states exactly what is proposed to be furnished, including complete specifications. Unless the Bidder specifies otherwise, it is understood the Bidder is offering a referenced brand item as specified or is bidding as specified when no brand is referenced, and does not propose to furnish an "equal." The City reserves the right to determine whether a substitute offer is equivalent to, and meets the standard of quality indicated by the brand name and number.

## **16. SAMPLES**

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When samples of items are called for by the specifications, samples must be furnished free of expense, and if not destroyed in the evaluation process will be returned at the Bidder's expense upon request. Request for the return of samples must accompany the sample and must include a UPS/Fed-Ex Pickup Slip, postage, or other acceptable mode of return. Individual samples must be labeled with Bidder's name, invitation number, item reference, manufacturer's brand name and number.

## **17. REGULATORY COMPLIANCE**

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Each Bidder represents and warrants that the goods or services furnished hereunder (including all labels, packages and containers for said goods) comply with all applicable standards, rules and regulations in effect under the requirements of all Federal, State, and local laws, rules and regulations as applicable, including the Occupational Safety and Health Act as amended, with respect to design, construction, manufacture, or use for their intended purpose of said goods or services. Each Bidder must furnish a "Material Safety Data Sheet" in compliance with the Illinois Toxic Substances Disclosure to Employees Act when required.

## **18. PRICING**

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The price quoted for each item is the full purchase price, including delivery to destination, and includes all transportation and handling charges, materials or service costs, patent royalties, and all other overhead charges of every kind and nature. Unless otherwise specified, prices shall remain firm for the contract period.

## **19. DISCOUNTS**

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Prices quoted must be net after deducting all trade and quantity discounts. Where cash discounts for prompt payment are offered, the discount period shall

begin with the date of receipt of a correct invoice or receipt or final acceptance of goods, whichever is later.

## **20. INSPECTION**

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Materials or equipment purchased are subject to inspection and approval at the City's destination. The City reserves the right to reject and refuse acceptance of items which are not in accordance with the instructions, specifications, drawings or data of Seller's warranty (express or implied). Rejected materials or equipment shall be removed by, or at the expense of, the Seller promptly after rejection.

## **21. BIDS AND PLAN DEPOSITS**

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- A. When required on the cover sheet, all bids shall be accompanied by a bid deposit in the amount specified. Bid deposits shall be in the form of cash, a certified check, or cashier's check drawn on a responsible bank doing business in the United States and shall be made payable to the City of Evanston. Bid Bonds are also acceptable. All bids not accompanied by a bid deposit, when required, will be rejected.
- B. The City will return the bid deposits of all but the 3 lowest qualified Bidders, whose deposit will be held until contract award or at the expiration of the sixty-day or ninety-day period for bid award.
- C. The bid deposit of the successful Bidder will be retained until contract documents have been executed and the Contractor has submitted all the required information. Failure to comply with the terms of this specification may be cause for forfeiture of said deposit.
- D. When required, plan deposits will be refunded should the plans be returned in good condition within 10 days of the bid opening.

## **22. DISPUTES**

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Any dispute concerning a question of fact arising under this bid shall be decided by the Purchasing Specialist, who shall issue a written decision to the Bidder. The decision of the Purchasing Specialist shall be final and binding.

## **23. CATALOGS**

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Each Bidder shall submit, when requested by the Purchasing Specialist, catalogs, descriptive literature, and detailed drawings, fully detailing features, designs, construction, appointments, finishes and the like not covered in the specifications, necessary to fully describe the material or work proposed to be furnished.

## **24. TAXES**

---

- A. Federal Excise Tax does not apply to materials purchased by the City of Evanston by virtue of Exemption Certificate No. A-208762, Illinois Retailers' Occupation Tax, Use Tax, and Municipal Retailers' Occupation Tax do not apply to materials or services purchased by the City of Evanston by virtue of Statute.

- B. The City of Evanston is exempt from Illinois Sales Tax by virtue of Exemption Identification number E9998-1750.
- C. The City's federal tax ID number is 36-6005870.

**25. PERMITS & FEES**

---

All Bidders awarded a contract must secure and pay for any licenses required by the City of Evanston. Necessary building permits will be required, but all permit fees will be waived and moneys for same must not be included in any bid.

**26. ROYALTIES & PATENTS**

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Seller must pay all royalties and license fees. Seller must defend all suits or claims for infringement of any patent, copyright or trademark rights, and must hold the City harmless from loss on account thereof.

**27. LOCAL PREFERENCE POLICY**

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Not used.

**28. POWER OF ATTORNEY**

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An Attorney-In-Fact, who signs any and all of the bond or contract bonds submitted with this bid, must file with each bond a certified and effectively dated copy of their Power of Attorney. These dates should be the same or after the date of the contract.

**29. WARRANTY**

---

- A. The contractor warrants that all goods and services furnished to the City shall be in accordance with specifications and free from any defects of workmanship and materials: that goods furnished to the City shall be merchantable and fit for the City's described purposes, and that no governmental law, regulation, order, or rule has been violated in the manufacture or sale of such goods.
- B. The contractor warrants all equipment furnished to be in acceptable condition, and to operate satisfactorily for a period of one (1) year from delivery of, or the completion of installation, whichever is latest, unless stated otherwise in the specifications, and that if a defect in workmanship and/or quality of materials are evidenced in this period, the Seller shall remit full credit, replace, or repair at City's discretion immediately, such equipment and/or parts that are defective at no additional cost to the City.
- C. The contractor warrants to the City that each item furnished hereunder, and any component part thereof, will be new and in conformity with the specifications in all respects, unless otherwise specified, and is of the best quality of its respective kind, free from faulty workmanship, materials, or design, and installed sufficiently to fulfill any operating conditions specified by the City.

- D. The contractor shall repair or replace any item or component part thereof found not to be in conformity with this paragraph provided the City notified the Seller of such nonconformity within one (1) year after initial use or within eighteen (18) months after delivery, whichever occurs first. In the event Seller fails to proceed diligently to so replace or repair within a reasonable time after receipt of such notice, the City may undertake or complete such replacement or repair for Seller's account, and the seller will be responsible for any additional costs. Acceptance shall not relieve the seller of its responsibility.

### **30. INCURRED COSTS**

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The City will not be liable for any costs incurred by Bidders in replying to this invitation for bids.

### **31. VARIANCES**

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Each Bidder must state or list by reference any variations to specifications, terms and/or conditions set forth herein with its bid.

### **32. INDEMNIFICATION**

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- A. The awarded Bidder/Contractor shall defend, indemnify and hold harmless the City and its officers, elected and appointed officials, agents, and employees from any and all liability, losses, or damages as a result of claims, demands, suits, actions, or proceedings of any kind or nature, including but not limited to costs, and fees, including attorney's fees, judgments or settlements, resulting from or arising out of any negligent or willful act or omission on the part of the Contractor or Contractor's subcontractors, employees, agents or subcontractors during the performance of this Agreement. Such indemnification shall not be limited by reason of the enumeration of any insurance coverage herein provided. This provision shall survive completion, expiration, or termination of this Agreement.
- B. Nothing contained herein shall be construed as prohibiting the City, or its officers, agents, or employees, from defending through the selection and use of their own agents, attorneys, and experts, any claims, actions or suits brought against them. The Contractor shall be liable for the reasonable costs, fees, and expenses incurred in the defense of any such claims, actions, or suits. Nothing herein shall be construed as a limitation or waiver of defenses available to the City and employees and agents, including but not limited to the Illinois Local Governmental and Governmental Employees Tort Immunity Act, 745 ILCS 10/1-101 *et seq.*
- C. At the City Corporation Counsel's option, Contractor must defend all suits brought upon all such Losses and must pay all costs and expenses incidental to them, but the City has the right, at its option, to participate, at its own cost, in the defense of any suit, without relieving Contractor of any of its obligations under this Agreement. Any settlement of any claim or suit related to this Project by Contractor must be made only with the prior written consent of the City Corporation Counsel, if the settlement requires any action on the part of the City.

- D. To the extent permissible by law, Contractor waives any limits to the amount of its obligations to indemnify, defend, or contribute to any sums due under any Losses, including any claim by any employee of Contractor that may be subject to the Illinois Compensation Act, 820 ILCS 305/1 et seq. or any other related law or judicial decision, including but not limited to, *Kotecki v. Cyclops Welding Corporation*, 146 Ill. 2d 155 (1991). The City, however, does not waive any limitations it may have on its liability under the Illinois Workers Compensation Act, the Illinois Pension Code or any other statute.
- E. The Contractor shall be responsible for any losses and costs to repair or remedy work performed under this Agreement resulting from or arising out of any act or omission, neglect, or misconduct in the performance of its Work or its subcontractors' work. Acceptance of the work by the City will not relieve the Contractor of the responsibility for subsequent correction of any such error, omissions and/or negligent acts or of its liability for loss or damage resulting therefrom.
- F. All provisions of this Section 32 shall survive completion, expiration, or termination of this Agreement.

### **33. DEFAULT**

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Time is of the essence as to the awarded contract and, of delivery or acceptable items or rendering of services is not completed by the time promised, the City reserves the right, without liability, in addition to its other rights and remedies, to terminate the contract by notice effective when received by Seller, as to stated items not yet shipped or services not yet rendered and to purchase substitute items or services elsewhere and charge the Seller with all losses incurred. The City shall be entitled to recover its attorney's fees and expenses in any successful action by the City to enforce this contract.

### **34. GOVERNING LAW**

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This contract shall be governed by and construed according to the laws of the State of Illinois. In the event of litigation, the venue will be Cook County, Illinois.

### **35. EQUAL EMPLOYMENT OPPORTUNITY**

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- A. In the event of the contractor's noncompliance with any provision of the Illinois Human Rights Act or Section 1-12-5 of the Evanston City Code, the contractor may be declared non-responsible and therefore ineligible for future contracts or subcontracts with the City of Evanston, and the contract may be canceled or voided in whole or in part, and such other sanctions or penalties may be imposed or remedies invoked as provided by Statute or regulation.
- B. During the performance of this contract, the contractor agrees as follows:

1. That it will not discriminate against any employee or applicant for employment because of race, color, religion, sex, national origin or ancestry, or age or physical or mental handicap that does not impair ability to work, and further that it will examine all job classifications to determine if minority persons or women are underutilized and will take appropriate affirmative action to rectify any such underutilization. Contractor shall comply with all requirements of City of Evanston Code Section 1-12-5
2. That, in all solicitations or advertisements for employees placed by it or on its behalf, it will state that all applicants will be afforded equal opportunity without discrimination because of race, color, religion, sex, national origin or ancestry.
3. That, if it hires additional employees in order to perform this contract, or any portion hereof, it will determine that availability (in accordance with the Fair Employment Commission's Rules and Regulations for Public Contracts) of minorities and women in the area(s) from which it may reasonably recruit and it will hire for each job classification for which employees are hired in such a way that minorities and women are not underutilized.
4. That it will send to each labor organization or representative of workers with which it has or is bound by a collective bargaining or other agreement or understanding, a notice advising such labor organization or representative of the contractor's obligations under the Illinois Fair Employment Practices Act and the Fair Employment Practices Commission's Rules and Regulations for Public Contracts. If any such labor organization or representative fails or refuses to cooperate with the contractor in its efforts to comply with such Act and Rules and Regulations, the contractor will promptly so notify the Illinois Fair Employment Practices Commission and the contracting agency and will recruit employees from other sources when necessary to fulfill its obligations hereunder.
5. That it will submit reports as required by the Illinois Fair Employment Practices Commission's Rules and Regulations for Public Contracts, furnish all relevant information as may from time to time be requested by the Fair Employment Practices Commission or the contracting agency, and in all respects comply with the Illinois Fair Employment Practices Commission's Rules and regulations for Public Contracts.
6. That it will permit access to all relevant books, records, accounts and work sites by personnel of the contracting agency, the City Manager, the Commission and the Illinois Fair Employment Practices Commission for purposes of investigation to ascertain compliance with the Illinois Fair Employment Practices Act and the Fair Employment Practices Act and the Fair Employment Practices Commission's Rules and Regulations for Public Contract.

7. That it will include verbatim or by reference the provisions of subsections (A) through (G) of this clause in every performance subcontract as defined in Section 2.10(b) of the Fair Employment Practices Commission's Rules and Regulations for Public Contracts so that such provisions will be binding upon every such subcontractor; and that it will also include the provisions of subsections (A), (E), (F), and (G) in every supply subcontract as defined in Section 2.10(a) of the Fair Employment Practices Commission's Rules and Regulations for Public Contracts so that such provisions will be binding upon every such subcontractor. In the same manner as with other provisions of this contract, the contractor will be liable for compliance with applicable provisions of this clause by all its subcontractors; and further it will promptly notify the contracting agency and the Illinois Fair Employment Practices Commission in the event any subcontractor fails or refuses to comply therewith. In addition, no contractor will utilize any subcontractor declared by the Fair Employment Practices Commission to be non-responsible and therefore ineligible for contracts or subcontracts with the State of Illinois or any of its political subdivisions or municipal corporations.
- C. BIDDER shall not discriminate based on race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 40 CFR Part 33 in the award and administration of contracts awarded under EPA financial assistance agreements. Failure by the contractor to carry out these requirements is a material breach of this contract which may result in the termination of this contract or other legally available remedies

### **36. DBE GOAL**

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The City of Evanston has a goal of awarding 17% of its contracts to Minority-Owned and Women-Owned Disadvantaged Enterprise businesses (M/W/D/EBEs) in compliance with the State of Illinois Disadvantaged Business Enterprise Policy. All Bidders must state the proposed involvement of DBEs in completing a portion of the services required by the City by completing the attached DBE forms. Any questions regarding DBE compliance should be submitted in writing to Cheryl Stuart, Purchasing Specialist at [cstuart@cityofevanston.org](mailto:cstuart@cityofevanston.org).

### **37. LOCAL EMPLOYMENT PROGRAM REQUIREMENTS**

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Not Used.

### **38. QUESTIONS**

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All questions related to this bid document should be submitted in writing to Cheryl Stuart, Purchasing Specialist at [cstuart@cityofevanston.org](mailto:cstuart@cityofevanston.org) with a copy to Paul Moyano, at [pmoyano@cityofevanston.org](mailto:pmoyano@cityofevanston.org). Only inquiries received a minimum of seven (7) working days prior to the date set for the opening of bids, will be given any consideration.

### **39. COORDINATION OF EXISTING SITE WITH DRAWINGS**

---

- A. Before submitting a bid, bidders shall carefully examine the drawings and specifications, visit the site, and fully inform themselves as to all conditions and limitations.
- B. Should a bidder find discrepancies in, or omissions from the drawings or specifications, or should be in doubt as to their meaning, the bidder should at once notify the Purchasing Specialist, who will issue necessary instructions to all bidders in the form of an addendum.

### **40. AFFIRMATIVE ACTION IN SUB-CONTRACTING (EXCERPT FROM RESOLUTION 59-R-73)**

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“Contractor agrees that he shall actively solicit bids for the subcontracting of goods or services from qualified minority businesses. At the request of the City, Contractor shall furnish evidence of his compliance with this requirement of minority solicitation. Contractor further agrees to consider the grant of subcontracts to said minority bidders on the basis of substantially equal bids in the light most favorable to said minority businesses. Contractor further affirms that in obtaining his performance and bid bonds, he will seek out and use companies who have records of, and/or who will make commitments to, the bonding of minority contractors on a rate basis comparable to their bonding of similar non-minority contractors. The contractor may be required to submit this evidence as part of the bid or subsequent to it.”

### **41. COMPLIANCE WITH LAWS**

---

- A. The bidder shall at all times observe and comply with all laws, ordinances and regulations of the Federal, State, Local and City Governments, which may in any manner affect the preparation of bids or the performance of the contract.

### **42. QUALIFICATION OF BIDDERS**

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- A. All bidders must be qualified in accordance with the instructions, procedures and methods set forth in this specification.
- B. In awarding contract, City may take into consideration, skill, facilities, capacity, experience, ability, responsibility, previous work, financial standing of bidder, amount of work being carried on by bidder, quality and efficiency of construction

equipment proposed to be furnished, period of time within which proposed equipment is furnished and delivered, necessity of prompt and efficient completion of work herein described. Inability of any bidder to meet requirements mentioned above may be cause for rejection of the bid. In addition, if the project covered by this contract is a minority set-aside project, the contractor's qualifications as a minority firm will determine the eligibility of the contractor to bid.

#### **43. COMPETENCY OF BIDDER**

---

- A. No bid will be accepted from or contract awarded to any person, firm or corporation that is in arrears or is in default to the City of Evanston upon any debt or contract, or that is a defaulter, as surety or otherwise, upon any obligation to said City, or had failed to perform faithfully any previous contract with the City.
- B. The bidder, if requested, must present within forty eight (48) hours evidence satisfactory to the Purchasing Manager of performance ability and possession of necessary facilities, pecuniary resources and adequate insurance to comply with the terms of these specifications and contract documents.

#### **44. PREFERENCE TO CITIZENS**

---

The Contractor shall abide by the Illinois Preference Act, 30 ILCS 570 et seq., which stipulates that whenever there is a period of excessive unemployment in Illinois, defined as any month immediately following two (2) consecutive months during which the level of unemployment in Illinois exceeds five percent (5%) as measured by the U.S. Bureau of Labor Statistics in its monthly publication of employment and unemployment figures, the Contractor shall employ only Illinois laborers unless otherwise exempted as so stated in the Act. ("Illinois laborer" means any person who has resided in Illinois for at least 30 days and intends to become or remain an Illinois resident) Other laborers may be used IF Illinois laborers are not available or are incapable of performing the particular type of work involved if so certified by the Contractor and approved by the project engineer.

#### **45. ACCESS**

---

Any contract entered into by the City and any sub-agreement hereunder, shall provide that representatives of the IEPA will have access to the work whenever it is in preparation or progress and that the contractor or subcontractor will provide proper facilities for such access and inspection. Such contract or sub-agreement must also provide that the IEPA or any authorized representative shall have access to any books, documents, papers, and records of the contractor or subcontractor, which are pertinent to the project for the purpose of making audit, examination, excerpts, and transcriptions thereof.

#### **46. NOTICE TO PROCEED**

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The City shall issue the Notice to Proceed within ten days of the execution of the Agreement. Should there be reasons why the Notice to Proceed cannot be issued within such period, the time may be extended by mutual agreement between the City and Contractor. If the Notice to Proceed has not been issued within the ten-day period or within the period mutually agreed upon, the Contractor may terminate the Agreement without further liability on the part of either party.

#### **47. NOTICE OF AWARD**

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The party to whom the contract is awarded will be required to execute the Agreement and obtain the performance BOND and payment BOND within ten (10) calendar days from the date when NOTICE OF AWARD is delivered to the BIDDER. The necessary Agreement and BOND forms shall accompany the NOTICE OF AWARD. In case of failure of the BIDDER to execute the Agreement, the OWNER may at his or her or her option consider the BIDDER in default, in which case the BID BOND accompanying the proposal shall become the property of the OWNER.

The OWNER within ten (10) days of receipt of acceptable performance BOND, payment BOND and Agreement signed by the party to whom the Agreement was awarded shall sign the Agreement and return to such party an executed duplicate of the Agreement. Should the OWNER not execute the Agreement within such period, the BIDDER may by WRITTEN NOTICE withdraw his or her signed Agreement. Such notice of withdrawal shall be effective upon receipt of the notice by the OWNER.

#### **48. EMPLOYMENT OF ILLINOIS WORKERS**

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The bidder must ensure compliance with the Employment of Illinois Workers on Public Works Act (30 ILCS 570) that requires contractors to use at least 90% Illinois laborers on all public works projects that receive State funds administered by the State during a period of excessive unemployment. Excessive unemployment is defined as any month immediately following 2 consecutive calendar months that the Illinois unemployment rate exceeds 5%.

#### **49. ILLINOIS WORKS JOBS PROGRAM ACT**

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The bidder must ensure compliance with the Illinois Works Apprenticeship Initiative. Waivers will not be honored unless they are approved by IL DCEO and submitted with the bid.

#### **50. DAVIS-BACON WAGE ACT**

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The bidder must ensure compliance with the Davis-Bacon Wage Act (40 USC 276a through 276a-5) as defined by the United States Department of Labor.

#### **51. ADDITIONAL PAYROLL REPORTING REQUIREMENTS**

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Monthly payroll reports must be submitted to Illinois Department of Labor through the certified transcript of payroll portal. You may access the portal

here: <https://labor.illinois.gov/laws-rules/conmed/certifiedtranscriptofpayroll.html>

All contractors and sub-contractors on public works projects must submit and upload certified payrolls on a monthly basis to the IDOL online portal, provide a pdf copy to the City's project manager and business work force development coordinator, along with a statement affirming that such records are true and accurate, that the wages paid to each worker are not less than the required prevailing rate and that the contractor is aware that filing records her or she knows to be false is a Class B misdemeanor.

The certified payroll record must include for every worker employed on the public works project the name, address, telephone number, social security number, job classification, hourly wages paid in each pay period, number of hours worked each day, and starting and ending time of work each day. These certified payroll records are considered public records and public bodies must make these records available to the public under the Freedom of Information Act, with the exception of the employee's address, telephone number and social security number. Any contractor who fails to submit a certified payroll or knowingly files a false certified payroll is guilty of a Class B misdemeanor.

As a condition of receiving payment, Contractor must (i) be in compliance with the Agreement, (ii) pay its employees prevailing wages when required by law (Examples of prevailing wage categories include public works, printing, janitorial, window washing, building and grounds services, site technician services, natural resource services, security guard and food services). Contractor is responsible for contacting the Illinois Dept. of Labor 217-782-1710; <https://www2.illinois.gov/idol/Laws-Rules/CONMED/Pages/prevailing-wage-act.aspx> compliance with prevailing wage requirements), (iii) pay its suppliers and sub-contractors according to the terms of their respective contracts, and (iv) provide lien waivers to the City upon request.

## **52. BUILD AMERICA, BUY AMERICA ACT**

---

The bidder must comply with the federal Build America, Buy America Act (BABA) which is included in the Infrastructure Investment and Jobs Act, Pub. L. No. 117-58 and specifies that all iron, steel, manufactured products, and construction materials used in the project are produced in the United States

END OF SECTION

SECTION 00 21 10  
E-BIDDING INFORMATION

DemandStar E-Bidding Information continues on next page.

# Registering for DemandStar



We are pleased to announce our membership in the DemandStar network. DemandStar is an online marketplace that connects our suppliers directly to the bids, quotes and RFPs that matter to them.

DemandStar is open and accessible to all businesses and provides instant access to our solicitations. By registering for your complimentary DemandStar account, you will receive:

- **Instant** access to bids, quotes and RFPs
- **Automatic** notifications, right to you inbox, of bids that match the commodity codes you select
- The ability to **quickly view** the contractual terms and scope of work
- All the **forms and documents** you need in one place
- Access to **more government bids** in neighboring cities, counties and states

**It's EASY!** Get started with these 3 easy steps!

## 1 REGISTER

Go to:

<https://www.demandstar.com/registration>

### Create an Account with DemandStar

You are one step away from picking your free government agency

Email Address

Company Name

I accept the DemandStar [Terms of Use](#) and [Privacy Policy](#)

Next



## 2 CHOOSE YOUR FREE AGENCY

Type in the name of the government agency you'd like to add, for example "City of Metropolis" in the Search Box

## 3 CHECK OUT

Check out with your **FREE AGENCY** Registration by clicking "Skip for now" on the page where it gives you options to add additional counties and States

### ← Choose Your Free Agency

Receive full access to the government agency of your choice and receive advance notifications of new opportunities.

City of Metropolis ✕

Narrow down your search by selecting a state and county.

<b>State</b>	<b>County</b>
Select State ▼	Select County ▼

- City of Metropolis – Board of Commisioners
- City of Metropolis Purchasing
- Metropolis Technical College

You have chosen **Metropolis Technical College** as your free agency.  
Add additional government agencies below for \$25 per County,  
Statewide and National subscriptions available.

My Subscriptions  [0]

**Nation (0)**

**States (0)**

**Counties (0)**

		Your Current Rate
<b>Total</b>	<b>(0 subscriptions)</b>	<b>\$0/year</b>

**Proceed to Checkout**

**Skip for Now**

**SIGN UP**

Visit [www.demandstar.com](http://www.demandstar.com)





# DEMANDSTAR

**B u i l d i n g C o m m u n i t i e s .**

(E-bidding) Electronic Bidding Instructions

# Introduction

To submit a bid electronically (e-bidding) on DemandStar

- The project **MUST** be setup for e-bidding by the government agency advertising the opportunity

Bid Identifier	Agency Name	Bid Status	Broadcast Date	Date Due ▼	Name	Actions
RFP-2019-01-0-2019/df	Town of Malabar	Active	5/15/2019	5/31/2019	Malabar Parks and Recreation Board Memorial Wall Project	Planholders, Download/Order, Details
EBID-20190077-0-2019/HF	City of Port St. Lucie, Procurement Management Department	Active	4/25/2019	5/31/2019	Purchase Breaching "Backpa Gas Masks and Gas Mask Cartridges for the Police Department JAG Grant Funded	E-Bidding, Planholders, Download/Order, Details



## How to check if it is an e-bidding opportunity

- Not all opportunities posted on DemandStar by government are available for e-bidding
- Those that are available for you to electronically bid will list "e-bidding" as an available "ACTION" when you look at the project details

In order to do e-bidding

1. Click on "E-bidding" in the actions column

Bid Identifier	Agency Name	Bid Status	Broadcast Date	Date Due ▼	Name	Actions
RFP-2019-01-0-2019/df	Town of Malabar	Active	5/15/2019	5/31/2019	Malabar Parks and Recreation Board Memorial Wall Project	Planholders, Download/Order, Details
EBID-20190077-0-2019/HF	City of Port St. Lucie, Procurement Management Department	Active	4/25/2019	5/31/2019	Purchase Breaching "Backpack" Gas Masks and Gas Mask Cartridges for the Police Department JAG Grant Funded	E-Bidding, Planholders, Download/Order, Details

In order to do e-bidding

2. Enter your contact information and enter in all required fields

Note: You **MUST** put a number of the “BID AMOUNT” box. However, that number can be 0 so as to allow for a more detailed description of your bid through your uploaded documents.

## Contact Information

*\*indicates required fields*

Company Name \*

Address 1 \*

Address 2

City \*

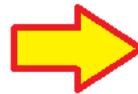
State \*

Postal Code \*

Phone \*

Fax

Country \*



Bid Amount \*

Alternate Bid Amount

Notes

# In order to do e-bidding

- In the agency required documents section – check the documents you intend on uploading and fulfilling. By checking these boxes this is **ONLY** an acknowledgement of how you will fulfill the requirement. You still have to upload the documents.

## Required Documents



The following documents are required by the agency for this project. Please select which documents you will be submitting electronically (online) and which ones you will submit directly to the agency (offline).

### Agency Required Documents

Document	None	Online/ Electronic	Offline/ Manual	Not submitting
-	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<a href="#">Bid Reply</a>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<a href="#">Checklist</a>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<a href="#">Subcontractor List</a>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<a href="#">Current Workload, List of Projects and Completion Dates</a>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
<a href="#">Questionnaire</a>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<a href="#">Drug Free Workplace Form</a>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

# In order to do e-bidding

Upload your response documents in an accepted file format

Make sure that you have covered and uploaded all the required documents

## E-Bid Response Documents

Agency Name	City of Port St. Lucie, Procurement Management Department
Bid Number	EBID-20190077-0-2019/HF
Bid Name	Purchase Breaching "Backpack" Kits, Gas Masks and Gas Mask Cartridges for the Police Department JAG Grant Funded
Bid Due Date	5/31/2019 3:00:00 PM Eastern time
Bid Opening	14 days, 21 hours, 45 minutes, 5 seconds

*No response documents uploaded*

### Agency Accepted File Formats

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Formats

Adobe Acrobat (\*.PDF )  
Microsoft Excel (\*.XLS )  
Microsoft Excel (\*.XLSX )  
Microsoft PowerPoint (\*.PPT )  
Microsoft Word (\*.DOC )  
Microsoft Word (\*.DOCX )

### Upload Electronic Documents

---

*\* indicates required fields*



Document Title \*

Specify Upload Document \*

No file chosen

(Type the path of the document, or click the Browse button.)

In order to do e-bidding

Once you decide you've uploaded all your documents that you would like to submit, make sure you click the **NEXT** button at the bottom of the screen

### E-Bid Response Documents

Agency Name: City of Port St. Lucie, Procurement Management Department  
Bid Number: EBID-20180218-6-2018jer  
Bid Name: Sculpture on Lawn at City Hall Temporary Art Installation  
Bid Due Date: 1/9/2019 2:00:00 PM Eastern time  
Bid Opening: 100 days, 1 hour, 20 minutes, 11 seconds

Document Title	Format	Size	Uploaded	Status	Action
 E-Bidding for Suppliers	Microsoft Word	12 Kb	10/1/2018 9:30:50 AM	Complete	<a href="#">View</a> <a href="#">Remove</a>

#### Agency Accepted File Formats

Formats

- Adobe Acrobat (\*.PDF)
- Microsoft Excel (\*.XLS)
- Microsoft Excel (\*.XLSX)
- Microsoft PowerPoint (\*.PPT)
- Microsoft Word (\*.DOC)
- Microsoft Word (\*.DOCX)

#### Upload Electronic Documents

\* indicates required fields

Document Title \*

Specify Upload Document \*

(Type the path of the document, or click the Browse button.)

Your document has successfully uploaded but your response is not yet complete. You must still click 'Submit Response' on Bid Response Details page in order to complete your response and receive a confirmation



# Completing your e-bid submittal

- Please **VERIFY** that you have attached **ALL** the required documents
- Click on the **Submit Response** button to complete your e-bid

## Agency Required Documents

EDIT

1. Bid Reply (Electronic/Online) ✓
2. Checklist (Electronic/Online) ✓
3. Subcontractor List (Electronic/Online) ✓
4. Current Workload, List of Projects and Completion Dates (Electronic/Online) ✓
5. Questionnaire (Electronic/Online) ✓
6. Drug Free Workplace Form (Electronic/Online) ✓
7. Current Certificate of Insurance (Electronic/Online) ✓
8. License/Certification to do Described Work (Electronic/Online) ✓
9. Reference Check Form (Electronic/Online) ✓
10. E-Bid Reply Excel Spreadsheet (Electronic/Online) ✓
11. E-Bid Bond (Electronic/Online) ✓
12. Vendor Code of Ethics (Electronic/Online) ✓
13. W-9 form (Electronic/Online) ✓

## Uploaded Documents

EDIT

1. test document upload to ensure ebidding active

### E-Bid Confirmation

After clicking "Submit Response" the following process will begin:

- We will verify that your response is complete as entered.
- You will see a confirmation page with your confirmation number and date/time stamp of your upload.
- You will receive a confirmation e-mail indicating a successful response submittal.
- You may track your response submission under the View Responses page.

If you do not receive any of the above, please call Supplier Services at (206) 940-0305.

<< Return

Submit Response

## Confirmation of Response

- When you complete you will receive a confirmation
- This is a confirmation that what you uploaded will be visible to the agency when the bid closes, **this is not** a confirmation that all your documents were fill out or submitted correctly

### E-Bid Response Details

**Agency Name** City of Port St. Lucie, Procurement Management Department

**Bid Number** EBID-20180218-0-2018/er

**Bid Name** **Sculpture on Lawn at City Hall Temporary Art Installation**

**Bid Due Date** 1/9/2019 2:00:00 PM Eastern time

**Bid Opening** 100 days, 1 hour, 5 minutes, 46 seconds

**Response #** 15104

**Results** Your bid response is submitted.

← Return

# Post Submission Edits

If you feel like you missed something or need to make a change you can go back to your submittal response and edit your e-bid. By clicking on “DETAILS” then “EDIT” the section you wish

Bid Identifier	Agency Name	Bid Status	Broadcast	Date Due ▼	Name	Status	Actions
EBID-20190077-0-2019/HF	City of Port St. Lucie, Procurement Management Department	Active	4/25/2019	5/31/2019	Purchase Breaching “Backpack” Kits, Gas Masks and Gas Mask Cartridges for the Police Department JAG Grant Funded	Incomplete	<a href="#">Details, Bid, History</a>

## Contact Information

**EDIT**

**Company Name** Sample DBE Company  
**Address 1** 509 Olive Way  
**Address 2**  
**City** Seattle  
**State** Washington  
**Postal Code** 98101  
**Phone** 2063739233  
**Fax** 2063739233  
**Country** United States of America  
**Bid Amount** \$0.00  
**Alternate Bid Amount**  
**Notes**



## Agency Required Documents

**EDIT**

1. Bid Reply (Electronic/Online) ✓

SECTION 00 30 10  
DISCLOSURE OF OWNERSHIP INTERESTS

City of Evanston Ordinance 15-0-78 requires all persons (APPLICANT) seeking to do business with the City to provide the following information with their bid. Every question must be answered. If the question is not applicable, answer with "NA".

APPLICANT NAME: \_\_\_\_\_

APPLICANT ADDRESS: \_\_\_\_\_

TELEPHONE NUMBER: \_\_\_\_\_

FAX NUMBER: \_\_\_\_\_

APPLICANT is (**Check One**)      1. Corporation ( ) 2. Partnership ( ) 3. Sole Owner ( )  
4. Association ( ) 5. Other ( ) \_\_\_\_\_

Please answer the following questions on a separate attached sheet if necessary.

**SECTION I - CORPORATION**

1a. Names and addresses of all Officers and Directors of Corporation.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

1b. (Answer only if corporation has 33 or more shareholders.) Names and addresses of all those shareholders owning shares equal to or in excess of 3% of the proportionate ownership interest and the percentage of shareholder interest. (Note: Corporations which submit S.E.C. form 10K may substitute that statement for the material required herein.)

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

1c. (Answer only if corporation has fewer than 33 shareholders.) Names and addresses of all shareholders and percentage of interest of each herein. (Note: Corporations which submit S.E.C. form 10K may substitute that statement for the material requested herein.)

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**SECTION 2 - PARTNERSHIP/ASSOCIATION/JOINT VENTURE**

2a. The name, address, and percentage of interest of each partner whose interests therein, whether limited or general, is equal to or in excess of 3%.

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2b. Associations: The name and address of all officers, directors, and other members with 3% or greater interest.

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**SECTION 3 - TRUSTS**

3a. Trust number and institution.

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3b. Name and address of trustee or estate administrator.

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3c. Trust or estate beneficiaries: Name, address, and percentage of interest in total entity.

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**SECTION 4 - ALL APPLICANTS - ADDITIONAL DISCLOSURE**

4a. Specify which, if any, interests disclosed in Section 1, 2, or 3 are being held by an agent or nominee, and give the name and address of principal.

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4b. If any interest named in Section 1,2, or 3 is being held by a "holding" corporation or other "holding" entity not an individual, state the names and addresses of all parties holding more than a 3% interest in that "holding" corporation or entity as required in 1(a), 1(b), 1(c), 2(a), and 2(b).

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4c. If "constructive control" of any interest named in Sections 1,2, 3, or 4 is held by another party, give name and address of party with constructive control. ("Constructive control" refers to control established through voting trusts, proxies, or special terms of venture of partnership agreements.)

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I have not withheld disclosure of any interest known to me. Information provided is accurate and current.

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of Person Preparing Statement

\_\_\_\_\_  
Title

ATTEST: \_\_\_\_\_ (Notary Seal)  
Notary Public

Commission Expires: \_\_\_\_\_

INTENTIONALLY LEFT BLANK



SECTION 00 30 40  
ADDITIONAL INFORMATION SHEET

Bid Name: \_\_\_\_\_

Bid Number #: \_\_\_\_\_

Company Name: \_\_\_\_\_

Contact Name: \_\_\_\_\_

Address: \_\_\_\_\_

City, State, Zip: \_\_\_\_\_

Telephone/FAX: # \_\_\_\_\_

E-mail: \_\_\_\_\_

**Comments:** \_\_\_\_\_

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SECTION 00 30 50  
MAJOR SUBCONTRACTORS LISTING

The following Tabulation of Major Subcontractors shall be attached and made a condition of the Bid. The Bidder expressly understands and agrees to the following provisions:

- A. If awarded a Contract as a result of this Bid, the major subcontractors used in the prosecution of the work will be those listed below.
- B. The following list includes all subcontractors who will perform work representing 5% (five percent) or more of the total Base Bid.
- C. The subcontractors listed below are financially responsible and are qualified to perform the work required.
- D. The subcontractors listed below comply with the requirements of the Contract Documents. If using a subcontractor for the electrical work, helical pier construction, or dewatering, the Bidder will provide references for three projects of similar size and construction for each of those subcontractors.
- E. Any substitutions in the subcontractors listed below shall be requested in writing by the Contractor and must be approved in writing by the Owner. All pertinent financial, performance, insurance and other applicable information shall be submitted with the request for substitutions(s). Owner shall respond to such requests within 14 calendar days following the submission of all necessary information to the full satisfaction of the Owner.

<u>Category</u>	<u>Name of Subcontractor</u>	<u>Address and Telephone Number</u>

---

(Attach additional sheets as required)

SECTION 00 30 60  
CONFLICT OF INTEREST FORM

\_\_\_\_\_, hereby certifies that it has conducted an investigation into whether an actual or potential conflict of interest exists between the Bidder, its owners and employees and any official or employee of the City of Evanston.

Bidder further certifies that it has disclosed any such actual or potential conflict of interest and acknowledges if Bidder has not disclosed any actual or potential conflict of interest, the City of Evanston may disqualify the bid.

\_\_\_\_\_  
(Name of Bidder if the Bidder is an Individual)  
(Name of Partner if the Bidder is a Partnership)  
(Name of Officer if the Bidder is a Corporation)

The above statements must be subscribed and sworn to before a notary public.  
Subscribed and Sworn to this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_.

\_\_\_\_\_  
Notary Public

(Notary Seal)

Commission Expires: \_\_\_\_\_

SECTION 00 30 70  
SIGNATURE FORM

**THE SECTION BELOW MUST BE COMPLETED IN FULL AND SIGNED**

The undersigned hereby certifies that they have read and understand the contents of this solicitation and attached service agreements, and agree to furnish at the prices shown any or all of the items above, subject to all instructions, conditions, specifications and attachments hereto. Failure to have read all the provisions of this solicitation shall not be cause to alter any resulting contract or to accept any request for additional compensation. By signing this document, the proposer hereby certifies that they are not barred from bidding on this contract as a result bid rigging or bid rotating or any similar offense (720 ILCS 5/33 E-3, E-4).

Authorized Signature: \_\_\_\_\_

Company Name: \_\_\_\_\_

Typed/Printed Name: \_\_\_\_\_

Date: \_\_\_\_\_

Title: \_\_\_\_\_

Telephone Number: \_\_\_\_\_

E-mail \_\_\_\_\_

Fax Number: \_\_\_\_\_

SECTION 00 41 00  
BID FORM

Proposal of \_\_\_\_\_ (hereinafter called "BIDDER"), organized and existing under the laws of the State of \_\_\_\_\_ doing business as \_\_\_\_\_\* to the City of Evanston (hereinafter called "OWNER").

\* **Insert "a corporation", "a partnership", or "an individual" as applicable.**

In compliance with your Notice to Bidders, BIDDER hereby proposes to perform all WORK for the construction of **Water Plant 4160V Electrical System Reliability Project (Bid No. 25-05)**, in strict accordance with the CONTRACT DOCUMENTS, within the time set forth therein, and at the prices stated below.

BIDDER hereby agrees to commence WORK under this contract on or before a date to be specified in the NOTICE TO PROCEED and to fully complete the PROJECT within **1,170 consecutive calendar days** thereafter.

BIDDER certifies that all iron, steel, manufactured products, and construction materials used in the project for the construction, alteration, maintenance, or repair of a public water system are produced in the United States in compliance with the federal Build America, Buy America Act, Pub. L. No. 117-58 §§ 70901-52.

BIDDER further agrees to pay as liquidated damages on this contract as follows:

1. The Contractor must commence work within 10 calendar days of Notice to Proceed from the City and the work must be substantially completed within 1,000 consecutive calendar days. In the event the work is not substantially complete within this time frame, then in addition to any remedies available to the City, the Contractor will pay to the City the sum of Two Thousand dollars per day for each calendar day beyond that date, until substantial completion of the work has been achieved.
2. Final project completion shall occur within 90 calendar days of the substantial completion of the project. For each calendar day beyond this time that the final completion is not achieved, liquidated damages shall be in the sum of Five Hundred dollars for each consecutive calendar day thereafter.
3. No unscheduled outage of any water plant systems shall occur, including treatment, back wash, chemical feed, pumping, and SCADA. Any unscheduled outage caused by the Contractor, or an outage extending beyond the scheduled duration, shall incur liquidated damages in the sum of Two Hundred dollars per hour until the system is fully restored and operational.

4. Semi-truck paved access for chemical deliveries to Garage 6 must not be interrupted for more than 120 consecutive days. Interruptions of greater than 120 consecutive days are subject to liquidated damages in the sum of Two Thousand dollars per day.

The liquidated damages are not a penalty but represent the fixed costs associated with OWNER's administrative fees and costs incurred by the OWNER's inability to place all or portions of this Project into service within the time stipulated in the Agreement. The payment of liquidated damages shall not, however, prevent the OWNER from pursuing non-monetary remedies for breach of contract or other claims for breach of contract not relating to failure to achieve final completion. Under certain sequences of events, the Contractor may be obligated to pay the OWNER for more than one liquidated damage at a time.

Liquidated damages will be assessed against the "amount earned to date" from the monthly payment application. In the event the amount is not adequate, the OWNER will invoice the Contractor directly for the remaining amount.

- I. By submission of the bid, each BIDDER certifies, and in the case of a joint bid, each party to the joint bid certifies as to his own organization, that in connection with the bid:
  - i. The prices in the bid have been arrived at independently, without consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices;
  - ii. Unless otherwise required by law, the prices quoted in the bid have not knowingly been directly or indirectly disclosed to any other BIDDER or to any competitor prior to opening; and
  - iii. No attempt has been made or will be made by the BIDDER to induce any other person or firm to submit or withhold a bid for the purpose of restricting competition.
- II. Each person signing the bid shall certify that:
  - i. He or she is the person in the BIDDER's organization responsible for the decision as to the prices being bid and that he or she has not participated, and will not participate, in any action contrary to (I)(i) through (I)(iii) above; or
  - ii. He or she is not the person in the BIDDER's organization responsible for the decision as to the prices being bid, but that he or she has been authorized to act as agent certifying that the persons determining the prices have not participated, and will not participate, in any action contrary to (I)(i) through (I)(iii) above, and as their bidder's agent shall so certify. He or she shall also certify that he or she has not participated, and will not participate, in any action contrary to (I)(i) through (I)(iii) above.

BIDDER acknowledges receipt of the following ADDENDUM (where applicable):

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BIDDER certifies that wages paid in connection with the PROJECT shall be paid at prevailing rates not less than those prevailing under the Davis-Bacon Wage Act. Bidder further certifies that the provisions contained in the following clauses will be exercised in the performance of any contract resulting from this BID and are made a part of the CONTRACT DOCUMENTS thereto by their inclusion in the BID as follows:

(1) Minimum wages.

(i) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in § 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)1(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

Subrecipients may obtain wage determinations from the U.S. Department of Labor's web site, [www.wdol.gov](http://www.wdol.gov).

(ii)(A) The subrecipient, on behalf of USEPA, shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The USEPA award official shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the subrecipient agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the subrecipient to IEPA. IEPA will transmit the report, to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify or disapprove every additional classification action within 30 days of receipt and so advise IEPA or will notify IEPA within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the subrecipient do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the award official shall refer the questions, including the views of all interested parties and the recommendation of the award official, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii)(B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program. Provided, that the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(2) Withholding. The subrecipient shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the sub-recipient may, after written notice to the contractor, sponsor, applicant, or owner, take such actions as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) Payrolls and basic records.

(i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is

enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the subrecipient, that is, the entity that receives the sub-grant or loan from IEPA. Such documentation shall be available on request of IEPA or USEPA. As to each payroll copy received, the subrecipient shall provide written confirmation in a form satisfactory to IEPA indicating whether or not the project is in compliance with the requirements of 29 CFR 5.5(a)(1) based on the most recent payroll copies for the specified week. The payrolls shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on the weekly payrolls. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). Form WH-347 is available for this purpose from the Wage and Hour Division Web site at <http://www.dol.gov/esa/whd/forms/wh347instr.htm> or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the subrecipient for transmission to IEPA or USEPA, if requested by USEPA, the contractor, or the Wage and Hour Division of the Department of Labor, for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the subrecipient.

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under § 5.5 (a)(3)(ii) of Regulations, 29 CFR Part 5, the appropriate information is being maintained under § 5.5 (a)(3)(i) of Regulations, 29 CFR Part 5, and that such information is correct and complete.

(2) That each laborer and mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR Part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of IEPA, USEPA or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency or IEPA may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

#### (4) Apprentices and trainees

(i) Apprentices. Apprentices will be permitted to work at less than predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the

Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination.

Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee

program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

(5) Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR Part 3, which are incorporated by reference in this contract.

(6) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the USEPA determines may be appropriate, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

(7) Contract termination: debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

(8) Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

(9) Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7.

Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and subrecipients, IEPA, USEPA, the U.S. Department of Labor, or the employees or their representatives.

(10) Certification of eligibility.

(i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

(11) Contract Work Hours and Safety Standards Act

(i) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

(ii) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (b)(1) of this section the contractor and any subcontractor responsible therefore shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clauses set forth in paragraph (b)(1) of this section, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (b)(1) of this section.

(iii) Withholding for unpaid wages and liquidated damages. The subrecipient, upon written request of the USEPA Award Official or an authorized representative of the Department of Labor, shall withhold or cause to be withheld, from any moneys payable on account of work

performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b)(2) of this section.

(iv) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (b)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (b)(1) through (4) of this section.

(v) In addition to the clauses contained in Item 3, above, in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in 29 CFR 5.1, the subrecipient shall insert a clause requiring that the contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the subrecipient shall insert in any such contract a clause providing that the records to be maintained under this paragraph shall be made available by the contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the IEPA, USEPA and the Department of Labor, and the contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

## (12) Compliance Verification

(i) The subrecipient shall periodically interview a sufficient number of employees entitled to DB prevailing wages (covered employees) to verify that contractors or subcontractors are paying the appropriate wage rates. As provided in 29 CFR 5.6(a)(6), all interviews must be conducted in confidence. The subrecipient must use Standard Form 1445 or equivalent documentation to memorialize the interviews. Copies of the SF 1445 are available from USEPA on request.

(ii) The subrecipient shall establish and follow an interview schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or

subcontract. At a minimum, the subrecipient must conduct interviews with a representative group of covered employees within two weeks of each contractor or subcontractor's submission of its initial weekly payroll data and two weeks prior to the estimated completion date for the contract or subcontract. Subrecipients must conduct more frequent interviews if the initial interviews or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. Subrecipients shall immediately conduct necessary interviews in response to an alleged violation of the prevailing wage requirements. All interviews shall be conducted in confidence.

(iii) The subrecipient shall periodically conduct spot checks of a representative sample of weekly payroll data to verify that contractors and subcontractors are paying the appropriate wage rates. The subrecipient shall establish and follow a spot check schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, the subrecipient must spot check payroll data within two weeks of each contractor or subcontractor's submission of its initial payroll data and two weeks prior to the completion date the contract or subcontract. Subrecipients must conduct more frequent spot checks if the initial spot check or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. In addition, during the examinations the subrecipient shall verify evidence of fringe benefit plans and payments thereunder by contractors and subcontractors who claim credit for fringe benefit contributions.

(iv) The subrecipient shall periodically review contractors and subcontractors use of apprentices and trainees to verify registration and certification with respect to apprenticeship and training programs approved by either the U.S. Department of Labor or a state, as appropriate, and that contractors and subcontractors are not using disproportionate numbers of, laborers, trainees and apprentices. These reviews shall be conducted in accordance with the schedules for spot checks and interviews described in Item 5(b) and (c) above.

(v) Subrecipients must immediately report potential violations of the DB prevailing wage requirements to the USEPA DB contact listed above and to the appropriated DOL Wage and Hour District Office listed at <http://www.dol.gov/esa/contacts/whd/america2.html>.

### (13) GENERAL STATEMENTS

(i) The undersigned has checked all of the figures contained in this proposal and further understands that the Owner will not be responsible for any errors or omissions made therein by the undersigned.

(ii) It is understood that the right is reserved by the Owner to reject any or all proposals, to waive all informality in connection therewith and to award a Contract for any part of the work or the Project as a whole.

(iii) The undersigned declares that the person(s) signing this proposal is/are fully authorized to sign on behalf of the named firm and to fully bind the named firm to all the conditions and provisions thereof.

(iv) It is agreed that no person(s) or company other than the firm listed below or as otherwise indicated hereinafter has any interest whatsoever in this proposal or the Contract that may be entered into as a result thereof, and that in all respects the proposal is legal and fair, submitted in good faith, without collusion or fraud.

(v) It is agreed that the undersigned has complied and/or will comply with all requirements concerning licensing and with all other local, state and national laws, and that no legal requirement has been or will be violated in making or accepting this proposal, in awarding the Contract to him, and/or in the prosecution of the Work required hereunder.

(vi) To be considered a bona fide offer, this proposal must be completed in full and accompanied by a bid deposit or a bid bond when required by Contract Documents or Addenda.

#### (14) BID SECURITY

If required by the bid documents, a scanned copy of the bid bond must be included with the bid electronic submission. The City is currently not able to accept a certified check, bank cashier's check or electronic bid bond at this time.

The City of Evanston Civic Center is unable to receive in person drop-off and it is closed to the public. The original bid bond must be mailed within ten (10) days after the due date, to the City of Evanston Purchasing Department, 2100 Ridge Avenue - Room 4200 Evanston, Illinois 60201 Attention Purchasing Manager using the USPS (certified or priority), UPS or FedEx mail options in order to have a tracking number.

Accompanying this electronic submittal is a scanned copy of a bank draft, bid bond, Cashier's check or Certified check as surety in the amount of not less than five percent (5%) of the Total Bid payable to the City of Evanston.

The amount of the check or draft is: \$ \_\_\_\_\_

If this bid is accepted and the undersigned shall fail to execute a contract and contract bond as required it is hereby agreed that the amount of the check or draft or bidder's bond substituted in lieu thereof, shall become the property of the City and shall be considered as payment of damages due to delay and other causes suffered by the City because of the failure to execute said contract and contract bond; otherwise said check or draft shall be returned to the undersigned.

In the event that one check or draft is intended to cover two or more bids, the amount must be equal to the sum of the project proposal guarantees of the individual sections covered. If the check or draft is placed on another project proposal, state below where it may be found, as follows: The check or draft will be found in the project proposal for: \_\_\_\_\_.

(15) PERFORMANCE/PAYMENT BOND

The undersigned bidder agrees to provide Performance Bond and Payment Bond executed in accordance with Contract Performance Bond form furnished by and acceptable to the Owner written with \_\_\_\_\_

\_\_\_\_\_ in the amount of 100% of the Contract Sum (Total Base Bid and all accepted alternatives and adjustments) the cost of which is included in the Bid.

Cost of bond for change order is \_\_\_\_\_ percent of change order cost.

(16) DISCLOSURE

The undersigned duly sworn deposes and says on oath that the bidder has withheld no disclosures of ownership interest and the information provided herein to the best of its knowledge is current and said undersigned has not entered into any agreement with any other bidder or prospective bidder or with any other person, firm or corporation relating to the price named in said proposal or any other proposal, nor any agreement or arrangement under which any person, firm or corporation is to refrain from bidding, nor any agreement or arrangement for any act or omission in restraint of free competition among bidders and has not disclosed to any person, firm or corporation the terms of this bid or the price named herein.

Bidder: \_\_\_\_\_

Business Address: \_\_\_\_\_

\_\_\_\_\_

Telephone Number: \_\_\_\_\_

(17) CONTACTS

In the event the Evanston City Council approves this bid response, list the name, address, telephone, and e-mail of the person to be contacted:

Name: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

Telephone Number: \_\_\_\_\_

e-mail: \_\_\_\_\_

### BID SCHEDULE

NOTE: Bids shall include sales tax and all other applicable taxes and fees.  
 BIDDER agrees to perform all the work described in the CONTRACT DOCUMENTS for  
 the following unit prices:

Item	Description	Reference Detail	Unit	Estimated Base Bid Quantity	Unit Price	Extended Price
LS-1	Work Result: Labor and Materials to perform all work not inclusive of LS-2 through LS-8, UP-1, UP-2, AL-1, AL-2, and Optional Bid Items.	All Contract Specifications Except Noted Specifically Below	Lump Sum	1	NA	
LS-2	Mobilization	01 50 00	Lump Sum	1	NA	
LS-3	Medium Voltage Electrical Equipment	26 12 16, 26 13 00, 26 14 00, 26 18 16, 26 24 14, 26 33 00	Lump Sum	1	NA	
LS-4	Low Voltage Electrical Equipment	26 22 00, 26 23 00, 26 24 13, 26 24 16 26 29 23, 26 29 53, 26 33 53	Lump Sum	1	NA	
LS-5	Packaged Engine Generator Systems	26 32 13	Lump Sum	1	NA	
LS-6	Foundations and Piles	31 66 00	Lump Sum	1	NA	
LS-7	Low Voltage and Medium Voltage MCC Maintenance and Testing	26 24 19, 26 14 00	Lump Sum	1	NA	
LS-8	Site Restoration	Contract Drawing R1	Lump Sum	1	NA	
UP-1	Contaminated Soil Disposal	31 23 16	Unit Price, CY	376 CY		
UP-2	Tuckpointing	04 01 21	Unit Price, SF	950 SF		
AL-1	SCADA Integration	40 67 17	Allowance	1	\$50,000	\$50,000
AL-2	General Allowance	01 29 00	Allowance	1	\$200,000	\$200,000

**Total of Bid** \_\_\_\_\_

**Total of Bid (in words)** \_\_\_\_\_

**Optional Bid Work to be completed as shown:**

The following optional bid items are not reimbursable under the IEPA SRF loan program. If accepted by the City, Bidder hereby proposes and agrees to furnish to the City of Evanston the Optional Bid Items set forth in the Specifications in accordance with the Contract Documents for the following amounts:

*1. Optional Bid: Spare Parts*

<b>Specification Section</b>	<b>Specification Reference</b>	<b>Lump Sum Amount</b>
26 05 53 - Electrical Identification	1.5	
26 11 13 - Substation Transformers	1.6	
26 13 00 - Medium Voltage Switchgear	1.7	
26 14 00 - Medium Voltage Motor Controllers	1.7	
26 23 00 - Low Voltage Switchgear	1.7	
26 24 13 - 480V Mobile Generator Termination Cabinet	1.7	
26 24 14 - 4160V Mobile Generator Termination Cabinet	1.7	
26 28 16 - Disconnect Switches	1.6	
26 29 23 - Adjustable Frequency Drives	1.6.D	
26 29 53 - Control Components and Devices	1.7	
26 32 13 - Packaged Engine Generator Systems	1.7	
26 33 00 - Battery Systems	1.6	
26 33 53 - Uninterruptible Power Supply Systems	1.7	
26 50 00 - Lighting	1.7	
28 31 00 - Signaling and Alarm	1.8	
<b>Total Lump Sum Amount for All Listed Spare Parts</b>		\$

The City reserves the right to choose any/or none of the Optional Bid Items to be incorporated into the Contract Agreement for this work.

The Bidder proposes to furnish and install in full compliance with the Contract Documents, the major items of equipment, as manufactured by the following listed manufacturers. Bidder shall fill in gray shaded cells for a responsive Bid. The named manufacturers shall not be changed after the Bid without the approval of the Engineer

No.	Item (Specification Section)	Manufacturer
1	Medium Voltage Cables (Section 26 05 13)	
2	Medium Voltage Transformers (Section 26 11 13)	
3	Medium Voltage Switchgear (Section 26 13 00)	
4	Medium Voltage Motor Controllers (Section 26 14 00)	
5	480 Volt Switchgear (Section 26 23 00)	
6	480V Mobile Generator Termination Cabinet (Section 26 24 13)	
7	4160V Mobile Generator Termination Cabinet (Section 26 24 14)	
8	Panelboards (Section 26 24 16)	
8	Adjustable Frequency Drives (Section 26 29 23)	
9	Packaged Engine Generator Systems (Section 26 32 13)	
10	Battery Systems (Section 26 33 00)	
11	Uninterruptible Power Supply Systems (Section 26 33 53)	

Bidder is currently certified as an MBE or WBE under EPA's DBE Program?

Yes \_\_\_\_ No \_\_\_\_

Respectfully submitted:

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Address

\_\_\_\_\_  
Title

\_\_\_\_\_  
Date

\_\_\_\_\_  
Telephone #

\_\_\_\_\_  
E-mail Address

(SEAL – if BID is by a corporation)

Attest:

\_\_\_\_\_

SUBSCRIBED AND SWORN to before me this \_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_

\_\_\_\_\_  
Notary Public

Commission Expires: \_\_\_\_\_

INTENTIONALLY LEFT BLANK

SECTION 00 42 00  
BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned,  
\_\_\_\_\_ as  
Principal, and \_\_\_\_\_ as  
Surety, are hereby held and firmly bound unto the City of Evanston as OWNER in the  
penal sum of \_\_\_\_\_ for the payment of  
which, well and truly to be made, we hereby jointly and severally bind ourselves,  
successors and assigns.

Signed, this \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_\_.

The Condition of the above obligation is such that whereas the Principal has submitted  
to \_\_\_\_\_ a certain BID, attached  
hereto and hereby made a part hereof to enter into a contract in writing, for the  
construction of the Water Plant 4160V Electrical System Reliability Project (Bid 25-05),  
which includes modifications to the existing Evanston Water Treatment Facility,  
including electrical equipment replacement and miscellaneous electrical improvements.  
The work also includes renovation and extension of the existing Garage 4, replacement  
of the ramp retaining wall, replacement of the garage ramps, and associated structural,  
electrical, civil, and mechanical works.

NOW, THEREFORE,

- (a) If said BID shall be rejected, or
- (b) If said BID shall be accepted and the Principal shall execute and deliver a contract in the Form of Contract attached hereto (properly completed in accordance with said BID) and shall furnish a BOND for his faithful performance of said contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said BID, then this obligation shall be void, otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any

and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its BOND shall be in no way impaired or affected by any extension of the time within which the OWNER may accept such bid; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

\_\_\_\_\_  
Principal (L.S.)

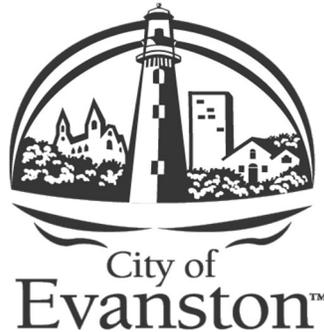
\_\_\_\_\_  
Surety

By: \_\_\_\_\_

IMPORTANT – Surety companies executing BONDS must appear on the Treasury Department’s most current list (Circular 570 as amended) and be authorized to transact business in the state where the project is located.

END OF SECTION

SECTION 00 52 00  
CONTRACTOR SERVICES AGREEMENT



**CONTRACTOR SERVICES AGREEMENT**

The parties referenced herein desire to enter into an agreement for professional services for

**Water Plant 4160V Electrical System Reliability Project  
(BID #25-05)**

THIS AGREEMENT (hereinafter referred to as the “Agreement”) is entered into between the City of Evanston, an Illinois municipal corporation with offices located at 2100 Ridge Avenue, Evanston Illinois 60201 (hereinafter referred to as the “City”), and [Insert Contractor name here], with offices located at [Insert Contractor address here], (hereinafter referred to as the “Contractor”). Compensation (the “Compensation”) for all basic services provided by the Contractor pursuant to the terms of this Agreement shall not exceed \$[Insert fee here].

*Revision March 2020*

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## RECITALS

WHEREAS, the City intends to retain the services of a qualified and experienced contractor for the following:

- *Medium Voltage Electrical Distribution Construction*
- *Generator Installation*
- *Helical Pile Construction*
- *Excavation and construction in close proximity to bodies of water with the groundwater within less than 10 feet of grade.*

WHEREAS, this Agreement shall include the following documents which are attached hereto:

- a) City of Evanston **Bid 25-05**, attached as Exhibit A.
- b) Contractor's response to **Bid 25-05**, attached as Exhibit B.
- c) Any sub-contractor sub-contracts related to this Agreement, attached as Exhibit C.

NOW, THEREFORE, in consideration of the mutual covenants hereinafter set forth, the parties agree as follows:

### 1 Services and Duties of the Contractor

1.1 The Contractor shall perform professional services and provide equipment (the "Work") in accordance with Exhibits A, B, C and D. The Contractor retains the right to control the manner of performance of the services provided for in this Agreement and is an independent contractor and not agent or an employee of the City. All employees and sub-contractors of the Contractor shall likewise not be considered to be employees of the City. Contractor is solely responsible for the means and methods of all work performed under the terms of this Agreement for this Project ("the Project"). Contractor is an independent Contractor and is solely responsible for all taxes, withholdings, and other statutory or contractual obligations of any sort, including but not limited to, Worker's Compensation Insurance. Nothing in this Agreement accords any third-party beneficiary rights whatsoever to any non-party to this Agreement that any non-party may seek to enforce. Contractor acknowledges and agrees that should Contractor or its sub-contractors provide false information, or fail to be or remain in compliance with this Agreement; the City may void this Agreement.

1.2 The Contractor warrants and states that it has read the Contract Documents, and agrees to be bound thereby, including all performance guarantees as respects Contractor's work and all indemnity and insurance requirements. Contractor further affirms that it has visited the Project site and has become familiar with all special conditions, if any, at the Project site. Contractor shall perform the Work and its obligations under this Agreement in accordance with and subject to the Contract Documents to the full extent that each such provision is applicable to the Work. Contractor shall take necessary precautions to properly protect the Work of others, if

any, from damage caused by operations under this Agreement. In addition, Contractor shall protect the work during normal and adverse weather conditions until the Project is complete and accepted by the City, or until the Contractor has fully completed its work under this Agreement. Contractor's obligations include, but are not limited to, placing and adequately maintaining at or about all locations of Project work, sufficient guards, barricades, lights, and enclosures to protect the Work.

1.3 The Contractor shall not have any public or private interest and shall not acquire directly or indirectly any such interest which conflicts in any manner with the performance of its services under this Agreement.

1.4 The Contractor shall designate, in writing, a person to act as its Project Manager for the work to be performed under this Agreement. Such person shall have complete authority to transmit instructions, receive information, interpret and define the Contractor's policies and decisions with respect to the work covered by this Agreement.

1.5 The Contractor shall employ only persons duly licensed by the State of Illinois to perform the professional services required under this Agreement for which applicable Illinois law requires a license, subject to prior approval of the City. The Contractor shall employ only well qualified persons to perform any of the remaining services required under this Agreement, also subject to prior approval of the City. The City reserves the right to require replacement of Contractor, sub-contractor, or supplier personnel for any reason. Contractor will replace the unacceptable personnel at no charge to the City. For all solicitations or advertisements placed by or on behalf of Contractor for employees for this Project it will state that the Contractor is an Equal Opportunity Employer.

1.6 Pursuant to the Illinois Freedom of Information Act, 5 ILCS 140/7(2), records in the possession of others whom the City has contracted with to perform a governmental function are covered by the Act and subject to disclosure within limited statutory timeframes (five (5) working days with a possible five (5) working day extension). Upon notification from the City that it has received a Freedom of Information Act request that calls for records within the Contractor's control, the Contractor shall promptly provide all requested records to the City so that the City may comply with the request within the required timeframe. The City and the Contractor shall cooperate to determine what records are subject to such a request and whether or not any exemption to the disclosure of such records, or part thereof, is applicable. Contractor shall indemnify and defend the City from and against all claims arising from the City's exceptions to disclosing certain records which Contractor may designate as proprietary or confidential. Compliance by the City with an opinion or a directive from the Illinois Public Access Counselor or the Attorney General under FOIA, or with a decision or order of Court with jurisdiction over the City, shall not be a violation of this Section.

1.7 The Contractor shall obtain prior approval from the City prior to sub-contracting with any entity or person to perform any of the work required under this Agreement. The Contractor may, upon request of the City, submit to the City a draft sub-contractor agreement for City review and approval prior to the execution of such an agreement. Any previously entered into sub-contractor agreement(s) are attached as Exhibit C. If the Contractor sub-contracts any of the

services to be performed under this Agreement, the sub-contractor agreement shall provide that the services to be performed under any such agreement shall not be sublet, sold, transferred, assigned or otherwise disposed of to another entity or person without the City's prior written consent. The Contractor shall be responsible for the accuracy and quality of any sub-contractor's work.

1.8 The Contractor shall cooperate fully with the City, other City contractors, other municipalities and local government officials, public utility companies, and others, as may be directed by the City. This shall include attendance at meetings, discussions and hearings as requested by the City. This cooperation shall extend to any investigation, hearings or meetings convened or instituted by OSHA relative to this Project, as necessary. Contractor shall cooperate with the City in scheduling and performing its Work to avoid conflict, delay in or interference with the work of others, if any, at the Project.

1.9 The Contractor acknowledges that it shall enforce and comply with all applicable Occupational Safety and Health Administration standards (OSHA) for this Project in effect as of the date of the execution of this Agreement, or as otherwise promulgated by OSHA in the future taking effect during the pendency of this Project. Contractor shall enforce all such standards and ensure compliance thereto as to its own agents and employees, and as to the agents and employees of any sub-contractor throughout the course of this Project. Contractor is solely responsible for enforcing and complying with all applicable safety standards and requirements on this Project, and is solely responsible for correcting any practices or procedures which do not comply with the applicable safety standards and requirements for this Project. Any Project specific safety requirements applicable to this Project must be followed by Contractor and any sub-contractor(s) on the Project. Additionally, all such safety requirements shall be made a part of any sub-contractor agreement.

1.10 The Contractor shall submit to the City a progress report each month this Agreement is in effect. The report shall include the following items:

- a) A summary of the Contractor's project activities, and any sub-contractor project activities that have taken place during the invoice period;
- b) A summary of the Contractor's project activities and any sub-contractor project activities, that shall take place during the next invoice period;
- c) A list of outstanding items due to or from the City; and
- d) A status of the Project schedule.

1.11 The Contractor shall perform the work required under this Agreement pursuant to high quality industry standards expected by the City. The Contractor shall apply for and receive all appropriate permits before performing any work in the City. The Contractor shall also provide the appropriate permit drawings for Building Permits to be issued for the Project, if said permits are obligated by the Project. The City will assist the Contractor with obtaining the appropriate building and right-of-way permits.

1.12 The Contractor shall provide drawings of record, in the following 3 electronic formats for all locations where equipment has been installed and/or work has been performed. The

electronic formats required by this Section 1.12 are Auto Cad Version 2007, ArcView and PDF.

1.13 Contractor recognizes that proper cleanup and removal of construction debris is an important safety consideration. The Contractor shall be solely responsible for daily construction site/area cleanup and removal of all construction debris in accordance with City-approved disposal practices. Contractor shall be solely responsible for identifying and removing at its expense all hazardous material and waste which it uses and generates.

1.14 To the extent that there is any conflict between a provision specified in this Agreement, with a provision specified in any of the other Contract Documents, as defined in Section 1.15, this Agreement shall control. The City and the Contractor may amend this Section 1.14 as provided by Section 15 herein.

The Contractor acknowledges and agrees that the City has no retained control over any of the Work done pursuant to this Agreement, and that the City is expressly exempt from the retained control exception as defined in the Restatement of Torts, Second, Section 414. This provision shall survive completion, expiration, or termination of this Agreement.

1.15 The Contract Documents for this Project consist of:

- a) This Agreement;
- b) The City's RFP/RFQ, and the plans, specifications, general conditions, drawings addenda, and modifications thereto;
- c) The Contractor's response to the RFP/RFQ/Bid;
- d) Other exhibits and schedules, if any, listed in this Agreement;
- e) Amendments or Other Contract Documents, if any; and
- f) Amendments/Modifications to this Agreement issued after execution thereof.

1.16 As a condition of receiving payment, Contractor must (i) be in compliance with the Agreement, (ii) pay its employees prevailing wages when required by law (Examples of prevailing wage categories include public works, printing, janitorial, window washing, building and grounds services, site technician services, natural resource services, security guard and food services). Contractor is responsible for contacting the Illinois Dept. of Labor 217-782-6206; <http://www.illinois.gov/idol/Laws-Rules/CONMED/Pages/Rates.aspx> to ensure compliance with prevailing wage requirements), (iii) pay its suppliers and sub-contractors according to the terms of their respective contracts, and (iv) provide lien waivers to the City upon request.

## 2 Standard Certifications

Contractor acknowledges and agrees that compliance with this section and each subsection for the term of the Agreement is a material requirement and condition of this Agreement. By executing this Agreement, Contractor certifies compliance with this section and each subsection and is under a continuing obligation to remain in compliance and report any non-compliance.

This section, and each subsection, applies to sub-contractors used on this Agreement.

Contractor shall include these Standard Certifications in any sub-contract used in the performance of the Agreement.

If this Agreement extends over multiple fiscal years, Contractor and its sub-contractors shall confirm compliance with this section in the manner and format determined by the City by the date specified by the City and in no event later than January 1 of each year that this Agreement remains in effect.

If the City determines that any certification in this section is not applicable to this Agreement, it may be stricken, subject to sole approval by the City, without affecting the remaining subsections.

2.1 As part of each certification, Contractor acknowledges and agrees that should Contractor or its sub-contractors provide false information, or fail to be or remain in compliance with the Standard Certification requirements, one or more of the following sanctions will apply:

- the Agreement may be void by operation of law,
- the City may void the Agreement, and
- Contractor and its sub-contractors may be subject to one or more of the following: suspension, debarment, denial of payment, civil fine, or criminal penalty.

2.2 By signing this Agreement, the Contractor certifies that it has not been barred from being awarded a contract with a unit of State or local Government as a result of bid rigging or bid rotating or similar offense, nor has it made any admission of guilt of such conduct that is a matter of public record. (720 ILCS 5/33 E-3, E-4).

2.3 In the event of the Contractor's noncompliance with any provision of Section 1-12-5 of the Evanston City Code, the Illinois Human Rights Act or any other applicable law, the Consultant may be declared non-responsible and therefore ineligible for future contracts or sub-contracts with the City, and the contract may be cancelled or voided in whole or in part, and such other sanctions or penalties may be imposed or remedies invoked as provided by statute or regulation.

2.4 During the term of this Agreement, the Contractor agrees as follows:

- a) That it will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, marital status, national origin or ancestry, or age or physical or mental disabilities that do not impair ability to work, and further that it will examine all job classifications to determine if minority persons or women are underutilized and will take appropriate affirmative action to rectify any such underutilization. Consultant shall comply with all requirements of City of Evanston Code Section 1-12-5.
- b) That, in all solicitations or advertisements for employees placed by it on its behalf, it will state that all applicants will be afforded equal opportunity without discrimination because of race, color, religion, sex, sexual orientation, marital

status, national origin, ancestry, or disability.

2.5 The Contractor certifies pursuant to the Illinois Human Rights Act (775 ILCS 5/2-105 *et. seq.*), that it has a written sexual harassment policy that includes, at a minimum, the following information:

- a) The illegality of sexual harassment;
- b) The definition of sexual harassment under State law;
- c) A description of sexual harassment utilizing examples;
- d) The Contractor's internal complaint process including penalties;
- e) Legal recourse, investigation and complaint process available through the Illinois Department of Human Rights and the Human Rights Commission, and directions on how to contact both; and
- f) Protection against retaliation as provided to the Department of Human Rights.

2.6 In accordance with the Steel Products Procurement Act (30 ILCS 565), Contractor certifies steel products used or supplied in the performance of a contract for public works shall be manufactured or produced in the U.S. unless the City grants an exemption.

2.7 Contractor certifies that it is properly formed and existing legal entity and as applicable has obtained an assumed name certificate from the appropriate authority, or has registered to conduct business in Illinois and is in good standing with the Illinois Secretary of State.

2.8 If Contractor, or any officer, director, partner, or other managerial agent of Contractor, has been convicted of a felony under the Sarbanes-Oxley Act of 2002, or a Class 3 or Class 2 felony under the Illinois Securities Law of 1953, Contractor certifies at least five years have passed since the date of the conviction.

2.9 Contractor certifies that if more favorable terms are granted by Contractor to any similar governmental entity in any state in a contemporaneous agreement let under the same or similar financial terms and circumstances for comparable supplies or services, the more favorable terms will be applicable under this Agreement.

2.10 Contractor certifies that it is not delinquent in the payment of any fees, fines, damages, or debts to the City of Evanston.

2.11 The Contractor certifies that all Design Professionals performing the Work under this Agreement will ensure that the Project shall be designed in conformance with the Americans with Disabilities Act of 1990, 42 U.S.C. Section 12101, *et seq.*, and all regulations promulgated thereunder. Design Professional means any individual, sole proprietorship, firm, partnership, joint venture, corporation, professional corporation, or other entity that offers services under the Illinois Architecture Practice Act of 1989 (225 ILCS 305/), the Professional Engineering Practice Act of 1989 (225 ILCS 325/), the Structural Engineering Licensing Act of 1989 (225 ILCS 340/), or the Illinois Professional Land Surveyor Act of 1989 (225 ILCS 330/).

2.12 The Contractor shall comply with all federal, state and local laws, statutes,

ordinances, rules, regulations, orders or other legal requirements now in force or which may be in force during the term of this Agreement. The Contractor shall comply with the Illinois Human Rights Act, 775 ILCS 5/1-101 *et. seq.*, Title VII of the Civil Rights Act of 1964, and the Illinois Prevailing Wage Act, 820 ILCS 130/0.01 *et. seq.*

### 3 Additional Services/Change Orders

3.1 If the representative of the City responsible for the Project verbally requests the Contractor to perform additional services, the Contractor shall confirm in writing that the services have been requested and that such services are additional services. Failure of the City to respond to the Contractor's confirmation of said services within thirty (30) calendar days of receipt of the notice shall be deemed a rejection of, and refusal to pay for the additional services. Contractor shall not perform any additional services until City has confirmed approval of said additional services in writing. If authorized in writing by the City, the Contractor shall furnish, or obtain from others, additional services of the following types, which shall be paid for by the City as set forth in Section 9 of this Agreement:

- a) Additional Services due to significant changes in scope of the Project or its design, including, but not limited to, changes in size, complexity or character of construction, or time delays for completion of work when such delays are beyond the control of the Contractor;
- b) Revisions of previously approved studies, reports, design documents, drawings or specifications;
- c) Preparation of detailed renderings, exhibits or scale models for the Project;
- d) Investigations involving detailed consideration of operations, maintenance and overhead expenses for the preparation of rate schedules, earnings and expense statements, feasibility studies, appraisals and valuations, detailed quantity surveys of material and labor, and material audits or inventories required for certification of force account construction performed by the City;
- e) Services not otherwise provided for in this Agreement.

3.2 The City may, upon written notice, and without invalidating this Agreement, require changes resulting in the revision or abandonment of work already performed by the Contractor, or require other elements of the work not originally contemplated and for which full compensation is not provided in any portion of this Agreement. Any additional services, abandonment of services which were authorized by the City, or changes in services directed by the City which result in the revision of the scope of services provided for in Exhibits A, B, C, and D that cause the total Compensation due Contractor under this Agreement to exceed \$25,000 or more, or increase or decrease the contract duration by more than 30 days are subject to approval by the Evanston City Council. These actions must be addressed either in a written Change Order or in a written amendment to this Agreement approved by both parties.

3.3 Contractor acknowledges and agrees that the Public Works Construction Change Order Act, 50 ILCS 525/1 *et seq.* shall apply to all Change Orders for the Project. It is expressly understood and agreed to by Contractor that it shall not be entitled to any damages or Compensation from the City on account of delay or suspension of all or any part of the Work.

Contractor acknowledges that delays are inherent in construction projects and Contractor assessed that risk and fully included that risk assessment within its contract sum specified in its Response to the City RFP/RFQ/Bid for this Project. The City shall not compensate Contractor for work that is more difficult than the contract sum specified in its Response would reflect. Delays to minor portions of the Work will not be eligible for extensions of time.

Delays to the Project caused by labor disputes or strikes involving trades not directly related to the Project, or involving trades not affecting the Project as a whole will not be eligible for an extension of time.

The City will not grant an extension of time for a delay by the Contractor's inability to obtain materials unless the Contractor first furnishes to the City documentary proof. The proof must be provided in a timely manner in accordance with the sequence of the Contractor's operations and accepted construction schedule.

In addition to any other changes requested by City (as described in Sections 3.1 and 3.2), the Company shall be entitled to request (and the City may grant) Change Orders with respect to:

- (a) The City-caused delays;
- (b) Change in Law;
- (c) Force Majeure Events.

The foregoing events shall entitle the Contractor to a change in the Compensation for this Project, if the Contractor demonstrates that it will unavoidably incur reasonable costs as a result thereof and the Contractor provides reasonable and detailed documentary support with respect to any such price impact.

The parties agree to reasonably confer regarding any such disputes with respect to the issuance of a Change Order.

Any payment for compensable delay will only be based upon actual costs excluding, without limitation, what damages, if any, the Contractor may have reasonably avoided. The Contractor understands that this is the sole basis for recovering delay damages and explicitly waives any right to calculate daily damages for office overhead, profit, or other purported loss.

All Contractor Change Orders authorized under this Section 3 shall be made in writing. In remitting a Change Order, the Contractor must first show in writing that:

- (a) The work was outside the scope of this Agreement,
- (b) The extra work was not made necessary due to any fault of Contractor;
- (c) The circumstances said to necessitate the change in performance were not reasonably foreseeable at the time the Agreement was signed;
- (d) The change is germane to the original Agreement; and
- (e) The Change Order is in the best interest of the City and authorized by law.

Any person who fails to first obtain the City's written authorization for a Change Order commits a Class 4 felony. The written determination and the written Change Order resulting from that determination shall be preserved in the contract's file which shall be open to the public for inspection.

**The City reserves all rights and causes of action, at law or equity, to seek redress against entities or persons who violate the requirements of this Section 3. By initialing below, Contractor hereby acknowledges that it is bound by this Section 3.**

**Contractor's Initials:** \_\_\_\_\_

3.4 The Contractor is required to include the City of Evanston as a reference whenever and wherever the Contractor provides references for similar projects for a period of one (1) year from the date of Final Acceptance by the City of the Work for this Project.

## 4 Bonds

4.1 Before the Scheduled Construction Commencement Date, the Contractor is required to furnish unconditional performance and payment bonds in the amount of 100% of the Compensation as security for the faithful performance and completion of all the Contractor's obligations under the Contract Documents and covering the payment of all materials used in the performance of this Agreement and for all labor and services performed under this Agreement. All Bonds shall be issued on a form acceptable to the City. The bonds must be for the entire term of the Agreement. Failure to provide these bonds shall constitute a breach of Contractor's obligations under this Agreement. Each surety providing the Bonds must have a Best's rating not less than A/X and be licensed in Illinois and shall be named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 as published in the Federal Register and available on the website of the U.S. Department of the Treasury, Financial Management Service, at [www.fms.treas.gov/c570/c570.html](http://www.fms.treas.gov/c570/c570.html). All Bonds signed by an agent must be accompanied by a certified copy of his or her authority to act. It shall be the duty of the Contractor to advise the surety or sureties of any Change Orders that result in an increase to the Compensation and to ensure that the amounts of the Bonds are updated to reflect and cover any such increases throughout the course of the Project. The cost of such Bonds shall be included within the Compensation.

4.2 If the surety behind any Bond furnished by the Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in the State or it ceases to meet any of the requirements of this Contract, the Contractor shall, within [5] five days thereafter, substitute another Bond of equivalent value and surety, both of which must be acceptable to the City. In addition, no further progress payments under the Agreement will be made by the City until the Contractor complies with the provisions of this Agreement. The Contractor shall furnish to the City proof of any required bonds and proof of required insurance as one of the conditions precedent to payment under the Agreement. Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment or performance of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or authorize a copy to be furnished. All surety Bonds provided for in this Section shall incorporate by reference this

Agreement, and any language that may be in any such surety Bond which conflicts with the provisions of this Agreement that define the scope of the surety('s) duty(ies) shall be of no force and effect.

## 5 Liquidated Damages in the Event Contractor Fails to Complete the Work

5.1 The parties agree that failure of Contractor to timely complete the Work required by this Agreement constitutes a default. The parties agree that this default will result in damage and injury to City. The parties further agree, however, that actual damages incurred by City as result of such default is difficult if not impossible to ascertain with any degree of certainty or accuracy. Accordingly, the parties have negotiated and have agreed that for each calendar day after written notice is delivered to Contractor and Contractor fails to cure such default, that Contractor will pay City, as and for liquidated damages, and not as a penalty, the sum of **Insert Word - Dollar Amount (i.e. Seven Hundred and Fifty Dollars) per day**. Contractor shall reimburse the City for all costs, expenses and fees (including, without limitation, attorneys' fees), if any, paid by the City in connection with such written demand by City. Contractor stipulates and agrees that the sums payable by Contractor under this Section are reasonable under the circumstances existing as of the execution of this Agreement. This Section 5.1 is not intended to limit any direct damages that may be recoverable by City related to the Contractor's failure to complete the Work in accordance with this Agreement. There shall be no early completion bonus if the Work is completed before the substantial completion date. The City, at its option, may withhold liquidated damages from progress payments payable to Contractor before the substantial completion date.

## 6 The City's Responsibilities

6.1 The City may evaluate the Contractor's and any sub-contractor's performance (interim and final). Timeliness in meeting the Project schedule and the overall relationship with the Contractor are factors that will be considered in the Contractor's performance rating. An unfavorable performance rating may be a factor when future assignments are being considered.

6.2 The City makes no representation or warranty of any nature whatsoever as to the accuracy of information or documentation provided by the City to the Contractor which were generated or provided by third parties.

## 7 Period of Service

7.1 The Contractor shall commence work on the Project after supplying the City with the Contractor's performance and payment bonds and all required insurance documents before starting its Work on this Project. The City shall determine when the Contractor has completed the Work required pursuant to this Agreement, and shall determine the date of Final Acceptance. Contractor recognizes time is of the essence regarding its performance on this Project. Contractor shall continue to perform its obligations while any dispute concerning the Agreement is being resolved, unless otherwise directed by the City.

7.2 Each phase of the project shall be completed in accordance with the activities

outlined in the City's Bid 25-05, Exhibit A. Project phases include:

- 7.2.1 Phase 0
- 7.2.2 Phase 1
- 7.2.3 Phase 2
- 7.2.4 Phase 3
- 7.2.5 Phase 4
- 7.2.6 Phase 5
- 7.2.7 Phase 6

## 8 *Payment for Services and Reimbursements*

8.1 Within the first five (5) business days of each month, the Contractor shall invoice the City for Work completed during the previous month. The Contractor shall provide a detailed invoice that relates invoiced items to the Contractor's response to Bid 25-05 in both quantity and unit cost. Any discrepancies in the monthly invoice shall be promptly brought to the attention of the Contractor by the City Project Manager and efforts shall be made to promptly resolve said discrepancies between the City and Contractor. In the event the City and Contractor cannot resolve invoice discrepancies, items in dispute will be removed from the invoice and the City shall approve the remainder of the invoice. Payment will be made as soon as possible following the City Council meeting in which the item appeared on the bills list, and in accordance with all applicable laws and rules of the City of Evanston and the State of Illinois.

8.2 In the event of termination by the City of this Agreement pursuant to paragraph 9.1 after completion of any phase of the basic services, fees due the Contractor for services rendered through such phase shall constitute final payment for such services, and no further fees shall be due to the Contractor. In the event of such termination by the City during any phase of the basic services, the Contractor shall be paid for services rendered on the basis of the proportion of work completed on the phase to date of termination.

8.3 The City shall have the right to withhold payment to the Contractor due to the quality of a portion or all of the work performed hereunder which is not in accordance with the requirements of this Agreement, or which is unsatisfactory, or is due to the Contractor's failure or refusal to perform any of its obligations hereunder. Compensation in excess of the total contract amount specified in this Agreement will not be allowed unless justified in the City's sole judgment and authorized in advance as provided for in Section 3 of this Agreement. Compensation for improper performance by the Contractor is disallowed.

8.4 Upon completion of the Work performed by the Contractor, prior to the submission of a request for final payment, the City and Contractor shall perform a final acceptance test and review of the Work performed and/or equipment installed pursuant to the Agreement. A punch list of items outstanding will be jointly developed by the City and Contractor. In addition, the Contractor shall submit drawings of record for the Project for the City to approve. The Contractor shall promptly resolve all punch list items to the satisfaction of the City, and shall transmit to the City in writing confirmation that all punch list items have been resolved. The City will review, and

the Contractor shall modify, as necessary, any drawings of record to the satisfaction of the City. Punch list items and drawings of record must be approved by the City prior to the Contractor submitting its final invoice for payment.

8.5 The Contractor shall submit an Affidavit and a final waiver of its lien, and all final waivers of liens of any sub-contractors, suppliers, and sub-sub-contractors, if applicable, with its final invoice, stating that all obligations incurred in performance of the professional services have been paid in full. The Affidavit will also include a statement stating that the professional services were performed in compliance with the terms of the Agreement. The Affidavit and all final lien waivers shall be on a form acceptable to the City.

8.6 All Project invoices shall be sent to:

City of Evanston *[Applicable department]*  
2100 Ridge Avenue  
Evanston, Illinois 60201

with a copy to:

City of Evanston *[Anyone else as applicable]*  
2100 Ridge Avenue  
Evanston, Illinois 60201

## 9 Notice and Cure/Termination

9.1 In furtherance of Contractor's Work on this Project, the City and the Contractor agree that the following Notice and Cure provision in this Section 9.1 shall apply during the duration of Contractor's work on this Project, in addition to the reserved rights of the City enumerated in this Agreement as follows:

- 5.1 Liquidated Damages;
- 8.3 City's right to withhold payment;
- 16.2 Contractor's duty to revise and correct errors; and
- 16.3 Contractor's duty to respond to City's notice of errors and omissions.

The City may notify Contractor of its intent to terminate this Agreement within (7) seven calendar days of issuance by the City of written notice to Contractor's Project Manager regarding defects in the Project or in Contractor's Work. The City shall specify any such nonconforming Work or defects in the Project in its notice to Contractor under this Section 9.1. Contractor will have the opportunity to cure the non-conforming Work within (7) seven calendar days after receipt of the written notice issued by the City. All such curative work done shall be performed and completed to the City's satisfaction. Nothing in this Section 9.1 shall otherwise affect the City's right to exercise its rights in Section 9.2.

9.2 The City shall have the right to terminate this Agreement upon fifteen (15) days written notice for any reason. Mailing of such notice shall be equivalent to personal notice and

shall be deemed to have been given at the time of receipt.

Payments made by the City pursuant to this Agreement are subject to sufficient appropriations made by the City of Evanston City Council. In the event of termination resulting from non-appropriation or insufficient appropriation by the City Council, the City's obligations hereunder shall cease and there shall be no penalty or further payment required.

9.3 Within thirty (30) days of termination of this Agreement, the Contractor shall turn over to the City any documents, drafts, and materials, including but not limited to, outstanding work product, data, studies, test results, source documents, AutoCAD Version 2007, ArcView, PDF, Word, Excel spreadsheets, technical specifications and calculations, and any other such items specifically identified by the City related to the Work herein. Upon receipt of said items, the Contractor shall be paid for labor and expenses incurred to the date of termination as provided in Section 8.2. This Agreement is subject to termination by either party if either party is restrained by a state or federal court of competent jurisdiction from performing the provisions of this Agreement. Upon such termination, the liabilities of the parties to this Agreement shall cease, but they shall not be relieved of the duty to perform their obligations through the date of termination. No lien shall be filed by the Contractor in the event of a termination of this Agreement by the City.

9.4 If, because of death or any other occurrence, including, but not limited to, Contractor becoming insolvent, it becomes impossible for any principal or principals of the Contractor to render the services set forth in this Agreement, neither the Contractor, nor its surviving principals shall be relieved of their obligations to complete the professional services. However, in the event of such an occurrence, the City at its own option may terminate this Agreement if it is not furnished evidence that competent professional services can still be furnished as scheduled.

9.5 In the event of an emergency or threat to the life, safety or welfare of the citizens of the City, the City shall have the right to terminate this Agreement without prior written notice.

## 10 Insurance

10.1 The Contractor shall, at its own expense, secure and maintain in effect throughout the duration of this contract, insurance against claims for injuries to persons or damages to property which may arise from or in connection with the performance of the Work hereunder by the Contractor, its agents, representatives, employees or sub-contractors. Contractor acknowledges and agrees that if it fails to comply with all requirements of this Section 10, the City may void the Agreement.

The Contractor must give to the City Certificates of Insurance identifying the City to be an Additional Insured for all Work done pursuant to this Agreement before City staff recommends award of the contract to City Council. Any limitations or modifications on the Certificate(s) of Insurance issued to the City in compliance with this Section that conflict with the provisions of this Section 10 shall have no force and effect.

After award of the Contract to Contractor (contracts over \$500,000 in value or if the project

is deemed high risk) the Contractor **shall** give the City a certified copy (ies) of the insurance policy (ies) evidencing the amounts set forth in Section 10.2, and copies of the Additional Insured endorsement to such policy (ies) which name the City as an Additional Insured for all Work done pursuant to this Agreement before Contractor does any Work pursuant to this Agreement. Contractor's certificate of insurance shall contain a provision that the coverage afforded under the policy(s) will not be canceled or reduced without thirty (30) days prior written notice (hand delivered or registered mail) to the City. Contractor shall promptly forward new certificate(s) of insurance evidencing the coverage(s) required herein upon annual renewal of the subject policies.

The policies and the Additional Insured endorsement must be delivered to the City within two (2) weeks of the request. All insurance policies shall be written with insurance companies licensed or authorized to do business in the State of Illinois and having a rating of not less than A-VII according to the A.M. Best Company. Should any of the insurance policies be canceled before the expiration date, the issuing company will mail thirty (30) days written notice to the City. The Contractor shall require and verify that all sub-contractors maintain insurance meeting all of the requirements stated herein.

Any deductibles or self-insured retentions must be declared to and approved by the City. At the option of the City, either the insurer shall reduce or eliminate such deductibles or self-insured retentions as respects the City, its officers, officials, employees and volunteers; or the Contractor shall provide a financial guarantee satisfactory to the City guaranteeing payment of losses and related investigations, claim administration and defense expenses.

10.2 Contractor shall carry and maintain at its own cost with such companies as are reasonably acceptable to City all necessary liability insurance (which shall include as a minimum the requirements set forth below) during the term of this Agreement, for damages caused or contributed to by Contractor, and insuring Contractor against claims which may arise out of or result from Contractor's performance or failure to perform the Services hereunder:

- a) Worker's compensation in statutory limits and employer's liability insurance in the amount of at least five hundred thousand dollars (\$500,000);
- b) Comprehensive general liability coverage which designates the City as an additional insured for not less than three million dollars (\$3,000,000) combined single limit for bodily injury, death and property damage, per occurrence;
- c) Comprehensive automobile liability insurance covering owned, non-owned, and leased vehicles for not less than one million dollars (\$1,000,000) combined single limit for bodily injury, death, or property damage, per occurrence; and

Contractor understands that the acceptance of Certificates of Insurance, policies, and any other documents by the City in no way releases the Contractor and its sub-contractors from the requirements set forth herein.

Contractor expressly agrees to waive its rights, benefits and entitlements under the "Other Insurance" clause of its commercial general liability insurance policy as respects the City. Contractor expressly agrees that its insurance coverage is required to be primary by this Agreement, that its insurance coverage shall be on a primary and non-contributory basis, and that

it and its insurance carrier are estopped from denying such coverage is primary. In the event Contractor fails to purchase or procure insurance as required above, the parties expressly agree that Contractor shall be in default under this Agreement, and that the City may recover all losses, attorney's fees and costs expended in pursuing a remedy, or reimbursement, at law or in equity, against Contractor.

## 11 Indemnification

11.1 The Contractor shall defend, indemnify and hold harmless the City and its officers, elected and appointed officials, agents, and employees from any and all liability, losses, or damages as a result of claims, demands, suits, actions, or proceedings of any kind or nature, including but not limited to costs, and fees, including attorney's fees, judgments or settlements, resulting from or arising out of any negligent or willful act or omission on the part of the Contractor or Contractor's sub-contractors, employees, agents or sub-contractors during the performance of this Agreement. Such indemnification shall not be limited by reason of the enumeration of any insurance coverage herein provided. This provision shall survive completion, expiration, or termination of this Agreement.

11.2 Nothing contained herein shall be construed as prohibiting the City, or its officers, agents, or employees, from defending through the selection and use of their own agents, attorneys, and experts, any claims, actions or suits brought against them. The Contractor shall be liable for the costs, fees, and expenses incurred in the defense of any such claims, actions, or suits. Nothing herein shall be construed as a limitation or waiver of defenses available to the City and employees and agents, including but not limited to the Illinois Local Governmental and Governmental Employees Tort Immunity Act, 745 ILCS 10/1-101 *et seq.*

At the City Corporation Counsel's option, Contractor must defend all suits brought upon all such Losses and must pay all costs and expenses incidental to them, but the City has the right, at its option, to participate, at its own cost, in the defense of any suit, without relieving Contractor of any of its obligations under this Agreement. Any settlement of any claim or suit related to this Project by Contractor must be made only with the prior written consent of the City Corporation Counsel, if the settlement requires any action on the part of the City.

To the extent permissible by law, Contractor waives any limits to the amount of its obligations to indemnify, defend, or contribute to any sums due under any Losses, including any claim by any employee of Contractor that may be subject to the Illinois Workers Compensation Act, 820 ILCS 305/1 *et seq.* or any other related law or judicial decision, including but not limited to, *Kotecki v. Cyclops Welding Corporation*, 146 Ill. 2d 155 (1991). The City, however, does not waive any limitations it may have on its liability under the Illinois Workers Compensation Act, the Illinois Pension Code or any other statute.

11.3 The Contractor shall be responsible for any losses and costs to repair or remedy work performed under this Agreement resulting from or arising out of any act or omission, neglect, or misconduct in the performance of its Work or its sub-contractors' work. Acceptance of the work by the City will not relieve the Contractor of the responsibility for subsequent correction of any such error, omissions and/or negligent acts or of its liability for loss or damage resulting therefrom.

11.4 All provisions of this Section 11 shall survive completion, expiration, or termination of this Agreement.

## 12 Drawings and Documents

12.1 Any drawings, survey data, reports, studies, specifications, estimates, maps, plans, computations, and other documents required to be prepared by the Contractor for the Project shall be considered Works for Hire and the sole property of the City.

12.2 The Contractor and its sub-contractor shall maintain for a minimum of three (3) years after the completion of this Agreement, or for three (3) years after the termination of this Agreement, whichever comes later, adequate books, records and supporting documents to verify the amounts, recipients and uses of all disbursements of funds passing in conjunction with the Agreement. The Agreement and all books, records and supporting documents related to the Agreement shall be available for review and audit by the City and the federal funding entity, if applicable, and the Contractor agrees to cooperate fully with any audit conducted by the City and to provide full access to all materials. Failure to maintain the books, records and supporting documents required by this Subsection shall establish a presumption in favor of the City for recovery of any funds paid by the City under the Agreement for which adequate books, records, and supporting documentation are not available to support their purported disbursement.

## 13 Successors and Assigns

13.1 The City and the Contractor each bind themselves and their partners, successors, executors, administrators, and assigns to the other party of the Agreement and to the partners, successors, executors, administrators, and assigns of such other party in respect to all covenants of this Agreement. Neither the City nor the Contractor shall assign, sublet, or transfer its interest in this Agreement without the written consent of the other. Nothing herein shall be construed as creating any personal liability on the part of any officer or agent of any public body, which may be a party hereto, nor shall it be construed as giving any right or benefits hereunder to anyone other than the City and the Contractor.

## 14 Force Majeure

14.1 Whenever a period of time is provided for in this Agreement for the Contractor or the City to do or perform any act or obligation, neither party shall be liable for any delays or inability to perform if such delay is due to a cause beyond its control and without its fault or negligence including, without limitation:

- a) Acts of nature;
- b) Acts or failure to act on the part of any governmental authority other than the City or Contractor, including, but not limited to, enactment of laws, rules, regulations, codes or ordinances subsequent to the date of this Agreement;
- c) Acts of war;
- d) Acts of civil or military authority;
- e) Embargoes;

- f) Work stoppages, strikes, lockouts, or labor disputes;
- g) Public disorders, civil violence, or disobedience;
- h) Riots, blockades, sabotage, insurrection, or rebellion;
- i) Epidemics or pandemics;
- j) Terrorist acts;
- k) Fires or explosions;
- l) Nuclear accidents;
- m) Earthquakes, floods, hurricanes, tornadoes, or other similar calamities;
- n) Major environmental disturbances; or
- o) Vandalism.

If a delay is caused by any of the *force majeure* circumstances set forth above, the time period shall be extended for only the actual amount of time said party is so delayed. Further, either party claiming a delay due to an event of *force majeure* shall give the other party written notice of such event within three (3) business days of its occurrence or it shall be deemed to be waived.

## 15 Amendments and Modifications

15.1 Except as otherwise provided herein, the nature and scope of Work specified in this Agreement may only be modified by a written Change Order, or a written amendment to this Agreement, approved by both parties. This Agreement may be modified or amended from time to time provided, however, that no such amendment or modifications shall be effective unless reduced to writing and duly authorized and signed by the authorized representatives of the parties.

## 16 Standard of Care & Warranty

16.1 The Contractor shall perform all of the provisions of this Agreement to the satisfaction of the City. The City shall base its determination of the Contractor's fulfillment of the scope of the work in accordance with generally accepted professional standards applicable to the Work for this Project. The Contractor shall perform all of the provisions of this Agreement with that degree of care and skill ordinarily exercised by members of the same profession currently practicing under similar conditions.

16.2 The Contractor shall be responsible for the accuracy of its professional services under this Agreement and shall promptly make revisions or corrections resulting from its errors, omissions, or negligent acts without additional compensation. The City's acceptance of any of the Contractor's professional services shall not relieve the Contractor of its responsibility to subsequently correct any such errors or omissions. If a Contractor has provided the City with specifications for this Project which are determined to be incorrect or which require revision during the solicitation process (including but not limited to Requests for Proposals, Requests for Qualifications, or bids), the Contractor shall make such corrections or revisions to the specifications at no cost to the City. Further, upon receipt of an invoice from the City, the Contractor shall promptly reimburse the City for the reasonable costs associated with the preparation and dissemination of said corrections or revisions to appropriate parties, including but not limited to preparation of the corrected or revised documents, and printing and distribution costs.

16.3 During the pendency of its Work on this Project, the Contractor shall respond to the City's notice of any errors or omissions within twenty-four (24) hours. The Contractor shall be required to promptly visit the Project site(s) if directed to by the City.

16.4 The Contractor shall comply with all federal, state, and local statutes, regulations, rules, ordinances, judicial decisions, and administrative rulings applicable to its performance under this Agreement.

16.5 Contractor guarantees and warrants to the City that:

- a) All materials and equipment furnished under this Agreement shall be of good quality and new, unless otherwise required or permitted by the Contract Documents;
- b) The Work of this Agreement shall be free from defects which are not inherent in the quality required; and
- c) The Work shall comply with the requirements set forth in the Contract Documents.

This warranty and guarantee shall be for a period of one (1) year from the date of completion and Final Acceptance of the Work by the City, or as otherwise provided in the Contract Documents.

If, within the one year warranty period, after the Contractor has received a final payment under this Agreement, any of the Work is found to be not be in accordance with the requirements of this Agreement, or where defects in materials or workmanship may appear, or be in need of repair, the Contractor shall correct non-conforming and/or defective work or materials promptly after receipt of written notice from the City. Contractor shall immediately at its own expense repair, replace, restore, or rebuild any such Work. This remedy is in addition to any other legal or equitable remedies the City may have under this Agreement or the law.

This guarantee and warranty shall not relieve Contractor of liability for latent defects, and shall be in addition to the City's rights under the law or other guarantees or warranties, express or implied.

16.6 The provisions of this Section 16 shall survive the completion, expiration or termination of this Agreement.

## 17 Savings Clause

17.1 If any provision of this Agreement, or the application of such provision, shall be rendered or declared invalid by a court of competent jurisdiction, or by reason of its requiring any steps, actions, or results, the remaining parts or portions of this Agreement shall remain in full force and effect.

18 Non-Waiver of Rights

18.1 No failure or delay by the City to exercise any power given to it hereunder or to insist upon strict compliance by Contractor with its obligations hereunder, nor any payment made by the City under this Agreement, shall constitute a waiver of the City’s right to demand strict compliance with the terms hereof, unless such waiver is in writing and signed by the City.

19 Entire Agreement

19.1 This Agreement sets forth all the covenants, conditions and promises between the parties with regard to the subject matter set forth herein. There are no covenants, promises, agreements, conditions or understandings between the parties, either oral or written, other than those contained in this Agreement. This Agreement has been negotiated and entered into by each party with the opportunity to consult with its counsel regarding the terms therein. No portion of the Agreement shall be construed against a party due to the fact that one party drafted that particular portion as the rule of *contra proferentem* shall not apply.

20 Governing Law

20.1 This Agreement shall be construed in accordance with and subject to the laws and rules of the City of Evanston and the State of Illinois both as to interpretation and performance. Venue for any action arising out of or due to this Agreement shall be in Cook County, Illinois. The City shall not enter into binding arbitration to resolve any dispute related to this Agreement. The City does not waive tort immunity by entering into this Agreement.

21 Ownership of Contract Documents

21.1 Contractor is specifically prohibited from using in any form or medium, the name or logo of the City for public advertisement, unless expressly granted written permission by the City. Submission or distribution of documents to meet official regulatory requirements or for similar purposes in connection with this Project is not to be construed as publication in derogation of the City’s reserved rights.

22 Notice

22.1 Any notice required to be given by this Agreement shall be deemed sufficient if made in writing and sent by certified mail, return receipt requested, or by personal service, to the persons and addresses indicated below or to such other addresses as either party hereto shall notify the other party of in writing pursuant to the provisions of this Subsection:

City of Evanston Project Manager, Bid 25-05  
2100 Ridge Avenue  
Evanston, Illinois 60201

if to the Contractor:



22.2 Mailing of such notice as and when provided above shall be equivalent to personal notice and shall be deemed to have been given at the time of mailing.

## 23 Severability

23.1 Except as otherwise provided herein, the invalidity or unenforceability of any particular provision, or part thereof, of this Agreement shall not affect the other provisions, and this Agreement shall continue in all respects as if such invalid or unenforceable provision had not been contained herein.

## 24 Execution of Agreement

24.1 This Agreement shall be signed last by the City Manager.

## 25 Counterparts

25.1 For convenience, this Agreement may be executed in any number of counterparts, each of which shall be deemed to be an original.

## 26 Authorizations

26.1 The Contractor's authorized representatives who have executed this Agreement warrant that they have been lawfully authorized by the Contractor's board of directors or its bylaws to execute this Agreement on its behalf. The City Manager affirms that he/she has been lawfully authorized to execute this Agreement. The Contractor and the City shall deliver upon request to each other copies of all articles of incorporation, bylaws, resolutions, ordinances, or other documents which evidence their legal authority to execute this Agreement on behalf of their respective parties.

## 27 Time of Essence

27.1 Time is of the essence with respect to each provision hereof in which time is a factor.



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SECTION 00 52 02  
BID BOND SUBMITTAL LABEL

**CUT AND ATTACH LABEL ON OUTSIDE OF SEALED BID/PROPOSAL SUBMITTAL**



-----

**SUBMITTAL NUMBER:** \_\_\_\_\_

**SUBMITTAL NAME:** \_\_\_\_\_

\_\_\_\_\_

**SUBMITTAL DUE DATE/TIME:** \_\_\_\_\_

**COMPANY NAME:** \_\_\_\_\_

**COMPANY ADDRESS:** \_\_\_\_\_

**COMPANY TELEPHONE #:** \_\_\_\_\_

-----

If required by the bid documents, a scanned copy of the bid bond must be included with the bid electronic submission. The City is currently not able to accept a certified check, bank cashier's check or electronic bid bond at this time.

The original bid bond (in the amount of 5% of the original bid amount) must be mailed within ten (10) days after the bid due date, to the City of Evanston Purchasing Department, 2100 Ridge Avenue - Room 4200 Evanston, Illinois 60201 Attention Purchasing Manager using the USPS (certified or priority), UPS or FedEx mail options in order to have a tracking number; which sum shall be forfeited in case the successful bidder fails to enter into a binding contract and provide a properly executed contract and surety bond within 15 days after the date the contract is awarded by the City.

00 52 10  
NON-DISCLOSURE AGREEMENT

Bidder's Name: \_\_\_\_\_

Project: **Water Plant 4160V Electrical System Reliability Project**

**CONFIDENTIAL INFORMATION.**

The term "Confidential Information" means any information or material which is proprietary to the Owner, which is not generally known other than by the Owner, and which the Consultant may obtain through any direct or indirect contact with the Owner. Regardless of whether specifically identified as confidential or proprietary, Confidential Information shall include any information provided by the Owner concerning the construction, operation and maintenance of the water system, including, without limitation, business records and plans, technical data, and contracts.

**CONFIDENTIALITY OF INFORMATION.**

It is understood that the Bidder (i) will keep confidential all information provided by the City of Evanston in connection with the above described work; (ii) will use such confidential information solely in connection with their engagement with the City of Evanston (iii) will not in future disclose any information derived in their work to any third person or entity.

The Bidder acknowledges that they are prohibited from releasing any information about the City of Evanston water treatment facility / pumping station or distribution system to any entity without the express written consent from the City of Evanston Public Works Director.

**SIGNED:**

**NOTARIZED:**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_  
Date

\_\_\_\_\_  
Date

Notary Seal:

00 61 00  
PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: that

\_\_\_\_\_  
(Name of Corporation)

\_\_\_\_\_  
(Address of Corporation)

a \_\_\_\_\_ hereinafter called Principal, and  
(Corporation, Partnership, or Individual)

\_\_\_\_\_  
(Name of Surety)

\_\_\_\_\_  
(Address of Surety)

hereinafter called Surety, are held and firmly bound unto:

**City of Evanston  
2100 Ridge Avenue  
Evanston, IL 60201**

hereinafter called OWNER, in the penal sum of \_\_\_\_\_  
\_\_\_\_\_ dollars, (\$ \_\_\_\_\_) in lawful  
money of the United States, for the payment of which sum well and truly to be made, we  
bind ourselves, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the Principal entered  
into a certain contract with the OWNER, dated the \_\_\_\_\_ day of \_\_\_\_\_,  
20\_\_\_\_, a copy of which is hereto attached and made a part hereof for the construction  
of the Water Plant 4160V Electrical System Reliability Project (Bid 25-05), which  
includes modifications to the existing Evanston Water Treatment Facility, including  
electrical equipment replacement, miscellaneous electrical improvements, renovation  
and extension of the existing Garage 4, replacement of the ramp retaining wall,  
replacement of the garage ramps, and associated structural, electrical, civil, and  
mechanical works.

NOW, THEREFORE, if the Principal shall well, truly and faithfully perform its duties, all  
the undertakings, covenants, terms, conditions, and agreements of said contract during  
the original term thereof, and any extensions thereof which may be granted by the  
OWNER, with or without notice to the Surety and during the one year guaranty period,  
and if he shall satisfy all claims and demands incurred under such contract, and shall  
fully indemnify and save harmless the OWNER from all costs and damages which it  
may suffer by reason of failure to do so, and shall reimburse and repay the OWNER all  
outlay and expense which the OWNER may incur in making good any default, then this  
obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said surety, for value received hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract or to WORK to be performed hereunder or the SPECIFICATIONS accompanying the same shall in any wise affect its obligation on this BOND, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract or to the WORK or to the SPECIFICATIONS.

PROVIDED, FURTHER, that no final settlement between the OWNER and the CONTRACTOR shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in \_\_\_\_\_ counterparts, each one of which shall be deemed an original, this the \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_\_.

PRINCIPAL:

\_\_\_\_\_  
By \_\_\_\_\_  
Name \_\_\_\_\_  
Title \_\_\_\_\_

(SEAL)  
ATTEST:

\_\_\_\_\_  
Name \_\_\_\_\_  
Title \_\_\_\_\_

SURETY:

\_\_\_\_\_  
By \_\_\_\_\_  
Name \_\_\_\_\_  
Address \_\_\_\_\_  
\_\_\_\_\_

(SEAL)  
ATTEST:

\_\_\_\_\_  
Name \_\_\_\_\_  
\_\_\_\_\_

NOTE: Date of BOND must not be prior to date of Contract.  
If CONTRACTOR is Partnership, all partners should execute BOND.  
IMPORTANT: Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the PROJECT is located

00 61 50  
PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: that

\_\_\_\_\_  
(Name of Contractor)

\_\_\_\_\_  
(Address of Contractor)

a \_\_\_\_\_, hereinafter called Principal, and  
(Corporation, Partnership, or Individual)

\_\_\_\_\_  
(Name of Surety)

\_\_\_\_\_  
(Address of Surety)

hereinafter called SURETY, are held and firmly bound unto:

**City of Evanston  
2100 Ridge Avenue  
Evanston, IL 60201**

hereinafter called OWNER, in the penal sum of \_\_\_\_\_  
dollars, (\$\_\_\_\_\_) in lawful money of the United States, for the payment of  
which sum well and truly to be made, we bind ourselves, successors, and assigns,  
jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that whereas, the Principal entered  
into a certain contract with the OWNER, dated the \_\_\_\_\_ day of  
\_\_\_\_\_, 20\_\_\_\_, a copy of which is hereto attached and made a part  
hereof for the construction of the Water Plant 4160V Electrical System Reliability Project  
(Bid 25-05), which includes modifications to the existing Evanston Water Treatment  
Facility, including electrical equipment replacement, miscellaneous electrical  
improvements, renovation and extension of the existing Garage 4, replacement of the  
ramp retaining wall, replacement of the garage ramps, and associated structural,  
electrical, civil, and mechanical works.

NOW, THEREFORE, if the Principal shall promptly make payment to all persons, firms,  
SUBCONTRACTORS, and corporations furnishing materials for or performing labor in  
the prosecution of the WORK provided for in such contract, and any authorized  
extension or modification thereof, including all amounts due for materials, lubricants, oil,  
gasoline, coal and coke, repairs on machinery, equipment and tools, consumed or used  
in connection with the construction of such WORK, and all insurance premiums on said  
WORK, and for all labor, performed in such WORK whether by SUBCONTRACTOR or  
otherwise, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said Surety for value received hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract or to the WORK to be performed hereunder or the SPECIFICATIONS accompanying the same shall in any wise affect its obligation on this BOND, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract or to the WORK or to the SPECIFICATIONS.

PROVIDED, FURTHER, that no final settlement between the OWNER and the CONTRACTOR shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, this instrument is executed in \_\_\_\_\_ counterparts, each one of which shall be deemed an original, this the \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_\_.

PRINCIPAL:

\_\_\_\_\_  
By \_\_\_\_\_  
Name \_\_\_\_\_  
Title \_\_\_\_\_

(SEAL)  
ATTEST:

\_\_\_\_\_  
Name \_\_\_\_\_  
Title \_\_\_\_\_

SURETY:

\_\_\_\_\_  
By \_\_\_\_\_  
Name \_\_\_\_\_  
Address \_\_\_\_\_  
\_\_\_\_\_

(SEAL)  
ATTEST:

\_\_\_\_\_  
Name \_\_\_\_\_  
\_\_\_\_\_

NOTE: Date of BOND must not be prior to date of Contract. If CONTRACTOR is Partnership, all partners should execute BOND. IMPORTANT: Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the state where the PROJECT is located.

00 66 00  
NOTICE OF INTENT TO AWARD

To: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Project Description: Construction of the Water Plant 4160V Electrical System Reliability Project (Bid 25-05).

The OWNER has considered the BID submitted by you for the above described WORK, in response to its Advertisement for Bids, dated February 6<sup>th</sup>, 2025 and Information for Bidders.

You are hereby notified that your BID will be accepted, contingent upon Illinois Environmental Protection Agency (IEPA) approval, for items in the amount of \_\_\_\_\_.

You will be required by the Information for Bidders to execute the Agreement and furnish the required CONTRACTOR'S Performance BOND, Payment BOND and insurance documentation within ten (10) calendar days from the date of the Notice of Award, to be sent upon IEPA approval, to you.

Dated this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_.

\_\_\_\_\_  
OWNER

By: \_\_\_\_\_

Title: \_\_\_\_\_

00 66 10  
NOTICE OF AWARD

To: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Project Description: Construction of the Water Plant 4160V Electrical System Reliability Project (Bid 25-05).

The OWNER has considered the BID submitted by you for the above described WORK in response to its Advertisement for Bids dated \_\_\_\_\_, 2025 and Instructions to Bidders.

You are hereby notified that your BID has been accepted for items in the amount of \$\_\_\_\_\_.

You are required by the Instructions to Bidders to execute the Agreement and furnish the required CONTRACTOR'S Performance BOND, Payment BOND and certificates of insurance within ten (10) calendar days from the date of this Notice to you.

If you fail to execute said Agreement and to furnish said BONDS and insurance documentation within ten (10) days from the date of this Notice, said OWNER will be entitled to consider all your rights arising out of the OWNER'S acceptance of your BID as abandoned and as a forfeiture of your BID BOND. The OWNER will be entitled to such other rights as may be granted by law.

You are required to return an acknowledged copy of this NOTICE OF AWARD to the OWNER.

Dated this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_.

\_\_\_\_\_  
(Owner)  
By \_\_\_\_\_  
Title \_\_\_\_\_

**ACCEPTANCE OF NOTICE**

Receipt of the above NOTICE OF AWARD is hereby acknowledged,

By \_\_\_\_\_,

This the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.

By \_\_\_\_\_

Title \_\_\_\_\_

00 66 20  
NOTICE TO PROCEED

To: \_\_\_\_\_

Date: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Project: Water Plant 4160V Electrical  
System Reliability Project  
(Bid 25-05)

You are hereby notified to commence WORK in accordance with the Agreement dated \_\_\_\_\_, 20\_\_\_\_, on or before \_\_\_\_\_, 20\_\_\_\_, and you are to complete the work within XXX consecutive calendar days thereafter.

The date of completion of all WORK is therefore \_\_\_\_\_, 20 \_\_\_\_.

\_\_\_\_\_  
(Owner)

By \_\_\_\_\_

Title \_\_\_\_\_

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE TO PROCEED is hereby acknowledged by \_\_\_\_\_

\_\_\_\_\_

this the \_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_.

By \_\_\_\_\_

Title \_\_\_\_\_

00 66 30  
CHANGE ORDER FORM

Order No. \_\_\_\_\_  
Date: \_\_\_\_\_  
Agreement Date: \_\_\_\_\_

PROJECT: \_\_\_\_\_  
OWNER: \_\_\_\_\_  
CONTRACTOR: \_\_\_\_\_

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The following changes are hereby made to the **AGREEMENT**:

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Change to **CONTRACT PRICE**:

Original **CONTRACT PRICE**: \$ \_\_\_\_\_  
Current **CONTRACT PRICE** adjusted by previous **CHANGE ORDERS** \$ \_\_\_\_\_  
Total change in **CONTRACT PRICE** for this **CHANGE ORDER** No. \_\_\_\_\_ \$ \_\_\_\_\_  
The **CONTRACT PRICE** including this **CHANGE ORDER** will be \$ \_\_\_\_\_

Original Date for Contract Completion \_\_\_\_\_  
Modified Date for Contract Completion \_\_\_\_\_

Recommended by (Engineer): \_\_\_\_\_ Date \_\_\_\_\_

Accepted by (Contractor): \_\_\_\_\_ Date \_\_\_\_\_

Approved by (Owner): \_\_\_\_\_ Date \_\_\_\_\_  
City of Evanston

NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL  
EMPLOYMENT OPPORTUNITY  
(EXECUTIVE ORDER 11246)

1. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Opportunity Construction Contract Specifications" set forth herein.
2. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Timetables	Goals for minority participation for each trade	Goals for female participation in each trade
	5%	12%

These goals are applicable to all of the Contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area.

The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals established for the geographical area where the contract resulting from this solicitation is to be performed. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order and the regulations in 41 CFR 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs within 10 working days of award of any construction subcontract in excess of \$10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address and telephone number of the subcontractor; employer identification number; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the contract is to be performed.

4. As used in this Notice, and in the contract resulting from this solicitation, the "covered area" is the City of Evanston, Cook County, Illinois.

## **41 CFR 60**

### **60-4.1 Scope and Application.**

This part applies to all contractors and subcontractors that hold any Federal or federally assisted construction contract in excess of \$10,000. The regulations in this part are applicable to all of a construction contractor's or subcontractor's construction employees who are engaged in on site construction including those construction employees who work on a non-Federal or non-federally assisted construction site. This part also establishes procedures, which all Federal contracting officers and all applicants, as applicable, shall follow in soliciting for and awarding Federal or federally assisted construction contracts. Procedures also are established which administering agencies shall follow in making any grant, contract, loan, insurance, or guarantee involving federally assisted construction which is not exempt from the requirements of Executive Order 11246, as amended. In addition, this part applies to construction work performed by construction contractors and subcontractors for Federal non-construction contractors and subcontractors if the construction work is necessary in whole or in part to the performance of a non-construction contract or subcontract.

[43 FR 49254, OCT. 20, 1978; 43 FR 51404, NOV. 3, 1978]

### **60-4.2 Solicitations.**

(a) All Federal contracting officers and all applicants shall include the notice set forth in paragraph (d) of this section and the Standard Federal Equal Employment Opportunity Construction Contract Specifications set forth in § 60-4.3 of this part in all solicitations for offers and bids on all Federal and federally assisted construction contracts or subcontracts to be performed in geographical areas designated by the Director pursuant to § 60-4.6 of the part. Administering agencies shall require the inclusion of the notice set forth in paragraph (d) of this section and the specifications set forth in § 60-4.3 of this part as a condition of any grant, contract, subcontract, loan, insurance or guarantee involving federally assisted construction covered by this Part 60-4.

(b) All non-construction contractors covered by Executive Order 11246 and the implementing regulations shall include the notice in paragraph (d) of this section in all construction agreements, which are necessary in whole or in part to the performance of the covered non-construction contract.

(c) Contracting officers, applicants and non-construction contractors shall give written notice to the Director within 10 working days of award of a contract subject to these provisions. The notification shall include the name, address and telephone number of the contractor; employer identification number; dollar amount of the contract, estimated starting and completion dates of the contract; the contract number; and geographical area in which the contract is to be performed.

(d) The following notice shall be included in, and shall be a part of, all solicitations for offers and bids on all Federal and federally assisted construction contracts or subcontracts in excess of \$10,000 to be performed in geographical areas designated by the Director pursuant to § 60-4.6 of this part (see 41 CFR 60-4.2(a)):

Notice of Requirement for Affirmative Action To Ensure Equal Employment Opportunity (Executive Order 11246)

1. The Offeror or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Specifications" set forth herein.
2. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Time-tables	Goals for minority participation for each trade	Goals for female participation in each trade
	5%	12%

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area. If the contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the contractor also is subject to the goals for both its federally involved and non-federally involved construction.

The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs within 10 working days of award of any construction subcontract in excess of \$10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address and telephone number of the subcontractor; employer identification number of the subcontractor; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the subcontract is to be performed.

4. As used in this Notice, and in the contract resulting from this solicitation, the "covered area" is (insert description of the geographical areas where the contract is to be performed giving the state, county and city, if any).

[43 FR 49254, OCT. 20, 1978; 43 FR 51401, NOV. 3, 1978, AS AMENDED AT 45 FR 65977, OCT. 3, 1980]

#### **60-4.3 Equal Opportunity Clauses.**

(a) The equal opportunity clause published at 41 CFR 60-1.4(a) of this chapter is required to be included in, and is part of, all nonexempt Federal contracts and subcontracts, including construction contracts and subcontracts. The equal opportunity clause published at 41 CFR 60-1.4(b) is required to be included in, and is a part of, all nonexempt federally assisted construction contracts and subcontracts. In addition to the clauses described above, all Federal contracting officers, all applicants and all non-construction contractors, as applicable, shall include the specifications set forth in this section in all Federal and federally assisted construction contracts in excess of \$10,000 to be performed in geographical areas designated by the Director pursuant to § 60-4.6 of this part and in construction subcontracts in excess of \$10,000 necessary in whole or in part to the performance of non-construction Federal contracts and subcontracts covered under the Executive order.

#### Standard Federal Equal Employment Opportunity Construction Contract Specifications (Executive Order 11246)

1. As used in these specifications:

a. "Covered area," means the geographical area described in the solicitation from which this contract resulted:

b. "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;

c. "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941.

d. "Minority" includes:

(i) Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);

(ii) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);

(iii) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and

(iv) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

2. Whenever the Contractor, or any Subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of \$10,000 the provisions of these specifications and the Notice which

contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.

3. If the Contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each Contractor or Subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other Contractors or Subcontractors toward a goal in an approved Plan does not excuse any covered Contractor or Subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.

4. The Contractor shall implement the specific affirmative action standards provided in paragraphs 7 a through p of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered Construction contractors performing construction work in geographical areas where they do not have a Federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the Federal Register in notice form, and such notices may be obtained from any Office of Federal Contract Compliance Programs office or from Federal procurement contracting officers. The Contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.

5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246, nor the regulations promulgated pursuant thereto.

6. In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, the Contractor must employ such apprentices and trainees during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

7. The Contractor shall take specific affirmative action to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The

Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:

a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.

b. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.

c. Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefore; along with whatever additional actions the Contractor may have taken.

d. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

e. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 7b above.

f. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.

g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with onsite supervisory personnel such as Superintendents, General Foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these

meetings, persons attending, subject matter discussed, and disposition of the subject matter.

h. Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other Contractors and Subcontractors with whom the Contractor does or anticipates doing business.

i. Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a Contractor's work force.

k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.

l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.

m. Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.

n. Ensure that all facilities and company activities are non-segregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

p. Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.

8. Contractors are encouraged to participate in voluntary associations, which assist in fulfilling one or more of their affirmative action obligations (7a through p). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under 7a through p of these Specifications provided that the contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation

which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

9. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally, the Contractor may be in violation of the Executive Order if a specific minority group of women is underutilized).

10. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

11. The Contractor shall not enter into any Subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

12. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

13. The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.8.

14. The Contractor shall designate a responsible official to monitor all employment related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

15. Nothing herein provided shall be construed as a limitation upon the application of other laws, which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

(b) The notice set forth in 41 CFR 60-4.2 and the specifications set forth in 41 CFR 60-4.3 replace the New Form for Federal Equal Employment Opportunity Bid Conditions for Federal and Federally Assisted Construction published at 41 FR 32482 and commonly known as the Model Federal EEO Bid Conditions, and the New Form shall not be used after the regulations in 41 CFR Part 60-4 become effective.

[43 FR 49254, OCT. 20, 1978; 43 FR 51401, NOV. 3, 1978, AS AMENDED AT 45 FR 65978, OCT. 3, 1980]

#### **60-4.4 Affirmative Action Requirements.**

(a) To implement the affirmative action requirements of Executive Order 11246 in the construction industry, the Office of Federal Contract Compliance Programs previously has approved affirmative action programs commonly referred to as "Hometown Plans," has promulgated affirmative action plans referred to as "Imposed Plans" and has approved "Special Bid Conditions" for high impact projects constructed in areas not covered by a Hometown or an Imposed Plan. All solicitations for construction contracts made after the effective date of the regulations in this part shall include the notice specified in § 60-4.2 of this part and the specifications in § 60-4.3 of this part in lieu of the Hometown and Imposed Plans including the Philadelphia Plan and Special Bid Conditions. Until the Director has issued an order pursuant to § 60-4.6 of this part establishing goals and timetables for minorities in the appropriate geographical areas or for a project covered by Special Bid Conditions, the goals and timetables for minorities to be inserted in the Notice required by 41 CFR 60-4.2 shall be the goals and timetables contained in the Hometown Plan, Imposed Plan or Special Bid Conditions presently covering the respective geographical area or project involved.

(b) Signatories to a Hometown Plan (including heavy highway affirmative action plans) shall have 45 days from the effective date of the regulations in this part to submit under such a Plan (for the director's approval) goals and timetables for women and to include female representation on the Hometown Plan Administrative Committee. Such goals for female representation shall be at least as high as the goals established for female representation in the notice issued pursuant to 41 CFR 60-4.6. Failure of the signatories, within the 45-day period, to include female representation and to submit goals for women or a new plan, as appropriate, shall result in an automatic termination of the Office of Federal Contract Compliance Program's approval of the Hometown Plan. At any time the Office of Federal Contract Compliance Programs terminates or withdraws its approval of a Hometown Plan, or when the plan expires and another plan is not approved, the contractors signatory to the plan shall be covered automatically by the specifications set forth in § 60-4.3 of this part and by the goals and timetables established for that geographical area pursuant to § 60-4.6 of this part.

## **60-4.5 Hometown Plans**

(a) A contractor participating, either individually or through an association, in an approved Hometown Plan (including heavy highway affirmative action plans) shall comply with its affirmative action obligations under Executive Order 11246 by complying with its obligations under the plan: *Provided*, That each contractor or subcontractor participating in an approved plan is individually required to comply with the equal opportunity clause set forth in 41 CFR 60-1.4; to make a good faith effort to achieve the goals for each trade participating in the plan in which it has employees; and that the overall good performance by other contractors or subcontractors toward a goal in an approved plan does not excuse any covered contractor's or subcontractor's failure to take good faith efforts to achieve the plan's goals and timetables. If a contractor is not participating in an approved Hometown Plan it shall comply with the specifications set forth in § 60-4.3 of this part and with the goals and timetables for the appropriate area as listed in the notice required by 41 CFR 60-4.2 with regard to that trade. For the purposes of this part 60-4, a contractor is not participating in a Hometown Plan for a particular trade if it:

- (1) Ceases to be signatory to a Hometown Plan covering that trade;
- (2) Is signatory to a Hometown Plan for that trade but is not party to a collective bargaining agreement for that trade;
- (3) Is signatory to a Hometown Plan for that trade but is party to a collective bargaining agreement with labor organizations, which are not or cease to be signatories to the same Hometown Plan for that trade;
- (4) Is signatory to a Hometown Plan for that trade but is party to a collective bargaining agreement with a labor organization for that trade but the two have not jointly executed a specific commitment to minority and female goals and timetables and incorporated the commitment in the Hometown Plan for that trade;
- (5) Is participating in a Hometown Plan for that trade which is no longer acceptable to the Office of Federal Contract Compliance Programs;
- (6) Is signatory to a Hometown Plan for that trade but is party to a collective bargaining agreement with a labor organization for that trade and the labor organization and the contractor have failed to make a good faith effort to comply with their obligations under the Hometown Plan for that trade.

(b) Contractors participating in Hometown Plans must be able to demonstrate their participation and document their compliance with the provision of the Hometown Plan. [43 FR 49254, OCT. 20, 1978; 43 FR 51401, NOV. 3, 1978]

## **60-4.6 Goals and Timetables.**

The Director, from time to time, shall issue goals and timetables for minority and female utilization, which shall be based on appropriate workforce, demographic, or other relevant data and which shall cover construction projects or construction contracts performed in specific geographical areas. The goals, which shall be applicable to each construction trade in a covered contractor's or subcontractor's entire workforce which is working in the area covered by the goals and timetables, shall be published as notices

in the Federal Register, and shall be inserted by the contracting officers and applicants, as applicable, in the Notice required by 41 CFR 60-4.2. Covered construction contractors performing construction work in geographical areas where they do not have a Federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed.  
[45 FR 65978, OCT. 3, 1980]

#### **60-4.7 Effect on Other Regulations.**

The regulations in this part are in addition to the regulations contained in this chapter, which apply to construction contractors and subcontractors generally. See particularly, 41 CFR 60-1.4 (a), (b), (c), (d), and (e); 60-1.5; 60-1.7; 60-1.8; 60-1.26; 60-1.29; 60-1.30; 60-1.32; 60-1.41; 60-1.42; 60-1.43; and 41 CFR Part 60-3; Part 60-20; Part 60-30; Part 60-40; and Part 60-50.

#### **60-4.8 Show Cause Notice.**

If an investigation or compliance review reveals that a construction contractor or subcontractor has violated the Executive order, any contract clause, specifications or the regulations in this chapter and if administrative enforcement is contemplated, the Director shall issue to the contractor or subcontractor a notice to show cause which shall contain the items specified in paragraphs (i) through (iv) of 41 CFR 60-2.2(c)(1). If the contractor does not show good cause within 30 days, or in the alternative, fails to enter an acceptable conciliation agreement which includes where appropriate, make up goals and timetables, back pay, and seniority relief for affected class members, the OFCCP shall follow the procedure in 41 CFR 60-1.26(b): *Provided*, That where a conciliation agreement has been violated, no show cause notice is required prior to the initiation of enforcement proceedings.

[43 FR 49254, OCT. 20, 1978; 43 FR 51401, NOV. 3, 1978]

#### **60-4.9 Incorporation by Operation of the Order.**

By operation of the order, the equal opportunity clause contained in § 60-1.4, the Notice of Requirement for Affirmative Action to Ensure Equal Employment Opportunity (Executive Order 11246) contained in § 60-4.2, and the Standard Federal Equal Employment Opportunity Construction Contract Specifications (Executive Order 11246) contained in § 60-4.3 shall be deemed to be a part of every solicitation or of every contract and subcontract, as appropriate, required by the order and the regulations in this chapter to include such clauses whether or not they are physically incorporated in such solicitation or contract and whether or not the contract is written.

SECTION 00 66 50  
FEDERAL WAGE DETERMINATION

Federal Wage Determination Rates continue on next page.

"General Decision Number: IL20250009 01/10/2025

Superseded General Decision Number: IL20240009

State: Illinois

Construction Types: Building, Heavy, Highway and Residential

County: Cook County in Illinois.

BUILDING, RESIDENTIAL, HEAVY, AND HIGHWAY PROJECTS (does not include landscape projects).

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	. Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least \$17.75 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2025.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	. Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least \$13.30 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2025.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <http://www.dol.gov/whd/govcontracts>.

Modification Number	Publication Date
0	01/03/2025
1	01/10/2025

ASBE0017-001 06/01/2024

	Rates	Fringes
<b>ASBESTOS WORKER/INSULATOR</b>		
Includes the application of all insulating materials, protective coverings, coatings, and finishes to all types of mechanical systems.....	\$ 55.02	35.75
Fire Stop Technician.....	\$ 44.02	32.76
<b>HAZARDOUS MATERIAL HANDLER</b>		
includes preparation, wetting, stripping removal scrapping, vacuuming, bagging and disposal of all insulation materials, whether they contain asbestos or not, from mechanical systems.....	\$ 41.27	32.76

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BOIL0001-001 05/01/2021

	Rates	Fringes
BOILERMAKER.....	\$ 52.61	33.07

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BRIL0021-001 06/01/2016

	Rates	Fringes
BRICKLAYER.....	\$ 44.88	26.62

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BRIL0021-004 06/01/2017

	Rates	Fringes
Marble Mason.....	\$ 44.63	26.83

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BRIL0021-006 06/01/2017

	Rates	Fringes
TERRAZZO WORKER/SETTER.....	\$ 44.38	25.84
TILE FINISHER.....	\$ 38.56	22.10
TILE SETTER.....	\$ 45.49	25.72

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BRIL0021-009 06/01/2017

	Rates	Fringes
MARBLE FINISHER.....	\$ 33.95	26.03

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BRIL0021-012 06/01/2017

	Rates	Fringes
Pointer, cleaner and caulker.....	\$ 45.42	24.06

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CARP0555-001 06/01/2022

BUILDING, HEAVY, AND HIGHWAY

	Rates	Fringes
CARPENTER Carpenter, Lather, Millwright, Piledriver, and Soft Floor Layer Building.....	\$ 52.01	38.85
Heavy & Highway.....	\$ 52.01	38.85

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CARP0555-002 10/01/2023

RESIDENTIAL CONSTRUCTION

	Rates	Fringes
CARPENTER.....	\$ 45.61	35.31

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 ELEC0009-003 05/26/2024

	Rates	Fringes
Line Construction		
Groundman.....	\$ 48.44	60.05%
Lineman and Equipment		
Operator.....	\$ 62.10	60.05%

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 ELEC0134-001 06/03/2024

	Rates	Fringes
ELECTRICIAN.....	\$ 55.55	41.57

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 ELEC0134-003 06/03/2024

	Rates	Fringes
ELECTRICIAN		
ELECTRICAL TECHNICIAN.....	\$ 49.86	30.05

The work shall consist of the installation, operation, inspection, maintenance, repair and service of radio, television, recording, voice sound vision production and reproduction, telephone and telephone interconnect, facsimile, data apparatus, coaxial, fibre optic and wireless equipment, appliances and systems used for the transmission and reception of signals of any nature, business, domestic, commercial, education, entertainment and residential purposes, including but not limited to communication and telephone, electronic and sound equipment, fibre optic and data communication systems, and the performance of any task directly related to such installation or service whether at new or existing sites, such tasks to include the placing of wire and cable and electrical power conduit or other raceway work within the equipment room and pulling wire and/or cable through conduit and the installation of any incidental conduit.

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ELEV0002-001 01/01/2024

	Rates	Fringes
ELEVATOR MECHANIC.....	\$ 67.84	37.885+a+b

FOOTNOTES:

a) PAID HOLIDAYS: New Year's Day; Memorial Day; Independence Day; Labor Day; Thanksgiving Day; Day after Thanksgiving Day; Veterans' Day and Christmas Day.

b) Employer contributes 8% of regular hourly rate as vacation pay credit for employee with more than 5 years of service, and 6% for employee with less than 5 years service

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\* ENGI0150-006 06/01/2024

Building and Residential Construction

	Rates	Fringes
OPERATOR: Power Equipment		
GROUP 1.....	\$ 60.80	49.20
GROUP 2.....	\$ 59.50	49.20
GROUP 3.....	\$ 56.95	49.20
GROUP 4.....	\$ 55.20	49.20

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: Mechanic; Asphalt Plant\*; Asphalt Spreader; Autograde\*; Backhoes with Caisson attachment\*;Batch Plant\*; Benoto(Requires two Engineers); Boiler and Throttle Valve; Caisson Rigs\*; Central Redi-Mix Plant\*; Combination Backhoe Front Endloader Machine; Compressor and Throttle Valve; Concrete Breaker (Truck Mounted)\*; Concrete Conveyor; Concrete Conveyor, Truck Mounted; Concrete Paver over 27E cu. ft.\*; Concrete Paver 27E cu ft and Under\*; Concrete Placer\*; Concrete Placing Boom; Concrete Pump (Truck Mounted); Concrete Tower; Cranes\*; Cranes, Hammerhead\*; Cranes, (GCI and similar type Requires two operators only); Creter Crane; Crusher, Stone, etc; Derricks; Derricks, Traveling\*; Formless Curb and Gutter Machine\*; Grader, Elevating; Grouting Machines; Highlift Shovels or Front Endloader 2 1/4 yd. and over; Hoists, Elevators, Outside

Type Rack and pinion and similar Machines; Hoists, One, Two, and Three Drum; Hoists, Two Tugger One Floor; Hydraulic Backhoes\*; Hydraulic Boom Trucks; Hydraulic Vac (and similar equipment); Locomotives; Motor Patrol\*; Pile Drivers and Skid Rig\*; Post Hole Digger; Pre- Stress Machine; Pump Cretes Dual Ram(Requiring frequent Lubrication and Water); Pump Cretes; Squeeze Cretes-Screw Type Pumps Gypsum Bulker and Pump; Raised and Blind Hole Drill\*; Roto Mill Grinder (36" and Over)\*; Roto Mill Grinder (Less Than 36")\*; Scoops-Tractor Drawn; Slip-Form Paver\*; Straddle Buggies; Tournapull; Tractor with Boom, and Side Boom; and Trenching Machines\*.

GROUP 2: Bobcat (over 3/4 cu yd); Boilers; Broom, Power Propelled; Bulldozers; Concrete Mixer (Two Bag and over); Conveyor, Portable; Forklift Trucks; Greaser Engineer; Highlift Shovels or Front End loaders under 2 1/4 cu yd; Automatic Hoists, Hoists, Inside Elevators; Hoists, Sewer Dragging Machine; Hoists, Tugger Single Drum; Laser Screed; Rock Drill (Self-Propelled); Rock Drill (Truck Mounted)\*; Rollers; Steam Generators; Tractors; Tractor Drawn Vibratory Roller (Receives an additional \$.50 per hour); Winch Trucks with "A" Frame.

GROUP 3: Air Compressor-Small 250 and Under (1 to 5 not to exceed a total of 300 ft); Air Compressor-Large over 250; Combination-Small Equipment Operator; Generator- Small 50 kw and under; Generator-Large over 50 kw; Heaters, Mechanical; Hoists, Inside Elevators (Remodeling or Renovatin work); Hydrualic Power Units (Pile Driving, Extracting, and Drilling); Low Boys; Pumps Over 3" (1 To 3 not to exceed a total of 300 ft); Pumps, Well Points; Welding Machines (2 through 5); Winches, 4 Small Electric Drill Winches; Bobcat (up to and including 3/4 cu yd)

GROUP 4 - Bobcats and/or other Skid Steer Loaders; Brick Forklifts; Oilers

\*-Requires Oiler

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\* ENGI0150-025 06/01/2024

Heavy and Highway Construction

Rates      Fringes

OPERATOR: Power Equipment		
GROUP 1.....	\$ 59.00	49.20
GROUP 2.....	\$ 58.45	49.20
GROUP 3.....	\$ 56.40	49.20
GROUP 4.....	\$ 55.00	49.20
GROUP 5.....	\$ 53.80	49.20

**POWER EQUIPMENT OPERATOR CLASSIFICATIONS**

GROUP 1: Asphalt Plant\*; Asphalt Heater and Planer combination; Asphalt Heater Scarfire\*, Asphalt Spreader; Autograder/ GOMACO or similar; ABG Paver\*, Backhoes with Caisson attachment\*, Ballast Regulator, Belt Loader\*; Caisson Rigs\*Car Dumper, Central Redi-Mix Plant\*, Combination Backhoe; Front End Loader Machine (1 cu yd or over Backhoe bucket or with attachments); Concrete Breaker (truck mounted); Concrete Conveyor; Concrete Paver over 27E cu ft\*; Concrete Placer\*; Concrete Tube Float; Cranes, all attachments\*; Cranes, Hammerhead, Linden, Peco and machines of a like nature\*; Creter Crane; Crusher, stone; All Derricks; Derrick Boats; Derricks, traveling\*; Dowell Machine with Air Compressor (\$1.00 above Class 1); Dredges\*; Field Mechanic Welder; Formless Curb and Gutter Machine\*; Gradall and machines of a like nature\*; Grader, Elevating; Grader, Motor Grader, Motor Patrol, Auto Patrol, Form Grader, Pull Grader, Subgrader; Guard Rail Post Driver mounted\*; Hoists, one, two, and three Drum; Hydraulic Backhoes\*; Backhoes with Shear attachments\*; Mucking Machine; Pile Drivers and Skid Rig\*; Pre-Stress Machine; Pump Cretes Dual Ram (requires frequent lubrication and water)\*; Rock Drill- Crawler or Skid Rig\*; Rock Drill truck mounted\*; Rock/ Track Tamper; Roto Mill Grinder, (36" and over)\*; Slip-Form Paver\*; Soil Test Drill Rig, truck mounted\*; Straddle Buggies; Hydraulic Telescoping Form (tunnel); Tractor Drawn Belt Loader\*; Tractor Drawn Belt Loader with attached Pusher (two engineers); Tractor with boom; Tractaire with attachment; Traffic Barrier Transfer Machine\*; Trenching Machine; Truck Mounted Concrete Pump with boom\*; Underground Boring and/or Mining Machines 5 ft in diameter and over tunnel, etc.\*; Wheel Excavator\* & Widener (Apsco); Raised or Blind Hoe Drill, Tunnel & Shaft\*

GROUP 2: Batch Plant\*; Bituminous Mixer; Boiler and Throttle Valve; Bulldozer; Car Loader Trailing Conveyors; Combination Backhoe Front End Loader Machine, (less than 1

cu yd Backhoe Bucket with attachments); Compressor and Throttle Valve; Compressor, common receiver (3); Concrete Breaker or Hydro Hammer; Concrete Grinding Machine; Concrete Mixer or Paver 7S series to and including 27 cu ft; Concrete Spreader; Concrete Curing Machine; Burlap Machine; Belting Machine and Sealing Machine; Concrete Wheel Saw; Conveyor Muck Cars (Haglund or similar type); Drills (all); Finishing Machine-Concrete; Greaser Engineer; Highlift Shovels or Front End Loader; Hoist- Sewer Dragging Machine; Hydraulic Boom Trucks, all attachments; Hydro-Blaster (requires two operators); Laser Screed\*; Locomotives, Dinky; Off-Road Hauling Units (including articulating); Pump Cretes; Squeeze Cretes-Screw Type pumps, Gypsum Bulker and Pump; Roller Asphalt; Rotary Snow Plows; Rototiller, Seaman, self-Propelled; Scoops-Tractor Drawn; Self-propelled Compactor; Spreader-Chip-Stone; Scraper; Scraper-Prime Mover in Tandem regardless of size (add \$1.00 to Group 2 hourly rate for each hour and for each machine attached thereto add \$1.00 to Group 2 hourly rate for each hour); Tank Car Heater; Tractors, Push, pulling Sheeps Foot, Disc, or Compactor, etc; Tug Boats

GROUP 3: Boilers; Brooms, all power propelled; Cement Supply Tender; Compressor, Common Receiver (2); Concrete Mixer, two bag and over; Conveyor, Portable; Farm type Tractors used for mowing, seeding, etc; Fireman on Boilers; Forklift Trucks; Grouting Machines; Hoists, Automatic; Hoists, all Elevators; Hoists, Tugger single Drum; Jeep Diggers; Low Boys; Pipe Jacking Machines; Post-hole Digger; Power Saw, Concrete, Power Driven; Pug Mills; Rollers, other than asphalt; Seed and Straw Blower; Steam Generators; Stump Machine; Winch Trucks with A-Frame; Work Boats; Tamper-Form motor driven

GROUP 4: Air compressor - Small 250 and under (1 to 5 not to exceed a total of 300 ft); Air Compressor - Large over 250; Combination - Small Equipment Operator; Directional Boring Machine; Generators - Small 50 kw and under; Generators - Large , over 50 kw; Heaters, Mechanical; Hydraulic power unit (Pile Driving, Extracting or Drilling); Light Plants (1 to 5); Pumps, over 3" (1 to 3, not to exceed a total of 300 ft); Pumps, Well Points; Tractaire; Welding Machines (2 through 5); Winches, 4 small electric drill winches;

GROUP 5: Bobcats (All); Brick Forklifts; Oilers; Directional Boring

\*Requires Oiler

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IRON0001-026 06/01/2024

	Rates	Fringes
IRONWORKER		
Sheeter.....	\$ 59.51	45.10
Structural and Reinforcing..	\$ 59.26	45.10

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IRON0063-001 06/01/2024

	Rates	Fringes
IRONWORKER, ORNAMENTAL.....	\$ 57.51	42.81

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IRON0063-002 06/01/2024

	Rates	Fringes
IRONWORKER		
Fence Erector.....	\$ 51.00	32.81

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IRON0136-001 07/01/2024

	Rates	Fringes
IRONWORKER		
Machinery Movers; Riggers;		
Machinery Erectors.....	\$ 51.00	43.94
Master Riggers.....	\$ 53.50	43.94

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LABO0002-006 06/01/2022

	Rates	Fringes
LABORER (BUILDING & RESIDENTIAL)		
GROUP 1.....	\$ 47.40	33.16
GROUP 2.....	\$ 47.40	33.16
GROUP 3.....	\$ 47.48	33.16
GROUP 4.....	\$ 47.50	33.16
GROUP 5.....	\$ 47.55	33.16
GROUP 6.....	\$ 47.60	33.16

GROUP 7.....	\$ 47.63	33.16
GROUP 8.....	\$ 47.73	33.16
GROUP 9.....	\$ 47.75	33.16
GROUP 10.....	\$ 47.85	33.16
GROUP 11.....	\$ 47.68	33.16
GROUP 12.....	\$ 48.40	33.16

LABORER CLASSIFICATIONS

GROUP 1: Building Laborers; Plasterer Tenders; Pumps for Dewatering; and other unclassified laborers.

GROUP 2: Fireproofing and Fire Shop laborers.

GROUP 3: Cement Gun.

GROUP 4: Chimney over 40 ft.; Scaffold Laborers.

GROUP 5: Cement Gun Nozzle Laborers (Gunite); Windlass and capstan person.

GROUP 6: Stone Derrickmen & Handlers.

GROUP 7: Jackhammermen; Power driven concrete saws; and other power tools.

GROUP 8: Firebrick & Boiler Laborers.

GROUP 9: Chimney on fire brick; Caisson diggers; & Well Point System men.

GROUP 10: Boiler Setter Plastic Laborers.

GROUP 11: Jackhammermen on fire brick work only.

GROUP 12: Dosimeter use (any device) monitoring nuclear exposure); Asbestos Abatement Laborer; Toxic and Hazardous Waste Removal Laborers.

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LABO0002-007 06/01/2022

	Rates	Fringes
LABORER (HEAVY & HIGHWAY)		
GROUP 1.....	\$ 47.40	33.16

GROUP 2.....	\$ 47.48	33.16
GROUP 3.....	\$ 47.55	33.16
GROUP 4.....	\$ 47.68	33.16
GROUP 5.....	\$ 47.40	33.16

LABORER CLASSIFICATIONS

GROUP 1: Common laborer; Tenders; Material expeditor (asphalt plant); Street paving, Grade separation, sidewalk, curb & gutter, strippers & All laborers not otherwise mentioned

GROUP 2: Asphalt tampers & smoothers; Cement gun laborers

GROUP 3: Cement Gun Nozzle (laborers), Gunitite

GROUP 4: Rakers, Lutemen; Machine-Screwmen; Kettleman; Mixermen; Drun-men; Jackhammermen (asphalt); Paintmen; Mitre box spreaders; Laborers on birch, overman and similar spreader equipment; Laborers on APSCO; Laborers on air compressor; Paving Form Setter; Jackhammermen (concrete); Power drive concrete saws; other power tools.

GROUP 5: Asbestos Abatement Laborers; Toxic and Hazardous Waste Removal Laborers, Dosimeter (any device) monitoring nuclear exposure

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LABO0002-008 06/01/2022

	Rates	Fringes
LABORER (Compressed Air)		
0 - 15 POUNDS.....	\$ 48.40	33.16
16 - 20 POUNDS.....	\$ 48.90	33.16
21 - 26 POUNDS.....	\$ 49.40	33.16
27 - 33 POUNDS.....	\$ 50.40	33.16
34 - AND OVER.....	\$ 51.40	33.16
LABORER (Tunnel and Sewer)		
GROUP 1.....	\$ 47.40	33.16
GROUP 2.....	\$ 47.53	33.16
GROUP 3.....	\$ 47.63	33.16
GROUP 4.....	\$ 47.75	33.16
GROUP 5.....	\$ 47.40	33.16

LABORER CLASSIFICATIONS (TUNNEL)

GROUP 1: Cage tenders; Dumpmen; Flagmen; Signalmen; Top laborers

GROUP 2: Air hoist operator; Key board operator; concrete laborer; Grout; Lock tenders (Free Air Side); Steel setters; Tuggers; Switchmen; Car pusher

GROUP 3: Concrete repairmen; Lock tenders (pressure side); Mortar men; Muckers; Grout machine operators; Track layers

GROUP 4: Air trac drill operator; Miner; Bricklayer tenders; Concrete blower operator; Drillers; Dynamiters; Erector operator; Form men; Jackhammermen; Powerpac; Mining machine operators; Mucking machine operator; Laser beam operator; Liner plate and ring setters; Shield drivers; Power knife operator; Welder- burners; Pipe jacking machine operator; skimmers; Maintenance technician

GROUP 5: Asbestos abatement laborer; Toxic and hazardous waste removal laborer; Dosimeter (any device) monitoring nuclear exposure

LABORER CLASSIFICATIONS (SEWER)

GROUP 1: Signalmen; Top laborers and All other laborers

GROUP 2: Concrete laborers and Steel setters

GROUP 3: Cement carriers; Cement mixers; Concrete repairmen; Mortar men; Scaffold men; Second Bottom men

GROUP 4: Air trac drill operator; Bottom men; Bracers-bracing; Bricklayer tenders; Catch basin diggers; Drainlayers; dynamiters; Form men; Jackhammermen; Powerpac; Pipelayers; Rodders; Welder-burners; Well point systems men

GROUP 5: Asbestos abatement laborer, Toxic and hazardous waste removal laborer; Dosimeter (any device) monitoring nuclear exposure

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LABO0225-001 06/01/2022

Rates      Fringes

LABORER (DEMOLITION/WRECKING)		
GROUP 1.....	\$ 42.40	33.16
GROUP 2.....	\$ 47.40	33.16
GROUP 3.....	\$ 47.40	33.16

LABORER CLASSIFICATIONS

GROUP 1 - Complete Demolition

GROUP 2 - Interior Wrecking and Strip Out Work

GROUP 3 - Asbestos Work with Complete Demolition/Wrecking or Strip Out Work

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PAIN0014-001 06/01/2024

	Rates	Fringes
PAINTER (including taper).....	\$ 53.05	33.91

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PAIN0027-001 06/01/2024

	Rates	Fringes
GLAZIER.....	\$ 51.55	44.09

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PLAS0005-002 07/01/2015

	Rates	Fringes
PLASTERER.....	\$ 42.25	26.65

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PLAS0502-001 06/01/2024

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER...	\$ 52.00	42.08

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PLUM0130-001 06/01/2024

	Rates	Fringes
PLUMBER.....	\$ 58.55	37.32

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PLUM0597-002 06/01/2023

	Rates	Fringes
PIPEFITTER.....	\$ 55.00	38.62

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 \* ROOF0011-001 12/01/2024

	Rates	Fringes
ROOFER.....	\$ 50.25	30.43

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 \* SFIL0281-001 01/01/2025

	Rates	Fringes
SPRINKLER FITTER.....	\$ 60.00	35.45

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 SHEE0073-001 06/01/2022

	Rates	Fringes
Sheet Metal Worker.....	\$ 49.10	42.91

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 SHEE0073-002 06/08/2018

	Rates	Fringes
Sheet Metal Worker ALUMINUM GUTTER WORK.....	\$ 31.32	37.02

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 TEAM0731-001 06/01/2024

COOK COUNTY - HEAVY AND HIGHWAY

	Rates	Fringes
TRUCK DRIVER		
2 or 3 Axles.....	\$ 43.45	29.49
4 Axles.....	\$ 43.70	29.49
5 Axles.....	\$ 43.90	29.49
6 Axles.....	\$ 44.10	29.49

FOOTNOTES:

A. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and

Christmas Day.

B. 900 straight time hours or more in 1 calendar year for the same employer shall receive 1 week paid vacation; 3 years - 2 weeks paid vacation; 10 years - 3 weeks paid vacation; 20 years - 4 weeks paid vacation.

C. An additional \$.20 per axle shall be paid for all vehicles with more than six (6) axles.

Low-Boy is an additional \$1.50 per hour  
Health and Welfare: \$448.80 per week  
Pension: \$562.80 per week

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TEAM0731-002 04/01/2023

	Rates	Fringes
Traffic Control Device Monitor TRAFFIC SAFETY WORKER: Primary duties include but are not limited to the delivery, maintenance and pick-up of traffic control devices, the set-up and installation of traffic signs, pavement markings, barricades, crash barrels and glare screens, traffic control surveillance, the repair and maintenance trucks, cars, arrow boards, message signs, barricade and sign fabrication equipment.....	\$ 40.10	20.95

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TEAM0786-001 06/01/2024

COOK COUNTY - BUILDING AND RESIDENTIAL

	Rates	Fringes
TRUCK DRIVER 2 & 3 Axles.....	\$ 52.05	0.25+a
4 Axles.....	\$ 52.31	0.25+a

5 Axles.....	\$ 52.53	0.25+a
6 Axles.....	\$ 52.74	0.25+a

FOOTNOTES:

a. An additional \$.20 per axle shall be paid for all vehicles with more than six (6) axles.

Low-Boy work classification is an additional \$1.50 per hour.

Health and Welfare: \$433.00 per week

Pension: \$400 per week.

B. 900 straight time hours or more in 1 calendar year for the same employer shall receive 1 week paid vacation; 3 years - 2 weeks paid vacation; 10 years - 3 weeks paid vacation; 20 years - 4 weeks paid vacation.

Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day.

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WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (iii)).

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The body of each wage determination lists the classifications and wage rates that have been found to be prevailing for the type(s) of construction and geographic area covered by the wage determination. The classifications are listed in alphabetical order under rate identifiers indicating whether the particular rate is a union rate (current union negotiated rate), a survey rate, a weighted union average rate, a state adopted rate, or a supplemental classification rate.

#### Union Rate Identifiers

A four-letter identifier beginning with characters other than ""SU"", ""UAVG"", ?SA?, or ?SC? denotes that a union rate was prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2024. PLUM is an identifier of the union whose collectively bargained rate prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. The date, 07/01/2024 in the example, is the effective date of the most current negotiated rate.

Union prevailing wage rates are updated to reflect all changes over time that are reported to WHD in the rates in the collective bargaining agreement (CBA) governing the classification.

#### Union Average Rate Identifiers

The UAVG identifier indicates that no single rate prevailed for those classifications, but that 100% of the data reported for the classifications reflected union rates. EXAMPLE: UAVG-OH-0010 01/01/2024. UAVG indicates that the rate is a weighted union average rate. OH indicates the State of Ohio. The next number, 0010 in the example, is an internal number

used in producing the wage determination. The date, 01/01/2024 in the example, indicates the date the wage determination was updated to reflect the most current union average rate.

A UAVG rate will be updated once a year, usually in January, to reflect a weighted average of the current rates in the collective bargaining agreements on which the rate is based.

### Survey Rate Identifiers

The ""SU"" identifier indicates that either a single non-union rate prevailed (as defined in 29 CFR 1.2) for this classification in the survey or that the rate was derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As a weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SUFL2022-007 6/27/2024. SU indicates the rate is a single non-union prevailing rate or a weighted average of survey data for that classification. FL indicates the State of Florida. 2022 is the year of the survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 6/27/2024 in the example, indicates the survey completion date for the classifications and rates under that identifier.

?SU? wage rates typically remain in effect until a new survey is conducted. However, the Wage and Hour Division (WHD) has the discretion to update such rates under 29 CFR 1.6(c)(1).

### State Adopted Rate Identifiers

The ""SA"" identifier indicates that the classifications and prevailing wage rates set by a state (or local) government were adopted under 29 C.F.R 1.3(g)-(h). Example: SAME2023-007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 01/03/2024 in the example, reflects the date on which the classifications and rates under the ?SA? identifier took effect under state law in the state from which the rates were adopted.

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## WAGE DETERMINATION APPEALS PROCESS

1) Has there been an initial decision in the matter? This can be:

- a) a survey underlying a wage determination
- b) an existing published wage determination
- c) an initial WHD letter setting forth a position on a wage determination matter
- d) an initial conformance (additional classification and rate) determination

On survey related matters, initial contact, including requests for summaries of surveys, should be directed to the WHD Branch of Wage Surveys. Requests can be submitted via email to [davisbaconinfo@dol.gov](mailto:davisbaconinfo@dol.gov) or by mail to:

Branch of Wage Surveys  
Wage and Hour Division  
U.S. Department of Labor  
200 Constitution Avenue, N.W.  
Washington, DC 20210

Regarding any other wage determination matter such as conformance decisions, requests for initial decisions should be directed to the WHD Branch of Construction Wage Determinations. Requests can be submitted via email to [BCWD-Office@dol.gov](mailto:BCWD-Office@dol.gov) or by mail to:

Branch of Construction Wage Determinations  
Wage and Hour Division  
U.S. Department of Labor  
200 Constitution Avenue, N.W.  
Washington, DC 20210

2) If an initial decision has been issued, then any interested party (those affected by the action) that disagrees with the decision can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Requests for review and reconsideration can be submitted via email to [dba.reconsideration@dol.gov](mailto:dba.reconsideration@dol.gov) or by mail to:

Wage and Hour Administrator  
U.S. Department of Labor  
200 Constitution Avenue, N.W.

Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board  
U.S. Department of Labor  
200 Constitution Avenue, N.W.  
Washington, DC 20210.

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END OF GENERAL DECISION"

00 66 60  
U.S. ENVIRONMENTAL PROTECTION AGENCY  
CERTIFICATION OF NONSEGREGATED FACILITIES

(Applicable to federally assisted construction contracts and related subcontracts exceeding \$10,000 which are not exempt from the Equal Opportunity clause.)

The federally assisted construction contractor certifies that he does not maintain or provide for his employees any segregated facilities at any of his establishments, and that he does not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The federally assisted construction contractor certifies further that he will not maintain or provide for his employees any segregated facilities at any of his establishments, and that he will not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The federally assisted construction contractor agrees that a breach of this certification is a violation of the Equal Opportunity clause in this contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, rest rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, creed, color, or national origin, because of habit, local custom or otherwise. The federally assisted construction contractor agrees that (except where he has obtained identical certifications from proposed subcontractors for specific time periods) he will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity clause, and that he will retain such certification in his files.

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Signature

Date

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Name and Title of Signer (Please type)

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Firm Name

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

00 67 00  
NOTICE TO LABOR UNIONS OR OTHER ORGANIZATIONS OF WORKERS  
NONDISCRIMINATION IN EMPLOYMENT

To: \_\_\_\_\_  
(Name of union or organization of workers)

The undersigned currently holds contract(s) with \_\_\_\_\_  
(Name of applicant)

involving funds or credit of the U.S. Government or (a) subcontract(s) with a prime contractor holding such contract(s).

You are advised that under the provisions of the above contracts(s) or subcontract(s) and in accordance with Executive Order 11246, as amended, dated September 24, 1965, as amended, the undersigned is obliged not to discriminate against any employee or applicant for employment because of race, color, creed or national origin. This obligation not to discriminate in employment includes, but is not limited to, the following:

HIRING, PLACEMENT, UPGRADING, TRANSFER OR DEMOTION,  
RECRUITMENT, ADVERTISING, OR SOLICITATION FOR EMPLOYMENT,  
TRAINING DURING EMPLOYMENT, RATES OF PAY OR OTHER FORMS OF  
COMPENSATION, SELECTION FOR TRAINING INCLUDING APPRENTICESHIP,  
LAYOFF OR TERMINATION.

This notice is furnished you pursuant to the provisions of the above contract(s) or subcontracts(s) and Executive Order 11246, as amended.

Copies of this notice will be posted by the undersigned in conspicuous places available to employees or applicants for employment.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
(Contractor or Subcontractor)  
\_\_\_\_\_  
(Date)

00 67 50  
CERTIFICATION REGARDING DEBARMENT, SUSPENSION, AND OTHER  
RESPONSIBILITY MATTERS

EPA Project Control #  
\_\_\_\_\_

United States Environmental Protection Agency  
Washington, DC 20460

**Certification Regarding Debarment, Suspension and Other Responsibility Matters**

The prospective participant to the best of its knowledge and belief that it and its principles:

- (a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
- (b) Have not within a three year period preceding this proposal be convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to retain, or performing a public (Federal, State or Local) transaction or contract under a public transaction: violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property.
- (c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State or Local) with commission of any of the offenses enumerated in paragraph (1) (b) of this certification; and
- (d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or Local) terminated for cause or default.

I understand that a false statement on this certification may be ground for rejection of this proposal or termination of the award. In addition, under 18 USC Sec. 1001 a false statement may result in fine of up to \$10,000 or imprisonment for up to 5 years, or both.

\_\_\_\_\_  
(Typed Name & Title of Authorized Representative)

\_\_\_\_\_  
(Signature of Authorized Representative)

\_\_\_\_\_  
(Date)

I am unable to certify the above statements. My explanation is attached.

EPA Form 5700-49 (11-88)

CERTIFICATION REGARDING DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY  
MATTERS  
00 67 50-1

## **Instructions**

Under executive order 12549, an individual or organization debarred or excluded from participation in Federal assistance or benefit programs may not receive any assistance award under a Federal program or subprogram hereunder for \$25,000 or more.

Accordingly, each prospective recipient of an EPA grant, loan, or cooperative agreement and any contract or sub-agreement participant hereunder must complete the attached certification or provide an explanation why they cannot. For further details see 40CRF 32.510. Participants' responsibilities, in the attached regulation.

### **Where to Submit**

The prospective EPA grant, loan or cooperative agreement recipient must return the signed certification or explanation with its application to the appropriate EPA Headquarters or Regional Office, as required in the application instructions.

A prospective prime contractor must submit a completed certification or explanation to the individual or organization awarding the contract.

Each prospective subcontractor must submit a completed certification or explanation to the prime contractor for the project.

### **How to Obtain Forms:**

EPA includes the certification form, instructions, and a copy of its implementing regulation (40 CRF Part 32) in each application kit. Applicants may reproduce these materials as needed to provide them to their prospective prime contractor, who, in turn may reproduce and provide them to prospective subcontractors.

### **Additional copies/assistance may be requested from:**

Compliance Branch  
Grants Administration Division (PM-216F)  
U.S. Environmental Protection Agency  
401 M Street, SW  
Washington, DC 20460  
(Telephone: 202-475-8025)

EPA Form 5700-49 (11-88)

CONSTRUCTION CONTRACTS OF LOAN RECIPIENT AND OTHER SECTIONS  
FROM: "PROCEDURES FOR ISSUING LOANS FROM THE PUBLIC WATER SUPPLY  
LOAN PROGRAM

**Section 662.420(b)(2) Change Orders**

- A) When the loan recipient authorizes the contractor to add, delete, or revise the work within the general scope of the contract documents, or authorizes an adjustment in the contract price or contract time, the loan recipient shall submit a change order to the Agency.
- B) For each change order, the loan recipient shall submit to the Agency for approval the following documentation:
  - i. one copy of the fully executed change order signed by the loan recipient, construction engineer, and the contractor; and
  - ii. a description of any changes, with justification for the changes.
- C) Prior approval by the Agency of a change order is required when a change order results in:
  - i. alterations in design scope that require a modification to a construction permit; or
  - ii. an increase in the amount of loan funds needed to complete the project.
- D) Failure to give timely notice of proposed project changes or action by the loan recipient that is not consistent with the Agency's determination on those changes may result in disallowance of loan participation for costs incurred that are attributable to the change.

**Section 662.620(f) Required Construction Contract Provisions**

Each construction contract shall include the following provisions:

- 1) Audit; access to records:
  - A) The contractor shall maintain books, records, documents and other evidence directly pertinent to performance on loan work in accordance with Generally Accepted Accounting Principles (GAAP). The contractor shall also maintain the financial information and data used by the contractor in the preparation or support of any cost submissions required under Section 365.420 (b)(2) of the loan rules and a copy of the cost

summary submitted to the owner. The Illinois Auditor General, the owner, the Agency, or any of their authorized representatives shall have access to the books, records, papers, documents, and other evidence for purposes of inspection, audit, examination, excerpts, transcriptions, and copying. The contractor shall provide facilities for access and inspection.

- B) For a formally advertised, competitively awarded, fixed price contract, the contractor shall include access to records as required by subsection (a)(1)(A) for all negotiated change orders and contract amendments in excess of \$25,000 that affect the contract price. In the case of all other prime contracts, the contractor shall agree to include access to records required by subsection (a)(1)(A) in all contracts and all tier subcontracts or change orders in excess of \$25,000 that are directly related to project performance.
- C) Audits shall be in accordance with auditing standards generally accepted in the United States.
- D) The contractor shall agree to the disclosure of all information and reports resulting from access to records required by subsection (a)(1)(A). When the audit concerns the contractor, the auditing agency shall afford the contractor an opportunity for an audit exit conference and an opportunity to comment on the pertinent portions of the draft audit report. The final audit report shall include the written comments, if any, of the audited parties.
- E) The records required by subsection (a)(1)(A) shall be maintained and made available during performance of the work under the loan agreement and for 3 years after the date of the final loan audit. In addition, records that relate to any dispute or litigation or the settlement of claims arising out of any performance, costs or items to which an audit exception has been taken, shall be maintained and made available for 3 years after resolution of the dispute, appeal, litigation, claim or exception.
- F) The right of access will generally be exercised with respect to financial records under:
  - i. Negotiated prime contracts;
  - ii. Negotiated change orders or contract amendments in excess of \$25,000 affecting the price of any formally advertised, competitively awarded, fixed price contract; and
  - iii. Subcontracts or purchase orders under any contract other than a formally advertised, competitively awarded, fixed price contract.

G) The right of access will generally not be exercised with respect to a prime contract, subcontract, or purchase order awarded after effective price competition. In any event, the right of access shall be exercised under any type of contract or subcontract:

- i. With respect to records pertaining directly to contract performance, excluding any financial records of the contractor; and
- ii. If there is any indication that fraud, gross abuse, or corrupt practices may be involved in the award or performance of the contract or subcontract.

2) Covenant against contingent fees.

The contractor shall warrant that no person or selling agency has been employed or retained to solicit or secure the contract upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee. For breach or violation of this warranty, the owner shall have the right to annul the contract without liability or in its discretion to deduct from the contract price or consideration, or otherwise recover, the full amount of such commission, percentage, brokerage, or contingent fee.

3) Wage provisions.

The Contractor shall pay prevailing wages in accordance with the Davis-Bacon Act (40 USC 3141 through 3148) as defined by the U.S. Department of Labor.

4) Disadvantaged business enterprise requirements.

The contractor shall provide evidence that the contractor has taken affirmative steps in accordance with 40 CFR 33 to assure that disadvantaged business enterprises are used when possible as sources of supplies, equipment, construction, and services, consistent with the provisions of the Agency's Operating Agreement with USEPA.

5) Debarment and suspension provisions.

The contract shall require the successful bidders to submit a Certificate Regarding Debarment, Suspension and Other Responsibility Matters (EPA Form 5700-49) showing compliance with federal Executive Order 12549.

6) Nonsegregated facilities provisions

The contractor shall be required to submit a Certification of Nonsegregated Facilities on forms provided by the Agency.

#### 7) American Iron and Steel

The contractor shall be required to use American Iron and Steel, if required by USEPA for that fiscal year.

#### 8) A clause that provides:

"No contractor or subcontractor shall discriminate on the basis of race, color, national origin or sex in the performance of this contract. The contractor or subcontractor shall carry out applicable requirements of 40 CFR 33 in the award and administration of contracts awarded under the PWSLP. Failure by the contractor or subcontractor to carry out these requirements is a material breach of this contract which may result in the termination of this contract or other legally available remedies."

### **Section 662.620(g) Subcontracts Under Construction Contracts**

The award or execution of all subcontracts by a prime contractor and the procurement and negotiation procedures used by the prime contractor shall comply with:

- 1) All applicable provisions of federal, State and local law;
- 2) All provisions of this Part 662 regarding fraud and other unlawful or corrupt practices;
- 3) All provisions of this Part 662 with respect to access to facilities, records and audit of records; and
- 4) All provisions of subsection 662.620(f)(5) that require a Certification Regarding Debarment, Suspension, and Other Responsibility Matters (EPA Form 5700-49) showing compliance with any controlling federal Executive Orders.

### **Section 662.620(h) Contractor Bankruptcy**

In the event of a contractor bankruptcy, the loan recipient shall notify the Agency and shall keep the Agency advised of any negotiations with the bonding company, including any proposed settlement. The Agency may participate in those negotiations and will advise the loan recipient of the impact of any proposed settlement to the loan agreement. The loan recipient shall be responsible for assuring that every appropriate procedure and incidental legal requirement is observed in advertising for bids and re-awarding a construction contract.

### **Section 662.620(i) Access**

Every contract entered by the loan recipient for construction work, and every subagreement, shall provide the Agency representatives with access to the work. The contractor or subcontractor shall provide facilities for such access and inspection.

### **Section 662.640(c) Remedies**

All claims, counter-claims, disputes and other matters in question between the recipient and the contractor arising out of, or relating to, a subagreement or its breach shall be decided by arbitration if the parties agree, or in a court of competent jurisdiction within the State.

00 68 50  
BIDDER CERTIFICATION REGARDING COMPLIANCE WITH ARTICLE 33E-11  
"CRIMINAL CODE OF 2012"

I \_\_\_\_\_, do hereby certify that:  
Name

1. I am \_\_\_\_\_ of the \_\_\_\_\_  
Position Firm

and have authority to execute this certification on behalf of the firm;

2. This firm is not barred from bidding on this contract due to either a Bid-rigging or Bid Rotating violation as set forth in Article 33E-11 to the "Illinois Criminal Code of 2012." [720 ILCS 55/33E-11]

Name of Firm \_\_\_\_\_

Signature \_\_\_\_\_

Title \_\_\_\_\_

Date \_\_\_\_\_

Corporate Seal (where appropriate)

On this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_, before me appeared \_\_\_\_\_ (Name) to me personally known, who, being duly sworn, did execute the foregoing affidavit, and did state that he or she was properly authorized by \_\_\_\_\_ (Name of Firm) to execute the affidavit and did so as his or her free act and deed.

Notary Public \_\_\_\_\_

Commission Expires \_\_\_\_\_

Notary Seal

SPECIFICATION FOR DISADVANTAGED BUSINESS ENTERPRISE PARTICIPATION  
CITY OF EVANSTON

I. Disadvantaged Business Enterprise Policy

- A. It is the policy of the State of Illinois to award a fair share of sub-agreements to disadvantaged businesses. In complying with this requirement, contractors are required to take affirmative steps to assure that disadvantaged businesses are used when possible as sources of supplies, equipment, construction, and services as explained herein.
- B. These specifications define the terms, conditions, and requirements of the State Revolving Fund Loan Program, and the City of Evanston's policy and procedures for complying with these requirements.
- C. As required by the award conditions of USEPA's Assistance Agreement with IEPA, the fair share percentages are 5% for MBEs and 12% for WBEs.

II. Pre-Contract Award Obligations

- A. All bidders are required to advertise subcontracting opportunities and to negotiate with disadvantaged businesses prior to bid opening. Failure to document such affirmative efforts shall be deemed, relative to disadvantaged business compliance non-responsive.
- B. To establish a bid as responsible, the Bidder will be required to document the proposed utilization of disadvantaged businesses with letters of intent signed by the bidder and by the disadvantaged business listed in the bid. The documentation requirements are outlined in Section III of this document.
- C. The City of Evanston's disadvantaged business policy clearly intends for Bidders to contact and encourage the participation of disadvantaged businesses prior to bid opening. Affirmative efforts (the written record of conscientious and honest communications between the bidder and disadvantaged business) must be initiated and completed by the bidder prior to bid opening. All bidders must document compliance with the requirements of the disadvantaged business policy.

III. Evaluation of Disadvantaged Business Utilization and Affirmative Efforts

- A. As a prerequisite to demonstrate compliance with the City of Evanston's disadvantaged business policy, ALL bidders shall provide the following with its bid:
  - 1. Completed and signed certification from the bidder(s), attesting that the bidder will award no sub-agreements, including the procurement of equipment, materials, supplies and services, in the performance of this contract.

OR

2. "Certification of publication," or adequate evidence of proof of publication, including an actual copy of the newspaper advertisement from a daily newspaper. **The advertisement must run one day at least (16) days prior to bid opening.** An example advertisement follows this section.

Bidders may publish the advertisement in an established, online bidder's clearinghouse such as the "Dodge Report (<http://construction.com/dodge/>)". If an online advertisement is placed with the "Dodge Report" or an equivalent website, a screenshot of the advertisement along with the webpage address, and a payment receipt is required as documentation. **The advertisement must run one day at least (16) days prior to bid opening.**

3. List of all disadvantaged business enterprise (DBE) and non-DBE's that submitted proposals to the bidder along with the date of the proposal. Names, addresses, phone number and/or e-mail are required.
4. List of all disadvantaged businesses not being utilized and justification for non-utilization.
5. If DBE subcontractors will be utilized for the project, a completed and signed copy of IEPA DBE Form No. 3 (DBE Subcontractor Utilization Form) or an equivalent "Notice of Intent" is needed from each subcontractor.
6. If DBE subcontractors will be utilized for the project, a completed and signed certification from the bidder(s), attesting that the bidder has no controlling or dominating interest or conflict of interest with the disadvantaged business that will be utilized.
7. In instances where the bidder(s) does not receive any proposals from disadvantaged businesses prior to bid opening, the bidder(s) must provide a written certification attesting that no proposals were received.

Failure to submit the documentation pursuant to the requirements of A(1-7) above may cause rejection of the bid as non-responsive.

#### IV. Sanctions

- A. The City of Evanston has the option to reject one or all bids when the information submitted by the bidder(s) fails to demonstrate compliance with the disadvantaged business requirements (i.e., the bidder fails to place their pre-bid advertisement in a daily newspaper, or approved website, at least sixteen (16) days prior to the bid opening).
- B. Upon finding that any Party has not complied with the requirements of these specifications, including misrepresenting a firm as a disadvantaged business, any one or a combination of the following actions may be taken.
  1. Declare the bidder and/or subcontractor non-responsible and therefore ineligible for contract award.

2. Disallow all contract costs associated with non-compliance.
3. Refer matters which may be fraudulent to the Illinois Attorney General.

V. Post-Contract Award Compliance

- A. As required by the award conditions of USEPA's Assistance Agreement with IEPA, all sub-agreements of the prime contractor must identify that the fair share percentages are 5% for MBEs and 12 % for WBEs.
- B. After award of the prime contract, copies of all disadvantaged business related sub-agreements between the prime contractor and subcontractors shall be submitted to the owner.
- C. Subsequent to bid submission, any changes in previously reported disadvantaged businesses utilization shall be handled in accordance with 40 CFR Part 33.302(b-h). If the contractor fails to initiate such actions, the owner may withhold payments and/or institute other appropriate sanctions.

**Suggested Disadvantaged Business (DBE)  
Advertisement for Construction Contractors**

Notice to Disadvantaged Businesses

\_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, is  
(Name of Company) (Address of Company) (Telephone)

seeking disadvantaged businesses for the \_\_\_\_\_  
(Name of Loan Recipient)

Project for subcontracting opportunities in the following areas:

\_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_.

All disadvantaged businesses should contact, IN WRITING, (certified letter, return receipt requested), \_\_\_\_\_, to discuss the subcontracting  
(Company Contact Person)

opportunities. All negotiations must be completed prior to the bid opening date

\_\_\_\_\_.  
(Date of Bid Opening)

\*The advertisement must clearly state the method of evaluating the proposals or quotations, and the relative importance attached to each criterion. Bidders must uniformly and objectively evaluate the proposals submitted by disadvantaged businesses in response to the advertisement based upon the evaluation criteria stated in the advertisement. The evaluation criteria must not be restrictive or exclusionary.

## Summary Report of Disadvantaged Business Enterprise Requirements for Contractors

- 1) Completed and signed certification from bidder(s), attesting that the bidder will award no sub-agreements, including the procurement of equipment, materials, supplies and services in the performance of this contract (may use IEPA DBE Form #1).

OR

"Certificate of publication, or adequate evidence of proof of publication, including an actual copy of the newspaper advertisement from a daily publication. For advertisements placed in a construction project clearinghouse such as [www.construction.com](http://www.construction.com), a screenshot of the advertisement, link to website, and receipt is required for proof of advertising.

- 2) List of all disadvantaged business enterprises (DBE) and non-DBE's that submitted proposals to the bidder/prime contractor. Specify as DBE or non-DBE, type of DBE and the other information listed below (DBE Form #4 may be used for this purpose).

Name of Company  
Name of Owners  
Address of Company  
E-mail Address of Company  
Telephone Number  
Date of Proposal  
Type of Business  
Type of DBE  
Description of work to be performed

- 3) List of disadvantaged businesses that submitted proposals to the bidder but will not be utilized. Justification for non-utilization must be provided (may use IEPA DBE Form #1).
- 4) Completed and signed copies IEPA DBE Form #3 (Subcontractor Utilization Form) or equivalent "Notice of Intent". Only applies if using DBE subcontractors.
- 5) Completed and signed certification from bidder(s) attesting that the bidder has no dominating or conflict of interest with the disadvantaged business to be utilized (IEPA DBE Form #1). Only applies if using DBE subcontractors.
- 6) In instances where the bidder(s) does not receive any proposals from disadvantaged businesses prior to bid opening, the bidder(s) must provide a written certification attesting that no proposals were received (IEPA DBE Form #1).
- 7) DBE Form #2 is **not** included in this packet. It is for consultants/engineers to report DBE activity. This form may be found in IEPA's DBE Guidance Manual which is available on the Agency's website or mailed upon request by calling 217-782-2027.

**IEPA Disadvantaged Business Enterprise (DBE) Program Form #1**  
**Contractor Certification Form**

**(To be completed by all Prime Contractors)**

Please check the appropriate boxes that apply and complete the information on the bottom of the form.

This firm will award no subcontracts (including in the procurement of equipment, supplies, or services), in the performance of this contract.

This firm advertised for DBE subcontractors according to the good faith efforts outlined in the IEPA DBE Guidance Document.

This firm received proposals from DBE(s) that will not be utilized. A list of the DBEs not hired, along with their address, phone number, and reason(s) for non-utilization, is below.

This firm did not receive any inquiries from DBEs.

I certify that the above is true. I further certify that this firm and its partners, directors, and officers do not possess a controlling interest in ownership or conflict of interest or any other authority to control the DBE to be used during the performance of the contracts.

By: \_\_\_\_\_  
NAME: \_\_\_\_\_  
TITLE: \_\_\_\_\_  
Company: \_\_\_\_\_

Date: \_\_\_/\_\_\_/\_\_\_\_\_

## EPA Disadvantaged Business Enterprise (DBE) Program Form #3 Subcontractor Utilization Form

(Only complete this form if DBE subcontractors or sub-consultants will be working on a project)

This form is intended to capture the DBE subcontractor's description of work to be performed and the price of the work submitted to the prime contractor. All subcontractors must complete this form, and it must be included in the prime contractor's bid package.

Subcontractor Name	Project Name
Contact Person's Name & Title	
Address	
Telephone	Email
DBE Certified By:	Select One: <b>MBE    WBE    SBE    DBE</b>
Prime Contractor Name	
<b>Type of Work to be Performed</b>	<b>Cost Estimate of Work</b>

I certify under penalty of perjury that the forgoing statements are true and correct. Signing this form does not signify a commitment to using the subcontractors above. I am aware that in the event of a replacement of a subcontractor, I will adhere to the replacement requirements set forth in 40 C.F.R. Part 33 Section 33.302(c).

<b>Prime Contractor Signature:</b>	<b>Print Name:</b>
<b>Date:</b>	<b>Title:</b>
<b>Subcontractor Signature:</b>	<b>Print Name:</b>
<b>Date:</b>	<b>Title:</b>

**IEPA Disadvantaged Business Enterprise (DBE) Program Form #4, Bidders List**  
**(Only complete this form if subcontractors or sub-consultants will be working on a project)**

Using this form/format is optional. Other formats are acceptable.

Company Name & Contact Person	Address	Phone No. w/ area code	Email	Proposed Work (supplies, paint, paint etc.)	DBE Status (MBE, WBE, DBE, SBE)
					Check if Hired <input type="checkbox"/>
					Check if Hired <input type="checkbox"/>
					Check if Hired <input type="checkbox"/>
					Check if Hired <input type="checkbox"/>

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BIDDER CERTIFICATION REGARDING USE OF  
IRON, STEEL, MANUFACTURED PRODUCTS, AND CONSTRUCTION MATERIALS  
PRODUCED IN THE UNITED STATES (BUILD AMERICA, BUY AMERICA ACT)

I, \_\_\_\_\_, do hereby certify that:  
Name

1. I am \_\_\_\_\_ of \_\_\_\_\_ and have authority to  
Title Name of Firm  
execute this certification on behalf of the firm.

2. I am aware that all iron, steel, manufactured products, and construction materials used for this project must be produced in the United States per the federal Build America, Buy America Act (BABA) signed by President Biden on November 15, 2021. Pub. L No. 117-58, §§ 70901-52.

3. I understand the term "iron and steel products" refers to the following products made primarily of iron or steel: lined or unlined pipes and fittings manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials.

4. I understand that all manufactured products used in the project must be produced in the United States. This means the manufactured product was manufactured in the United States, and the cost of the components of the manufactured product that are mined, produced, or manufactured in the United States is greater than 55 percent of the total cost of all components of the manufactured product.

5. I acknowledge that all construction materials for this project must be manufactured in the United States. This means all manufacturing processes for the construction materials occurred in the United States.

6. I am aware that this requirement applies to all portions of the project that are subcontracted.

Name of Company \_\_\_\_\_

Signature \_\_\_\_\_

Title \_\_\_\_\_

Date \_\_\_\_\_

Corporate Seal (where appropriate)

## **Requirements Specific to Buy America, Build America Act (BABA)**

On November 15, 2021, President Biden signed into law the Infrastructure Investment and Jobs Act ("IIJA"), Pub. L. No. 117-58, which includes the Build America, Buy America Act ("BABA"). The purpose of BABA is to ensure that federally funded infrastructure projects only utilize iron, steel, manufactured products, and construction materials produced in the United States. The requirement to use products produced in the United States applies to all projects for the construction, alteration, maintenance, or repair of publicly owned treatment works (POTW) or public water systems. Since Illinois' Clean Water State Revolving Fund (CWSRF) and Drinking Water State Revolving Fund (DWSRF) utilize federal funds, loan recipients must use iron, steel, manufactured products, and construction materials that are produced in the United States. Guidance is available on USEPA's website: <https://www.epa.gov/cwsrf/build-america-buy-america-baba>. Waivers from the requirements are available under certain circumstances. BABA requires the following:

1. All iron and steel used in the project are produced in the United States. This means all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States.
2. All manufactured products used in the project are produced in the United States. This means the manufactured product was manufactured in the United States, and the cost of the components of the manufactured product that are mined, produced, or manufactured in the United States is greater than 55 percent of the total cost of all components of the manufactured product, unless another standard for determining the minimum amount of domestic content of the manufactured product has been established under applicable law or regulation.
3. All construction materials are manufactured in the United States. This means that all manufacturing processes for the construction material occurred in the United States.

BABA only applies to items that are consumed in, incorporated into, or affixed to an infrastructure project. It does not apply to tools, equipment, and supplies, such as temporary scaffolding, brought to the construction site and removed at project completion. BABA does not apply to equipment and furnishings, such as movable chairs, desks, and portable computer equipment, that are used at or within the finished infrastructure project but are not an integral part of or permanently affixed to the structure. BABA requirements apply to an entire infrastructure project, even if it is funded by both Federal and non-Federal funds under one or more awards.

**Construction Materials** includes an article, material, or supply that consists primarily of:

- non-ferrous metals;
- plastic and polymer-based products including polyvinylchloride, composite building materials, and polymers used in fiber optic cables;
- glass including optic glass;
- lumber; or
- drywall.

**Construction Materials** does NOT include items made primarily of iron or steel; manufactured products; cement and cementitious materials; aggregates such as stone, sand, or gravel; or aggregate binding agents or additives.

### **Requirements Specific to Iron and Steel**

The existing American Iron and Steel (AIS) Requirements will continue as part of BABA. An iron or steel product is one of the items listed below and is made primarily of iron or steel that is permanently incorporated into the public water system or treatment works.

- Pipes (lined or unlined) and pipe fittings
- Pipe clamps and restraints
- Valves
- Structural steel
- Manhole Covers and other municipal castings such as valves boxes, drainage grates, bollards, etc.
- Construction materials such as trusses, wire, grating, wire, ductwork, fence tubing, wall panels, etc.
- Hydrants
- Flanges
- Tanks
- Reinforced precast concrete

For one of the listed iron or steel products to be considered subject to the BABA requirements, it must be made of greater than 50% iron or steel, measured by the material costs. "Steel" means an alloy that includes at least 50 percent iron, between .02 and 2 percent carbon, and may include other elements. Metallic elements such as chromium, nickel, molybdenum, manganese, and silicon may be added during the melting of steel for the purpose of enhancing properties such as corrosion resistance, hardness, or strength. The definition of steel covers carbon steel, alloy steel, stainless steel, tool steel and other specialty steels. AIS Guidance is available at: <https://epa.illinois.gov/topics/grants-loans/state-revolving-fund/guidance/american-iron-and-steel-requirements.html>

### **Recordkeeping and Documenting the Country of Origin for Iron, Steel, Manufactured Products, & Construction Materials used in Loan Funded Projects**

Loan recipients with assistance from their general contractor must be able to verify that products used in their projects comply with the BABA requirements. USEPA recommends loan recipients use a "Step Certification" process to ensure that producers adhere to the BABA requirements. Step certification is a process under which each handler (supplier, fabricator, manufacturer, etc.) of the iron, steel, manufactured products, or construction materials certifies that their step in the process was domestically performed. Each time a step in the manufacturing process takes place, the manufacturer delivers its work along with a certification of its origin.

A certification can be quite simple if it includes the name of the manufacturer, the location of the manufacturing facility (not company headquarters), a description of the product or item being delivered, and a signature by a manufacturer's responsible party. Certification could be achieved by other methods such as requiring the final manufacturer, who delivers the products to the worksite, to provide certification that all manufacturing processes occurred in the US. While this type of certification is easier and acceptable, it may not provide the same degree of assurance and additional documentation may be needed. USEPA auditors recommend keeping records of when and where the products were delivered. Records from the manufacturer should refer to specific items such as pipes, valves, meters. Try to avoid records containing broad statements such as, "All products delivered were USA made".

Regardless of the method, documents regarding the country of origin for all covered items should be collected and maintained by the loan recipients. Having a good paper trail is invaluable during an inspection or audit.

### Sample Certification Letter

Below is a sample step certification letter for BABA compliance. The completed letter is provided to the construction contractor or loan applicant by the supplier, fabricator, manufacturer, etc. of covered products. Documentation must be provided on company letterhead

<b>Company Letterhead</b>
Date
Company Name Company Address City, State, Zip
Subject: Build America, Buy America Act Step Certification for Project (Identify Project Here xxx)
I, (company representative), certify that the (melting, bending, coating, galvanizing, cutting, etc.) process for (manufacturing or fabricating) the following products and/or materials shipped or provided for the subject project are in full compliance with the federal Build America, Buy America Act requirements as required in EPA's State Revolving Fund Programs.
Item, Products, and/or Materials: 1. XXX 2. XXX 3. XXX
Such process took place at the following location (City and State must be included):
If any of the above compliance statements change while providing material for this project, we will immediately notify the prime contractor and the engineer.
Signed by Company Representative
Name Clearly Typed

EMPLOYMENT OF ILLINOIS WORKERS ON PUBLIC WORKS ACT

This law comes into effect following two consecutive months of a state unemployment rate above 5 percent. More information about the Employment of Illinois Workers on Public Works Act can be found here:

<http://www.ilga.gov/legislation/ilcs/ilcs3.asp?ActID=549&ChapterID=7>.

The Employment of IL Workers on Public Works Act requires the workforce on all public works projects to be comprised of a minimum of 90% Illinois residents.

The Illinois Department of Labor (IDOL) administers the Employment of Illinois Workers on Public Works Act, which was enacted to alleviate unemployment in Illinois by ensuring that most workers on public works projects live in the state. The requirement applies to all labor on public works projects or improvements. That includes public works projects that are funded in whole or in part with state funds or funds administered by the state of Illinois. Any public works project financed in whole or in part by federal funds administered by the state of Illinois is covered under the provisions of this act.

By signing below, the Contractor confirms awareness of this requirement.

---

(Typed Name & Title of Authorized Representative)

---

(Signature of Authorized Representative)

(Date)

---

(Company/Organization)

## ILLINOIS WORKS JOBS PROGRAM ACT – APPRENTICESHIP INITIATIVE

**Summary:** The Illinois Works Jobs Program Act, 30 ILCS 559/Art. 20, is a statewide initiative to ensure that all Illinois residents have access to State capital projects and careers in the construction industry and building trades and to provide contracting and employment opportunities to historically underrepresented populations in the construction industry. This will be accomplished through three programs created by the Illinois Works Jobs Program Act: the Illinois Works Apprenticeship Initiative, the Illinois Works Pre-Apprenticeship Program, and the Illinois Works Bid Credit Program. Additional information is available at the following website:

<https://www2.illinois.gov/dceo/WorkforceDevelopment/Pages/IllinoisWorksJobsProgramAct.aspx>.

The goal of the Illinois Works Apprenticeship Initiative (“10% apprenticeship goal”) is that for projects estimated to cost \$500,000 or more, apprentices will perform either 10% of the total labor hours actually worked in each prevailing wage classification or 10% of the estimated labor hours in each prevailing wage classification, whichever is less. The 10% apprenticeship goal applies to projects being paid for in whole or in part by appropriated capital funds to construct a public work either through a contract or grant issued by a State agency. A determination was made that this requirement also applies to IEPA loans. The \$500,000 threshold applies to the total project cost and NOT the total cost or value of an individual construction contract.

**Certification:** Apprentices are required to be U.S. Dept. of Labor certified (not limited to pre-apprentice program graduates).

### Applicability

**If a project is estimated to received \$500,000 or more of State Capital Funding for the Project:**

If the state’s contribution to the project amount equals 50% or more of the cost for the project, the 10% apprenticeship requirement applies to all prevailing wage eligible work performed by contractors on the public works project.

If the state’s contribution to the project is less than 50% of the cost for the project, the 10% apprenticeship requirement applies only to prevailing wage eligible work being funded from state funds.

**The Project has less than \$500,000 of State Capital Funding, but the Total Estimated Project Cost is \$500,000 or more:**

If the state’s contribution to the project amount equals 50% or more of the estimated cost for the project, the 10% apprenticeship requirement applies to all prevailing wage eligible work performed by contractors on the public works project.

If the state’s contribution to the project is less than 50% of the estimated cost for the project, the 10% apprenticeship requirement does not apply.

**Total Estimated Project Cost is less than \$500,000:** The 10% apprenticeship requirement does not apply. The \$500,000 threshold applies to the total project cost and NOT the total cost or value of an individual construction contract.

**Waivers from the Requirements:** If goals cannot be met, the state has discretion to grant waivers, reductions or to hold public hearings on the issue. Factors to be considered include the scale of the project and whether the contractor or subcontractor seeking the action has previously requested reductions or waivers. A waiver form is available on the IEPA website at:

<https://www2.illinois.gov/epa/Documents/epa-forms/water/financial-assistance/apprenticeship/Waiver-Request.pdf>. The form can also be obtained from DCEO.

**Reporting:** An example quarterly reporting form is attached. A fillable version is available on the IEPA website. Contractors should coordinate with the loan applicant and their consultant for further instructions regarding these forms. Loan applicants are ultimately responsible for reporting quarterly labor hours to the state, but coordination with their contractor is essential. All loan funded projects are subject to payment of Davis Bacon wages.

**For general apprenticeship questions,** please contact the Illinois Works Office at: [CEO.ILWorks@Illinois.gov](mailto:CEO.ILWorks@Illinois.gov).

## Illinois Works Apprenticeship Initiative Periodic Grantee Report

Organization Name		FEIN Number		DUNS Number	
Grant Awarding Agency	IEPA - Loan Department	Project Start Date		Project End Date	
Grant Number	Loan No.	Estimated Total Project Costs		Estimated Total State Contribution	

**Applicable Apprenticeship Goal (Select all that apply):**

10% total project cost     10% total state contribution only

Waiver Approved by IL DCEO    IL DCEO Waiver Approval Date

(If a waiver was granted for any prevailing wage classification, the Grantee does not need to report on those classifications on this form.)

Reduction Approved by IL DCEO    IL DCEO Reduction Approval Date

(If selected, enter the applicable prevailing wage classification(s) and approved reduced percentage(s).)

Prevailing Wage Classification	Reduced Percentage

**Reporting Period:**

Period Start Date     Period End Date

## Illinois Works Apprenticeship Initiative Periodic Grantee Report

Please provide information in this chart for the entire project if the apprenticeship goal applies to the entire project. Provide information for only the state contribution if the apprenticeship goal applies only to state appropriated capital funds.

Prevailing Wage Classification	Total Hours for Classification in Reporting Period	Total Apprenticeship Hours for Classification in Reporting Period	% of Apprenticeship Hours	Total Hours for Classification YTD	Total Apprenticeship Hours YTD	% of Apprenticeship Hours YTD

SECTION 00 70 00  
STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT (EJCDC- C-700)

SEE NEXT PAGE

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the controlling Laws and Regulations.

# STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

**ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE**

and

Issued and Published Jointly by

**ACEC**

AMERICAN COUNCIL OF ENGINEERING COMPANIES



**ASCE** American Society  
of Civil Engineers

**P/E** National Society of  
Professional Engineers  
*Professional Engineers in Private Practice*

AMERICAN COUNCIL OF ENGINEERING COMPANIES

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ASSOCIATED GENERAL CONTRACTORS OF AMERICA

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AMERICAN SOCIETY OF CIVIL ENGINEERS

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PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE  
*A Practice Division of the*  
NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

Endorsed by



CONSTRUCTION SPECIFICATIONS INSTITUTE

These General Conditions have been prepared for use with the Suggested Forms of Agreement Between Owner and Contractor (EJCDC C-520 or C-525, 2007 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other. Comments concerning their usage are contained in the Narrative Guide to the EJCDC Construction Documents (EJCDC C-001, 2007 Edition). For guidance in the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (EJCDC C-800, 2007 Edition).

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1420 King Street, Alexandria, VA 22314-2794  
(703) 684-2882  
[www.nspe.org](http://www.nspe.org)

American Council of Engineering Companies  
1015 15th Street N.W., Washington, DC 20005  
(202) 347-7474  
[www.acec.org](http://www.acec.org)

American Society of Civil Engineers  
1801 Alexander Bell Drive, Reston, VA 20191-4400  
(800) 548-2723  
[www.asce.org](http://www.asce.org)

Associated General Contractors of America  
2300 Wilson Boulevard, Suite 400, Arlington, VA 22201-3308  
(703) 548-3118  
[www.agc.org](http://www.agc.org)

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# STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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## ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

### 1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
  2. *Agreement*—The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.
  3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
  4. *Asbestos*—Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.
  5. *Bid*—The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
  6. *Bidder*—The individual or entity who submits a Bid directly to Owner.
  7. *Bidding Documents*—The Bidding Requirements and the proposed Contract Documents (including all Addenda).
  8. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid security of acceptable form, if any, and the Bid Form with any supplements.
  9. *Change Order*—A document recommended by Engineer which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

10. *Claim*—A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.
11. *Contract*—The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.
12. *Contract Documents*—Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.
13. *Contract Price*—The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).
14. *Contract Times*—The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any; (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer’s written recommendation of final payment.
15. *Contractor*—The individual or entity with whom Owner has entered into the Agreement.
16. *Cost of the Work*—See Paragraph 11.01 for definition.
17. *Drawings*—That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.
18. *Effective Date of the Agreement*—The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.
19. *Engineer*—The individual or entity named as such in the Agreement.
20. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.
21. *General Requirements*—Sections of Division 1 of the Specifications.

22. *Hazardous Environmental Condition*—The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto.
23. *Hazardous Waste*—The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.
24. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
25. *Liens*—Charges, security interests, or encumbrances upon Project funds, real property, or personal property.
26. *Milestone*—A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.
27. *Notice of Award*—The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.
28. *Notice to Proceed*—A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.
29. *Owner*—The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.
30. *PCBs*—Polychlorinated biphenyls.
31. *Petroleum*—Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.
32. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.
33. *Project*—The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.

34. *Project Manual*—The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.
35. *Radioactive Material*—Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.
36. *Resident Project Representative*—The authorized representative of Engineer who may be assigned to the Site or any part thereof.
37. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.
38. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.
39. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor’s Applications for Payment.
40. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.
41. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.
42. *Specifications*—That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.
43. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.
44. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and

“substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.

45. *Successful Bidder*—The Bidder submitting a responsive Bid to whom Owner makes an award.
46. *Supplementary Conditions*—That part of the Contract Documents which amends or supplements these General Conditions.
47. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or Subcontractor.
48. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
49. *Unit Price Work*—Work to be paid for on the basis of unit prices.
50. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.
51. *Work Change Directive*—A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

## 1.02 Terminology

- A. The words and terms discussed in Paragraph 1.02.B through F are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives:*

1. The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09 or any other provision of the Contract Documents.

C. *Day:*

1. The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective:*

1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
  - a. does not conform to the Contract Documents; or
  - b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
  - c. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).

E. *Furnish, Install, Perform, Provide:*

1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
  3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
  4. When “furnish,” “install,” “perform,” or “provide” is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, “provide” is implied.
- F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

## **ARTICLE 2 – PRELIMINARY MATTERS**

### *2.01 Delivery of Bonds and Evidence of Insurance*

- A. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.
- B. *Evidence of Insurance:* Before any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

### *2.02 Copies of Documents*

- A. Owner shall furnish to Contractor up to ten printed or hard copies of the Drawings and Project Manual. Additional copies will be furnished upon request at the cost of reproduction.

### *2.03 Commencement of Contract Times; Notice to Proceed*

- A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

#### 2.04 *Starting the Work*

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to the date on which the Contract Times commence to run.

#### 2.05 *Before Starting Construction*

- A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review:
  - 1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;
  - 2. a preliminary Schedule of Submittals; and
  - 3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

#### 2.06 *Preconstruction Conference; Designation of Authorized Representatives*

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit instructions, receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

#### 2.07 *Initial Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and

adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

### **ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE**

#### **3.01 *Intent***

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that reasonably may be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the indicated result will be provided whether or not specifically called for, at no additional cost to Owner.
- C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

#### **3.02 *Reference Standards***

- A. Standards, Specifications, Codes, Laws, and Regulations
  1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard, specification, manual, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

### 3.03 *Reporting and Resolving Discrepancies*

#### A. *Reporting Discrepancies:*

1. *Contractor's Review of Contract Documents Before Starting Work:* Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor discovers, or has actual knowledge of, and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.
2. *Contractor's Review of Contract Documents During Performance of Work:* If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) any standard, specification, manual, or code, or (c) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

#### B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

- a. the provisions of any standard, specification, manual, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference in the Contract Documents); or
- b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

### 3.04 *Amending and Supplementing Contract Documents*

- A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.
- B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:
  1. A Field Order;
  2. Engineer's approval of a Shop Drawing or Sample (subject to the provisions of Paragraph 6.17.D.3); or
  3. Engineer's written interpretation or clarification.

### 3.05 *Reuse of Documents*

- A. Contractor and any Subcontractor or Supplier shall not:
  1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions; or
  2. reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

### 3.06 *Electronic Data*

- A. Unless otherwise stated in the Supplementary Conditions, the data furnished by Owner or Engineer to Contractor, or by Contractor to Owner or Engineer, that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic

media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

- B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.
- C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

#### **ARTICLE 4 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS**

##### *4.01 Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.
- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

##### *4.02 Subsurface and Physical Conditions*

- A. *Reports and Drawings:* The Supplementary Conditions identify:

1. those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site; and
  2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).
- B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the “technical data” contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such “technical data” is identified in the Supplementary Conditions. Except for such reliance on such “technical data,” Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:
1. the completeness of such reports and drawings for Contractor’s purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
  2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
  3. any Contractor interpretation of or conclusion drawn from any “technical data” or any such other data, interpretations, opinions, or information.

#### 4.03 *Differing Subsurface or Physical Conditions*

- A. *Notice:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed either:
1. is of such a nature as to establish that any “technical data” on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or
  2. is of such a nature as to require a change in the Contract Documents; or
  3. differs materially from that shown or indicated in the Contract Documents; or
  4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such

condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

B. *Engineer's Review:* After receipt of written notice as required by Paragraph 4.03.A, Engineer will promptly review the pertinent condition, determine the necessity of Owner's obtaining additional exploration or tests with respect thereto, and advise Owner in writing (with a copy to Contractor) of Engineer's findings and conclusions.

C. *Possible Price and Times Adjustments:*

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
  - a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and
  - b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:
  - a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or
  - b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or
  - c. Contractor failed to give the written notice as required by Paragraph 4.03.A.
3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, neither Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or

arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

#### 4.04 *Underground Facilities*

A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data provided by others; and
2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
  - a. reviewing and checking all such information and data;
  - b. locating all Underground Facilities shown or indicated in the Contract Documents;
  - c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction; and
  - d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated:*

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
2. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such

consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

#### 4.05 *Reference Points*

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

#### 4.06 *Hazardous Environmental Condition at Site*

- A. *Reports and Drawings:* The Supplementary Conditions identify those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at the Site.
- B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:
1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or
  2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any “technical data” or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.
  - D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 4.06.E.
  - E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered written notice to Contractor: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.
  - F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner’s own forces or others in accordance with Article 7.
  - G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any

of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

- H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

## **ARTICLE 5 – BONDS AND INSURANCE**

### *5.01 Performance, Payment, and Other Bonds*

- A. Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.
- B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety.

The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed each bond.

- C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

#### 5.02 *Licensed Sureties and Insurers*

- A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

#### 5.03 *Certificates of Insurance*

- A. Contractor shall deliver to Owner, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.
- B. Owner shall deliver to Contractor, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.
- C. Failure of Owner to demand such certificates or other evidence of Contractor's full compliance with these insurance requirements or failure of Owner to identify a deficiency in compliance from the evidence provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.
- D. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor.
- E. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

5.04 *Contractor's Insurance*

- A. Contractor shall purchase and maintain such insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:
1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;
  2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;
  3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;
  4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:
    - a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or
    - b. by any other person for any other reason;
  5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and
  6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.
- B. The policies of insurance required by this Paragraph 5.04 shall:
1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, be written on an occurrence basis, include as additional insureds (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;
3. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;
4. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);
5. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and
6. include completed operations coverage:
  - a. Such insurance shall remain in effect for two years after final payment.
  - b. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

5.05 *Owner's Liability Insurance*

- A. In addition to the insurance required to be provided by Contractor under Paragraph 5.04, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

5.06 *Property Insurance*

- A. Unless otherwise provided in the Supplementary Conditions, Owner shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:
  1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants, and

subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee;

2. be written on a Builder's Risk "all-risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required by the Supplementary Conditions.
  3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);
  4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;
  5. allow for partial utilization of the Work by Owner;
  6. include testing and startup; and
  7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued.
- B. Owner shall purchase and maintain such equipment breakdown insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee.
- C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other loss payee to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.
- D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or

others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

- E. If Contractor requests in writing that other special insurance be included in the property insurance policies provided under this Paragraph 5.06, Owner shall, if possible, include such insurance, and the cost thereof will be charged to Contractor by appropriate Change Order. Prior to commencement of the Work at the Site, Owner shall in writing advise Contractor whether or not such other insurance has been procured by Owner.

#### 5.07 *Waiver of Rights*

- A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or loss payees thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.
- B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for:
  - 1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them.

5.08 *Receipt and Application of Insurance Proceeds*

- A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the loss payees, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order.
- B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.

5.09 *Acceptance of Bonds and Insurance; Option to Replace*

- A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain

prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

- A. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to Paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

**ARTICLE 6 – CONTRACTOR'S RESPONSIBILITIES**

6.01 *Supervision and Superintendence*

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

6.02 *Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.
- B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any

legal holiday without Owner's written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

### 6.03 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.
- B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

### 6.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 as it may be adjusted from time to time as provided below.
  - 1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.
  - 2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

### 6.05 *Substitutes and "Or-Equals"*

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other

Suppliers may be submitted to Engineer for review under the circumstances described below.

1. *“Or-Equal” Items:* If in Engineer’s sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an “or-equal” item, in which case review and approval of the proposed item may, in Engineer’s sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:
  - a. in the exercise of reasonable judgment Engineer determines that:
    - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
    - 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and
    - 3) it has a proven record of performance and availability of responsive service.
  - b. Contractor certifies that, if approved and incorporated into the Work:
    - 1) there will be no increase in cost to the Owner or increase in Contract Times; and
    - 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.
2. *Substitute Items:*
  - a. If in Engineer’s sole discretion an item of material or equipment proposed by Contractor does not qualify as an “or-equal” item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.
  - b. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.

- c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented by the General Requirements, and as Engineer may decide is appropriate under the circumstances.
- d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
  - 1) shall certify that the proposed substitute item will:
    - a) perform adequately the functions and achieve the results called for by the general design,
    - b) be similar in substance to that specified, and
    - c) be suited to the same use as that specified;
  - 2) will state:
    - a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time,
    - b) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and
    - c) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;
  - 3) will identify:
    - a) all variations of the proposed substitute item from that specified, and
    - b) available engineering, sales, maintenance, repair, and replacement services; and
  - 4) shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change.

- B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.
- C. *Engineer's Evaluation:* Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by a Change Order in the case of a substitute and an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.
- D. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- E. *Engineer's Cost Reimbursement:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.
- F. *Contractor's Expense:* Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

#### 6.06 *Concerning Subcontractors, Suppliers, and Others*

- A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.
- B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement,

- and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.
- C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:
1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity; nor
  2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.
- D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.
- E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.
- F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as a loss payee on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or

Supplier waives all rights against Owner, Contractor, Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

#### 6.07 *Patent Fees and Royalties*

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.
- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

#### 6.08 *Permits*

- A. Unless otherwise provided in the Supplementary Conditions, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when

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necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

#### 6.09 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.
- C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

#### 6.10 *Taxes*

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

#### 6.11 *Use of Site and Other Areas*

##### A. *Limitation on Use of Site and Other Areas:*

- 1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner

or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.
  3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.
- B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.
- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.
- D. *Loading Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

#### 6.12 *Record Documents*

- A. Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to Engineer for reference. Upon completion of the Work, these record documents, Samples, and Shop Drawings will be delivered to Engineer for Owner.

### 6.13 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:
1. all persons on the Site or who may be affected by the Work;
  2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
  3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.
- C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.
- D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
- E. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

- F. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

- A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.15 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

6.16 *Emergencies*

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

6.17 *Shop Drawings and Samples*

- A. Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals (as required by Paragraph 2.07). Each submittal will be identified as Engineer may require.

1. *Shop Drawings:*

- a. Submit number of copies specified in the General Requirements.
- b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 6.17.D.

2. *Samples:*
  - a. Submit number of Samples specified in the Specifications.
  - b. Clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 6.17.D.
- B. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.
- C. *Submittal Procedures:*
  1. Before submitting each Shop Drawing or Sample, Contractor shall have:
    - a. reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
    - b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
    - c. determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
    - d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
  2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal.
  3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawings or Sample submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

D. *Engineer's Review:*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.

E. *Resubmittal Procedures:*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

6.18 *Continuing the Work*

- A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 *Contractor's General Warranty and Guarantee*

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on representation of Contractor's warranty and guarantee.

- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
  2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
1. observations by Engineer;
  2. recommendation by Engineer or payment by Owner of any progress or final payment;
  3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
  4. use or occupancy of the Work or any part thereof by Owner;
  5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;
  6. any inspection, test, or approval by others; or
  7. any correction of defective Work by Owner.

#### 6.20 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly

employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable .

- B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
- C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:
  - 1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
  - 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

#### 6.21 *Delegation of Professional Design Services*

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable law.
- B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.
- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design

professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.

- D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

## **ARTICLE 7 – OTHER WORK AT THE SITE**

### *7.01 Related Work at Site*

- A. Owner may perform other work related to the Project at the Site with Owner's employees, or through other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:
  - 1. written notice thereof will be given to Contractor prior to starting any such other work; and
  - 2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.
- B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.

- C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

#### 7.02 *Coordination*

- A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:
  - 1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;
  - 2. the specific matters to be covered by such authority and responsibility will be itemized; and
  - 3. the extent of such authority and responsibilities will be provided.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

#### 7.03 *Legal Relationships*

- A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.
- B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's wrongful actions or inactions.
- C. Contractor shall be liable to Owner and any other contractor under direct contract to Owner for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's wrongful action or inactions.

### **ARTICLE 8 – OWNER'S RESPONSIBILITIES**

#### 8.01 *Communications to Contractor*

- A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

8.02 *Replacement of Engineer*

A. In case of termination of the employment of Engineer, Owner shall appoint an engineer to whom Contractor makes no reasonable objection, whose status under the Contract Documents shall be that of the former Engineer.

8.03 *Furnish Data*

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

8.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

8.05 *Lands and Easements; Reports and Tests*

A. Owner's duties with respect to providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph 4.02 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

8.06 *Insurance*

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

8.07 *Change Orders*

A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.03.

8.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

8.09 *Limitations on Owner's Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

8.10 *Undisclosed Hazardous Environmental Condition*

- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 4.06.

8.11 *Evidence of Financial Arrangements*

- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents.

8.12 *Compliance with Safety Program*

- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed pursuant to Paragraph 6.13.D.

**ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION**

9.01 *Owner's Representative*

- A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract Documents.

9.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 9.09. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of

construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

9.03 *Project Representative*

- A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

9.04 *Authorized Variations in Work*

- A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor, who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

9.05 *Rejecting Defective Work*

- A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.06 *Shop Drawings, Change Orders and Payments*

- A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.
- B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.

C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.

D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.05.

9.08 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question.

B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believes that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.

C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.

D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.09 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to

Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to the Resident Project Representative, if any, and assistants, if any.

#### 9.10 *Compliance with Safety Program*

- A. While at the Site, Engineer's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Engineer has been informed pursuant to Paragraph 6.13.D.

### **ARTICLE 10 – CHANGES IN THE WORK; CLAIMS**

#### 10.01 *Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).
- B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that

should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

#### 10.02 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.D.

#### 10.03 *Execution of Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:
  - 1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;
  - 2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and
  - 3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

#### 10.04 *Notification to Surety*

- A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

#### 10.05 *Claims*

- A. *Engineer's Decision Required:* All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be

required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.

- B. *Notice:* Written notice stating the general nature of each Claim shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Times shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).
- C. *Engineer's Action:* Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:
1. deny the Claim in whole or in part;
  2. approve the Claim; or
  3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.
- D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.
- E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.
- F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

## ARTICLE 11 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

### 11.01 *Cost of the Work*

A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 11.01.B, and shall include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.
2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
  - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
  - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
  - c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
  - d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
  - e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
  - f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.
  - g. The cost of utilities, fuel, and sanitary facilities at the Site.



## 11.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.
- B. *Cash Allowances:*
1. Contractor agrees that:
    - a. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
    - b. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.
- C. *Contingency Allowance:*
1. Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

## 11.03 Unit Price Work

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

- D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:
1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and
  2. there is no corresponding adjustment with respect to any other item of Work; and
  3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

## **ARTICLE 12 – CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES**

### *12.01 Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.
- B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:
1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or
  2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or
  3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).
- C. *Contractor's Fee:* The Contractor's fee for overhead and profit shall be determined as follows:
1. a mutually acceptable fixed fee; or

2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
  - a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;
  - b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;
  - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 12.01.C.2.a and 12.01.C.2.b is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;
  - d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;
  - e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
  - f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

#### 12.02 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.
- B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

#### 12.03 *Delays*

- A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made

- therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.
- B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
  - C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.
  - D. Owner, Engineer, and their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.
  - E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

## **ARTICLE 13 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK**

### *13.01 Notice of Defects*

- A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. Defective Work may be rejected, corrected, or accepted as provided in this Article 13.

### 13.02 *Access to Work*

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

### 13.03 *Tests and Inspections*

- A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.
- B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:
  - 1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;
  - 2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in Paragraph 13.04.C; and
  - 3. as otherwise specifically provided in the Contract Documents.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.
- E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation.
- F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover

the same and Engineer has not acted with reasonable promptness in response to such notice.

#### 13.04 *Uncovering Work*

- A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.
- B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.
- C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.
- D. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

#### 13.05 *Owner May Stop the Work*

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

### 13.06 *Correction or Removal of Defective Work*

- A. Promptly after receipt of written notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).
- B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

### 13.07 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
  - 1. repair such defective land or areas; or
  - 2. correct such defective Work; or
  - 3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
  - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.

- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.
- E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

#### 13.08 *Acceptance of Defective Work*

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness) and for the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

#### 13.09 *Owner May Correct Defective Work*

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days written notice to Contractor, correct, or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the

Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.

- C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.
- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

## **ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION**

### *14.01 Schedule of Values*

- A. The Schedule of Values established as provided in Paragraph 2.07.A will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.

### *14.02 Progress Payments*

#### *A. Applications for Payments:*

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of

sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

*B. Review of Applications:*

1. Engineer will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:
  - a. the Work has progressed to the point indicated;
  - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and any other qualifications stated in the recommendation); and
  - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

- a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or
  - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
- a. to supervise, direct, or control the Work, or
  - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
  - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
  - d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or
  - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:
- a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;
  - b. the Contract Price has been reduced by Change Orders;
  - c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or
  - d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. *Payment Becomes Due:*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor.

D. *Reduction in Payment:*

1. Owner may refuse to make payment of the full amount recommended by Engineer because:
  - a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;
  - b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
  - c. there are other items entitling Owner to a set-off against the amount recommended; or
  - d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.
2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor remedies the reasons for such action.
3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1 and subject to interest as provided in the Agreement.

14.03 *Contractor's Warranty of Title*

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

#### 14.04 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the tentative certificate to Owner, notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will, within said 14 days, execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.
- E. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the tentative list.

#### 14.05 *Partial Utilization*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a

separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 14.04.A through D for that part of the Work.
2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

#### 14.06 *Final Inspection*

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

## 14.07 *Final Payment*

### A. *Application for Payment:*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.
2. The final Application for Payment shall be accompanied (except as previously delivered) by:
  - a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.6;
  - b. consent of the surety, if any, to final payment;
  - c. a list of all Claims against Owner that Contractor believes are unsettled; and
  - d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

### B. *Engineer's Review of Application and Acceptance:*

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for

payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Payment Becomes Due:*

1. Thirty days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and will be paid by Owner to Contractor.

14.08 *Final Completion Delayed*

- A. If, through no fault of Contractor, final completion of the Work is significantly delayed, and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment (for Work fully completed and accepted) and recommendation of Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if bonds have been furnished as required in Paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.09 *Waiver of Claims*

- A. The making and acceptance of final payment will constitute:
  1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and
  2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

## ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

### 15.01 *Owner May Suspend Work*

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

### 15.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will justify termination for cause:
  1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);
  2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;
  3. Contractor's repeated disregard of the authority of Engineer; or
  4. Contractor's violation in any substantial way of any provisions of the Contract Documents.
- B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:
  1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion);
  2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere; and
  3. complete the Work as Owner may deem expedient.

- C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph, Owner shall not be required to obtain the lowest price for the Work performed.
- D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.
- E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.
- F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B and 15.02.C.

### 15.03 *Owner May Terminate For Convenience*

- A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
  - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
  - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;
  - 3. all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or

arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and

4. reasonable expenses directly attributable to termination.
- B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

#### 15.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.
- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

### **ARTICLE 16 – DISPUTE RESOLUTION**

#### 16.01 *Methods and Procedures*

- A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.
- B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

- C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:
1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions; or
  2. agrees with the other party to submit the Claim to another dispute resolution process; or
  3. gives written notice to the other party of the intent to submit the Claim to a court of competent jurisdiction.

## **ARTICLE 17 – MISCELLANEOUS**

### *17.01 Giving Notice*

- A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:
1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended; or
  2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

### *17.02 Computation of Times*

- A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

### *17.03 Cumulative Remedies*

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this Paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

17.04 *Survival of Obligations*

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

17.05 *Controlling Law*

- A. This Contract is to be governed by the law of the state in which the Project is located.

17.06 *Headings*

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

SECTION 00 73 00  
SUPPLEMENTARY CONDITIONS

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## SUPPLEMENTARY CONDITIONS

### PART I - AMENDMENTS TO GENERAL CONDITIONS

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract (EJCDC Document No. C-700, 2007 edition) and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

#### ARTICLE 1 - DEFINITIONS AND TERMINOLOGY

##### SC-1.01A.8

Delete "The advertisement or invitation to bid" and replace with "Notice to Bidders".

##### SC-1.01A.42

Delete paragraph 1.01A.42 of the General Conditions in its entirety and replace with the following:

42. Specifications – Sections included under Divisions 01 through 48 of the Project Manual.

##### SC-1.01A

Add the following paragraphs immediately after paragraph 1.01A.51 of the General Conditions which are to read as follows:

52. Conditions of the Contract – General Conditions and Supplementary Conditions.

53. General Conditions – The Standard General Conditions of the Construction Contract; EJCDC Document No. C-700; 2007 edition.

54. Loan Recipient – The OWNER.

#### ARTICLE 2 - PRELIMINARY MATTERS

##### SC-2.01B

Delete paragraph 2.01B of the General Conditions in its entirety and replace with the following:

B. Before any Work at the Site is started, CONTRACTOR shall deliver to OWNER, with copies to ENGINEER and each additional insured identified in Article 5 of the Supplementary Conditions, certificates of insurance (and other evidence of insurance which OWNER or any additional insured may reasonably request) which CONTRACTOR is required to purchase and maintain in accordance with the requirements of Article 5.

##### SC-2.02A

Delete "ten" in the first line and replace with "three."

SC-2.03A

Delete paragraph 2.03A of the General Conditions in its entirety and replace with the following:

A. The Contract Time will commence to run on the day indicated in the Notice to Proceed from the City. Required bonds and insurance documents must be provided by the Contractor prior to issuance of Notice to Proceed.

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

SC-3.01C

Add a new paragraph immediately after paragraph 3.01C of the General Conditions which is to read as follows:

D. Each and every provision of law and clause required by law to be inserted in these Contract Documents shall be deemed to be inserted herein, and they shall be read and enforced as though it were included herein, and if through mistake or otherwise, any such provision is not inserted, or if not correctly inserted, then upon the application of either party, the Contract Documents shall forthwith be physically amended to make such insertion.

SC-3.03B.1

Add the following new paragraph immediately after paragraph 3.03B.1 of the General Conditions which is to read as follows:

2. In resolving inconsistencies within the Contract Documents, precedence shall be given in the following descending order:

- a. Agreement
- b. Change Orders
- c. Addenda
- d. Supplementary Conditions
- e. Instructions to Bidders
- f. General Conditions
- g. Specifications
- h. Drawings (Figure dimensions on Drawings shall take precedence over scaled dimensions, and detailed drawings shall take precedence over general drawings.)
- i. Notice to Bidders

ARTICLE 4 - AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS;  
HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

SC-4.02A.1

Delete paragraph 4.02A of the General Conditions in its entirety.

SC-4.05A

Add the following new paragraph immediately after paragraph 4.05A of the General Conditions which is to read as follows:

B. ENGINEER may check the lines, elevations, reference marks, batter boards, etc., set by CONTRACTOR, and CONTRACTOR shall correct any errors disclosed by such check. Such a check shall not be considered as approval of CONTRACTOR's work and shall not relieve CONTRACTOR of the responsibility for accurate construction of the entire Work. CONTRACTOR shall furnish personnel to assist ENGINEER in checking lines and grades.

## ARTICLE 5 - BONDS AND INSURANCE

### SC-5.01A

Add the following sentences to the end of 5.01A of the General Conditions which is to read as follows:

Performance bonds shall be furnished from insurance companies having not less than A+ Policyholders Rating from the most recent Alfred M. Best and Co., Inc. listing available. Certification of the insurance company's rating shall be provided prior to contract implementation and quarterly thereafter until contract completion. Should such rating fall below the required A+ level during performance of the contract, it will be the contractor's responsibility to notify the City and provide a new bond from an insurance company whose rating meets the City's requirements.

### SC-5.03B

Add the following new paragraph immediately after paragraph 5.03E of the General Conditions which is to read as follows:

F. CONTRACTOR shall provide evidence of its insurance coverage on the ACORD certificate of insurance form and shall include the following statement in its entirety in the section of the form entitled "Description of Operations/Locations/Vehicles/Special Items".

The City of Evanston and Greeley and Hansen, and their officers, directors, partners, employees and other consultants and SUBCONTRACTORS are named as additional insureds with respect to the insured's Commercial General Liability and Automobile Liability Insurance Policies. All insurers waive all rights of subrogation against the City of Evanston and Greeley and Hansen, their officers, directors, partners, employees and other consultants and SUBCONTRACTORS. All insurance is primary for all claims covered thereby. Commercial General Liability Insurance includes contractual liability coverage.

### SC-5.04A

The limits of liability for the insurance required by paragraph 5.04 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by law:

#### 5.04A.1 and 5.04A.2 Workers' Compensation

- |                           |             |
|---------------------------|-------------|
| (1) Worker's Compensation | Statutory   |
| (2) Employer's Liability  | \$1,000,000 |

5.04A.3, 5.04A.4, and 5.04A.5 Commercial General Liability including Premise/Operations; Explosion, Collapse and Underground Property Damage; Products/Completed Operations, Broad Form Contractual, Independent CONTRACTORS; Broad Form Property Damage; and Personal Injury liabilities:

- |                      |             |                  |
|----------------------|-------------|------------------|
| (1) Bodily Injury:   | \$3,000,000 | Each Occurrence  |
|                      | \$3,000,000 | Annual Aggregate |
| (2) Property Damage: | \$3,000,000 | Each Occurrence  |
|                      | \$3,000,000 | Annual Aggregate |
| (3) Personal Injury: | \$3,000,000 | Annual Aggregate |

5.04A.6 Comprehensive Automobile Liability including all owned (private and others), hired and non-owned vehicles:

- |                     |             |                 |
|---------------------|-------------|-----------------|
| (1) Bodily Injury   | \$1,000,000 | Each Person     |
|                     | \$1,000,000 | Each Accident   |
| (2) Property Damage | \$1,000,000 | Each Occurrence |

#### SC-5.06A

Delete the first sentence of paragraph 5.06A of the General Conditions and replace with the following:

CONTRACTOR shall purchase and maintain property insurance upon the Work at the site, written on the completed value form, in an amount equal to the total bid price for the completed construction.

#### SC-5.06B

Delete paragraph 5.06B of the General Conditions in its entirety.

#### SC-5.06C

Delete paragraph 5.06C of the General Conditions in its entirety and replace with the following:

C. All the policies of insurance (or the certificates or other evidence thereof) required to be purchased and maintained by the CONTRACTOR in accordance with paragraph 5.06A. (1) shall contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least thirty days' prior written notice has been given to OWNER, ENGINEER and each other loss payee by certified mail and (2) shall contain provisions to the effect that the insurer(s) waive all rights of subrogation against the OWNER, ENGINEER and their officers, directors, partners, employees and other consultants and SUBCONTRACTORS of each and any of them.

#### SC-5.06E

Delete paragraph 5.06E of the General Conditions in its entirety.

SC-5.07A

Delete paragraph 5.07A of the General Conditions in its entirety and replace with the following:

A. All insurance policies provided by the CONTRACTOR shall contain provisions to the effect that the insurer waives all rights of subrogation against any of the insured, loss payee, (and the officers, directors, members, partners, employees, agents, consultants and SUBCONTRACTORS of each and any of them) OWNER and the ENGINEER.

SC-5.08A

Delete paragraph 5.08A of the General Conditions in its entirety.

SC-5.08B

Delete paragraph 5.08B of the General Conditions in its entirety.

SC-5.09A

Delete paragraph 5.09A of the General Conditions in its entirety and replace with the following:

A. If OWNER has any objection to the coverage afforded by or other provisions of the insurance required to be purchased and maintained by CONTRACTOR in accordance with this Article 5 on the basis of its not complying with the Contract Documents, OWNER will notify CONTRACTOR in writing thereof within ten days of the date of delivery of such certificates to OWNER in accordance with paragraph 2.01. CONTRACTOR shall provide such additional information in respect of insurance provided by CONTRACTOR as OWNER may reasonably request.

## ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

SC-6.02B

Add the following new paragraphs immediately after paragraph 6.02B of the General Conditions which are to read as follows:

C. Regular working hours are defined as 8 hours per day, Monday through Friday, excluding holidays, between the hours of 7:00 AM and 3:00 PM. Requests to work other than regular working hours shall be submitted to ENGINEER not less than 5 days prior to any proposed weekend work or scheduled extended work weeks. Occasional unscheduled overtime on weekdays may be permitted provided two hours' notice is given to ENGINEER.

D. CONTRACTOR shall reimburse the OWNER for additional engineering and/or inspection costs incurred as a result of overtime work in excess of the regular working hours stipulated in Article SC-6.02C. At OWNER's option, overtime costs may either be deducted from the CONTRACTOR's monthly payment request or deducted from the CONTRACTOR's retention prior to release of final payment. Overtime costs for the OWNER's personnel shall be based on the individual's current overtime wage rate. Overtime costs for personnel employed by the ENGINEER or OWNER's independent testing laboratory shall be calculated in accordance with the terms of their respective contracts with the OWNER.

E. This Agreement is subject to the applicable provisions of the Contract Work Hours and Safety Standards Act, Public Law 87-581, 87th Congress. No CONTRACTOR or SUBCONTRACTOR contracting for any part of the Work shall require or permit any laborer or mechanic to be employed on the Work in excess of 40 hours in any work week unless such laborer or mechanic receives compensation at a rate not less than one and one-half times that person's basic rate of pay for all hours worked in excess of 40 hours in such work week. OWNER will not compensate the CONTRACTOR or SUBCONTRACTOR for the additional cost of labor over the basic rate of pay.

F. CONTRACTOR shall employ only competent persons to do the work and whenever OWNER shall notify CONTRACTOR, in writing, that any person on the Work appears to be incompetent, disorderly, or otherwise unsatisfactory, such person shall be removed from the Project and shall not again be employed on it except with the consent of OWNER.

G. CONTRACTOR and SUBCONTRACTORS shall, insofar as practicable, give preference in the hiring of workers for the Project to qualified local residents with first preference being given to citizens of the United States who have served in the armed forces of the United States and have been honorably discharged therefrom or released from active duty therein.

H. Except as may be otherwise required by law, all claims and disputes pertaining to the classification of labor employed on the project under this Contract shall be decided by the governing body having jurisdiction.

I. CONTRACTOR and all SUBCONTRACTORS shall comply with the Regulations of the Secretary of Labor made pursuant to the Anti-Kickback Act of June 30, 1940 (40 U.S.C. 276c) and all amendments or modifications thereto. CONTRACTOR and all SUBCONTRACTORS shall furnish OWNER with weekly Statements of Compliance. In case of Subcontracts, CONTRACTOR shall cause appropriate provision to be inserted in all subcontracts for the Work which CONTRACTOR may let to ensure compliance with said Anti-Kickback Act by all SUBCONTRACTORS subject thereto, and CONTRACTOR shall be responsible for the submission of all Statements of Compliance required of SUBCONTRACTORS by said Anti-Kickback Act except as the Secretary of Labor may specifically provide for reasonable limitations, variations, and exemptions from the requirements thereof.

#### SC-6.05F

Add the following new paragraphs immediately after paragraph 6.05F of the General Conditions which are to read as follows:

G. In order for substitutions to be considered, the CONTRACTOR shall submit, within 30 days after issuance of Notice to Proceed, complete data as set forth herein to permit complete evaluation of all proposed substitutions. No substitution will be considered unless the CONTRACTOR provides the required data within the 30-day period..

#### SC-6.06A

Delete paragraphs 6.06A and 6.06B of the General Conditions in their entirety and replace with the following:

A. CONTRACTOR shall not employ any SUBCONTRACTOR, Supplier or other person or organization, (including those who are to furnish the principal items of materials or equipment), whether initially or as a substitute, against whom OWNER may have reasonable objection. Acceptance of any

SUBCONTRACTOR, other person or organization by OWNER shall not constitute a waiver of any right of OWNER to reject defective Work. CONTRACTOR shall not be required to employ any SUBCONTRACTOR, other person or organization against whom CONTRACTOR has reasonable objection.

B. Not Used.

SC-6.06E

Add the following new sentence at the end of paragraph 6.06E of the General Conditions to read as follows:

OWNER or ENGINEER may furnish to any such SUBCONTRACTOR, Supplier or other person or organization, to the extent practicable, information about amounts paid on their behalf to CONTRACTOR in accordance with CONTRACTOR's Applications for Payment.

SC-6.07B

Delete paragraph 6.07B of the General Conditions in its entirety.

SC-6.08A

Delete the last sentence in paragraph 6.08A of the General Conditions in its entirety.

SC-6.10A

Add the following new sentence at the end of paragraph 6.10A of the General Conditions to read as follows:

The materials and supplies to be used in the Work of this Contract are exempt from the Sales and Use Tax of the State of Illinois. CONTRACTOR shall obtain the proper certificates, maintain the necessary records and otherwise comply with the requirements of State of Illinois

SC-6.16A

Delete the last sentence in paragraph 6.16A of the General Conditions in its entirety and replace with the following:

If ENGINEER determines that the incident giving rise to the emergency action was not the responsibility of the CONTRACTOR and that a change in the Contract Documents is required because of the action taken by the CONTRACTOR in response to such an emergency, a Work Change Directive or Change Order will be issued.

SC-6.19C

Add the following new paragraph immediately after paragraph 6.19C of the General Conditions which is to read as follows:

#### D. Manufacturer's Guaranty/Warranty

1. The CONTRACTOR shall obtain the following guaranty/warranty from the manufacturer of all major pieces of equipment furnished and installed on this Project. Such guaranty/warranty shall be for the benefit of OWNER and be furnished in writing by the manufacturer. The CONTRACTOR's and manufacturer's obligations under this provision are in addition to other express or implied warranties under the Contract Documents and under the law and in no way diminish any other right that the OWNER may have against the CONTRACTOR or manufacturer for faulty material, equipment or work. The warranty period shall not be interpreted as a limitation on the time in which the OWNER can enforce such other duties, obligations, rights, or remedies.

2. The manufacturer warrants and guarantees for a period of one year from the date of Substantial Completion, or such longer period that may be specified in the Contract Documents, that all materials and equipment furnished and installed shall be free from flaws, defects in material and workmanship and shall be in conformance with the Contract Documents.

#### SC-6.20A

Delete paragraph 6.20A of the General Conditions in its entirety and replace with the following:

A. To the fullest extent permitted by Laws and Regulations, CONTRACTOR shall defend, indemnify and hold harmless OWNER, ENGINEER and the officers, directors, members, partners, employees, agents, consultants and SUBCONTRACTORS of each and any of them from and against all claims, costs, losses and damages (including but not limited to all fees and charges of ENGINEERS, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost or loss or damage:

1. is attributable to bodily injury, sickness, disease or death or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom; and

2. is caused in whole or in part by any negligent act or omission of CONTRACTOR, any SUBCONTRACTOR, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable, regardless of whether or not caused in part by any negligence or omission of an individual or entity indemnified hereunder or whether liability is imposed upon such indemnified party by Laws and Regulations regardless of the negligence of any such indemnified party unless caused by the sole negligence of a party indemnified hereunder. If through the acts of neglect on the part of CONTRACTOR, any other CONTRACTOR or any SUBCONTRACTOR shall suffer loss or damage on the Work, CONTRACTOR shall settle with such other CONTRACTOR or SUBCONTRACTOR by agreement or arbitration if such other CONTRACTOR or SUBCONTRACTOR will so settle. If such other CONTRACTOR or SUBCONTRACTOR shall assert any claim against OWNER and/or ENGINEER, or the officers, directors, members, partners, employees, agents, consultants and SUBCONTRACTORS of each on account of any damage alleged to have been sustained, OWNER shall notify CONTRACTOR, who shall indemnify and save harmless OWNER, ENGINEER, and the officers, directors, members, partners, employees, agents, consultants and SUBCONTRACTORS of each against any such claims.

#### SC-6.21E

Delete paragraph 6.21E of the General Conditions in its entirety and replace with the following:

E. CONTRACTOR shall not be responsible for the adequacy of the performance criteria or design criteria contained in the Contract Documents.

## ARTICLE 7 - OTHER WORK AT THE SITE

### SC-7.03C

Add a new paragraph immediately after paragraph 7.03C in the General Conditions which is to read as follows:

### SC-7.04 Damage to other CONTRACTOR's Property

A. Should CONTRACTOR cause damage to the work or property of any separate CONTRACTOR at the Site, or should any claim arising out of CONTRACTOR's performance of the Work at the Site be made by any separate CONTRACTOR against CONTRACTOR, OWNER, ENGINEER, ENGINEER's Consultants, the Construction Coordinator or any other person, CONTRACTOR shall promptly attempt to settle with such other CONTRACTOR by agreement, or to otherwise resolve the dispute by arbitration or at law. CONTRACTOR shall, to the fullest extent permitted by Laws and Regulations, defend, indemnify and hold OWNER, ENGINEER, ENGINEER's Consultants and the Construction Coordinator harmless from and against all claims, damages, losses and expenses (including, but not limited to, fees of ENGINEERS, architects, attorneys and other professionals, and court and arbitration or mediation costs) arising directly, indirectly or consequentially out of any action, legal or equitable, brought by any separate CONTRACTOR against OWNER, ENGINEER, ENGINEER's Consultants or the Construction Coordinator to the extent based on a claim arising out of CONTRACTOR's performance of the Work. Should a separate CONTRACTOR cause damage to the Work or property of CONTRACTOR or should the performance of Work by any separate CONTRACTOR at the Site give rise to any other claim, CONTRACTOR shall not institute any action, legal or equitable, against OWNER, ENGINEER, ENGINEER's Consultants or the Construction Coordinator or permit any action against any of them to be maintained and continued in its name or for its benefit in any court or before any arbiter which seeks to impose liability on or to recover damages from OWNER, ENGINEER, ENGINEER's Consultants or the Construction Coordinator on account of any such damage or claim. If CONTRACTOR is delayed at any time in performing or furnishing Work by any act or neglect of a separate CONTRACTOR and OWNER and CONTRACTOR are unable to agree as to the extent of any adjustment in Contract Times attributable thereto, CONTRACTOR may make a claim for an extension of times in accordance with Article 12. An extension of the Contract Times shall be CONTRACTOR's exclusive remedy with respect to OWNER, ENGINEER, ENGINEER's Consultants and Construction Coordinator for any delay, disruption, interference or hindrance caused by any separate CONTRACTOR. This paragraph does not prevent recovery from OWNER, ENGINEER, ENGINEER's Consultant or Construction Coordinator for activities that are their respective responsibilities.

## ARTICLE 8 - OWNER'S RESPONSIBILITIES

### SC-8.06

Delete paragraph 8.06 of the General Conditions in its entirety.

## ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

### SC-9.03A

Add the following new paragraph immediately after paragraph 9.03A of the General Conditions which is to read as follows:

B. ENGINEER will furnish a Resident Project Representative and assistants to assist ENGINEER in observing the performance of the Work. The duties and responsibilities of the Resident Project Representative will be as enumerated in a document entitled "Duties, Responsibilities and Limitations of the Authority of Resident Project Representative" and will be made available to CONTRACTOR at the start of the Work.

#### ARTICLE 11 - COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

##### SC-11.01A.1

Delete the second sentence in paragraph 11.01A.1 of the General Conditions in its entirety and replace with the following:

Such employees shall include one foreman (unless agreed upon prior to beginning Work).

##### SC-11.02A

Delete paragraphs 11.02A through 11.02D of the General Conditions in their entirety.

#### ARTICLE 12 - CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

##### SC-12.01C.1

Delete paragraph 12.01C.1 of the General Conditions in its entirety.

##### SC-12.01C.2

In the second line of paragraph 12.01C.2.b, before the semicolon add the following words "based on SUBCONTRACTOR's Cost of the Work".

Delete "five percent" in paragraph 12.01C.2.b of the General Conditions and replace with "three percent."

Delete "15 percent" in the seventh line of paragraph 12.01.C.2.c of the General Conditions and replace with "10 percent" and delete the words "five percent" in the twelfth line and replace with "three percent."

SC-12.03 Delete paragraph 12.03.B of the General Conditions in its entirety and insert the following in its place:

- B. No claim for payment, compensation or adjustment of any kind (other than the extensions of time provided for herein) shall be made or asserted against the OWNER or ENGINEER by the CONTRACTOR for damages caused by hindrances or delays from any cause, whether such hindrances or delays be avoidable or unavoidable, and the CONTRACTOR shall make no claim for damages by reason of any such hindrances or delays, and will accept in full satisfaction of such hindrances or delays an extension of time to complete the performance of the Work as specified.

SC-12.04 THROUGH SC-12.06. ADD the following paragraphs:

12.04 The date of beginning and the time for completion of the Work are essential conditions of the Contract and the Work embraced shall be commenced on a date specified in the Notice to Proceed.

12.05 The CONTRACTOR shall proceed with the Work at such rate of progress to insure full completion within the Contract Time. It is expressly understood and agreed, by and between the CONTRACTOR and the OWNER, that the Contract Time for the completion of the Work described herein is a reasonable time, taking into consideration the average climate and economic conditions and other factors prevailing in the locality of the Work. It is expressly understood and agreed, by and between the CONTRACTOR and the OWNER, that once mobilized, the CONTRACTOR shall diligently proceed with the work in a manner that minimizes disruption to the OWNER's operations, ensuring that all activities are executed efficiently and with consideration for the OWNER's ongoing activities.

12.06 Should CONTRACTOR fail to perform the work within the periods of time stipulated in the Agreement, CONTRACTOR shall be liable for all additional costs for ENGINEER's services beyond substantial completion date and/or final completion date. OWNER will deduct these costs from any monies due or that may become due CONTRACTOR as surety and pay ENGINEER for said services.

#### ARTICLE 13 - TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

##### SC-13.05A

Add the following new paragraph immediately after paragraph 13.05A of the General Conditions to read as follows:

B. If OWNER stops Work under paragraph 13.05A, CONTRACTOR shall be entitled to no extension of Contract Time or increase in Contract Price.

#### ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

##### SC-14.02A.3

Delete Paragraph 14.02A.3 of the General Conditions in its entirety and replace it with the following:

3. Progress payments will be made less a 10% retainage for each payment, which will be held until final acceptance of the work by the City.

Add a new paragraph immediately after paragraph 14.02A.3 of the General Conditions which is to read as follows:

4. CONTRACTOR shall furnish evidence that payment received on the basis of materials and equipment not incorporated and suitably stored, has in fact been paid to the respective supplier(s) within 60 days of payment by OWNER. Failure to provide such evidence of payment may result in the withdrawal of previous approval(s) and removal of the cost of related materials and equipment from the next submitted Application for Payment.

#### SC-14.02C.1

Delete paragraph 14.02C.1 of the General Conditions in its entirety and replace it with the following:

1. Forty five days after the OWNER receives payment from the funding agency, the amount recommended by ENGINEER will (subject to the provisions of Paragraph 14.02D) become due, and when due will be paid by OWNER to CONTRACTOR.
2. Should CONTRACTOR neglect to pay any undisputed claims, made in writing to OWNER within 30 days after completion of the Work, but continuing unsatisfied for a period of 90 days, OWNER may pay such claim and deduct the amount thereof from the balance due CONTRACTOR. OWNER may also, with the written consent of CONTRACTOR, use any monies retained, due, or to become due under this Contract for the purpose of paying for both labor and materials for the Work, for which claims have not been filed.
3. Security is provided both by the Payment Bond and the power of OWNER to retain any monies for claims, but payment by one shall in no way impair or discharge the liability of the other.
4. Any and all liens for work and materials may be paid off by OWNER within a reasonable time after filing for record in accordance with State and local laws, a notice of such liens except where the claim on which the lien is filed is being litigated by CONTRACTOR, and in such case OWNER may pay the amount of any final judgment or decree or any such claim within a reasonable time after such final judgment or decree shall be rendered.
5. All monies paid by OWNER in settlement of liens as aforesaid, with the costs and expenses incurred by OWNER in connection therewith, shall be charged to CONTRACTOR, shall bear interest at the rate of three percentage points above the rediscount rate then charged by the Federal Reserve Bank, and shall be deducted from the next payment due CONTRACTOR under the terms of this Contract.

#### SC-14.03A

Add the following new paragraphs immediately after paragraph 14.03A of the General Conditions which are to read as follows:

B. No materials or supplies for the Work shall be purchased by CONTRACTOR or SUBCONTRACTOR subject to any chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller. CONTRACTOR warrants that CONTRACTOR has good title to all materials and supplies used by CONTRACTOR in the Work, free from all liens, claims or encumbrances.

C. CONTRACTOR shall defend, indemnify and save OWNER and ENGINEER harmless from all claims growing out of the lawful demands of SUBCONTRACTORS, laborers, workmen, mechanics, materialmen, and furnishers of machinery and parts thereof, equipment, power tools, and all supplies, including commissary, incurred in the furtherance of the performance of this Contract. CONTRACTOR

shall at OWNER's request, furnish satisfactory evidence that all obligations of the nature hereinabove designated have been paid, discharged, or waived. If CONTRACTOR fails to do so, then OWNER may, after having served written notice on the said CONTRACTOR either pay unpaid bills, of which OWNER has written notice, direct, or withhold from the CONTRACTOR's unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged whereupon payment to CONTRACTOR shall be resumed, in accordance with the terms of this Contract, but in no event shall the provisions of this sentence be construed to impose any obligations upon OWNER to either CONTRACTOR or CONTRACTOR's Surety. In paying any unpaid bills of the CONTRACTOR, OWNER shall be deemed the agent of CONTRACTOR and any payment so made by OWNER shall be considered as payment made under the Contract by OWNER to CONTRACTOR and OWNER shall not be liable to CONTRACTOR for any such payment made in good faith.

#### SC-14.07B.1

Delete paragraph 14.07B.1 of the General Conditions in its entirety and replace with the following:

1. If, on the basis of ENGINEER's observation of the Work during construction and final inspection, and ENGINEER's review of the final Application for Payment and accompanying documentation - all as required by the Contract Documents, ENGINEER is satisfied that the Work has been completed and CONTRACTOR's other obligations under the Contract Documents have been fulfilled, ENGINEER will indicate in writing ENGINEER's recommendation of payment and present the Application to OWNER for payment. Thereupon ENGINEER will give written notice to OWNER and CONTRACTOR that the Work is acceptable subject to the provisions of paragraph 14.09. Otherwise, ENGINEER will return the Application to CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case CONTRACTOR shall make the necessary corrections and resubmit the Application. If the Application and accompanying documentation are appropriate as to form and substance, OWNER shall in accordance with the applicable State or local General Law, pay CONTRACTOR the amount recommended by ENGINEER.

#### SC-14.07C.1

Delete paragraph 14.07C.1 of the General Conditions in its entirety and replace with the following:

1. Forty five days after the OWNER receives payment from the funding agency, the amount recommended by ENGINEER, less any sum OWNER is entitled to set off against ENGINEER's recommendation, including but not limited to liquidated damages, will become due and will be paid by OWNER to CONTRACTOR.

#### SC-14.08A

Delete "stipulated in the Agreement" in paragraph 14.08A of the General Conditions.

### ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

#### SC-15.02A.4

Add the following new paragraph immediately after paragraph 15.02A.4 of the General Conditions which is to read as follows:

5. If CONTRACTOR abandons the Work, or sublets this Contract or any part thereof, without the previous written consent of OWNER, or if the Contract or any claim thereunder shall be assigned by CONTRACTOR otherwise than as herein specified.

## ARTICLE 16 - DISPUTE RESOLUTION

### SC-16.01A

Delete the paragraph 16.01A of the General Conditions in its entirety and replace with the following:

A. Either OWNER or CONTRACTOR may request mediation of any Claim submitted to ENGINEER for a decision under paragraph 10.05 when such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of this Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract.

### SC-16.01C.3

Add a new paragraph at the end of paragraph 16.01C.3 of the General Conditions which is to read as follows:

D. CONTRACTOR shall carry on the Work and maintain the progress schedule during the dispute resolution proceedings, unless otherwise agreed by CONTRACTOR and OWNER in writing.

## ARTICLE 17 - MISCELLANEOUS

### SC-17.06

Add the following new paragraphs immediately after paragraph 17.06 of the General Conditions:

#### 17.07 Addresses

A. Both the address given in the Bid Form upon which this Agreement is founded, and CONTRACTOR's office at or near the site of the Work are hereby designated as places to either of which notices, letters, and other communications to CONTRACTOR shall be certified, mailed, or delivered. The delivering at the above named place, or depositing in a postpaid wrapper directed to the first-named place, in any post office box regularly maintained by the post office department, of any notice, letter or other communication to CONTRACTOR shall be deemed sufficient service thereof upon CONTRACTOR; and the date of said service shall be the date of such delivery or mailing. The first-named address may be changed at any time by an instrument in writing, executed and acknowledged by CONTRACTOR, and delivered to OWNER and ENGINEER. Nothing herein contained shall be deemed to preclude or render inoperative the service of any notice, letter, or other communication upon CONTRACTOR personally.

#### 17.08 Wage Rates

A. The requirements and provisions of all applicable laws and any amendments thereof or additions thereto as to the employment of labor, and to the schedule of minimum wage rates established in compliance with laws shall be a part of these Contract Documents. Copies of the wage schedules are included in Section 00 66 50 of these Contract Documents. If, after the Notice of Award, it becomes necessary to employ any person in a trade or occupation not classified in the wage determinations, such

person shall be paid at not less than such rates as shall be determined by the officials administrating the laws mentioned above. Such approved minimum rate shall be retroactive to the time of the initial employment of such person in such trade or occupation. CONTRACTOR shall notify OWNER of CONTRACTOR's intention to employ persons in trades or occupations not classified in sufficient time for OWNER to obtain approved rates for such trades or occupations. The CONTRACTOR is advised that the prevailing wages are subject to revision on a monthly basis and that the CONTRACTOR shall comply with the then current prevailing wages.

B. The schedules of wages referred to above are minimum rates only, and OWNER will not consider any claims for additional compensation made by CONTRACTOR because of payment by CONTRACTOR of any wage rate in excess of the applicable rate contained in these Contract Documents. All disputes in regard to the payment of wages in excess of these specified in the schedules shall be resolved by CONTRACTOR.

C. The said schedules of wages shall continue to be the minimum rates to be paid during the life of this Agreement and a legible copy of said schedules shall be kept posted in a conspicuous place at the site of the Work.

D. No overtime premiums will be paid by the OWNER.

CITY OF EVANSTON  
WATER PLANT 4160V ELECTRICAL SYSTEM RELIABILITY PROJECT

**DESCRIPTION**

**DIVISION**

**PROCUREMENT AND CONTRACTING REQUIREMENTS**

**DIVISION 0**

**GENERAL REQUIREMENTS**

**DIVISION 1**

**EXISTING CONDITIONS**

**DIVISION 2**

DEMOLITION  
PAVEMENT REMOVAL

**EARTHWORK**

**DIVISION 31**

EXCAVATION – EARTH AND ROCK  
CONSTRUCTION SITE DEWATERING  
BACKFILLING  
SLOPE PROTECTION AND EROSION CONTROL  
SHORING, SHEETING AND BRACING

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31 23 22

31 23 23

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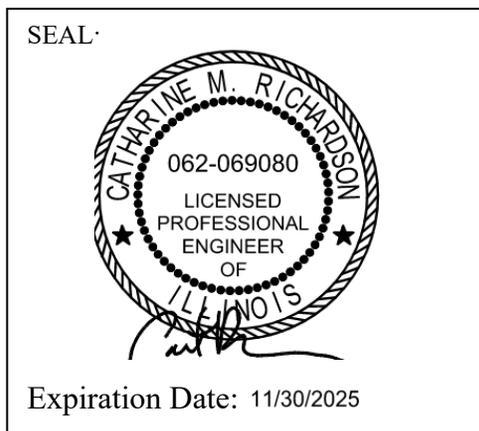
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**UTILITIES**

**DIVISION 33**

SIGNATURE –  
LICENSED

DATE: 1/31/2025



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CITY OF EVANSTON  
WATER PLANT 4160V ELECTRICAL SYSTEM RELIABILITY PROJECT

**DESCRIPTION**

**DIVISION**

**MASONRY**

**DIVISION 4**

**METALS**

**DIVISION 5**

GALVANIZING

05 05 13

METAL FABRICATIONS

05 50 00

METAL PAN STAIRS

05 51 13

ALUMINUM HANDRAILS AND RAILINGS

05 52 12

**WOOD, PLASTICS, AND COMPOSITES**

**DIVISION 6**

**THERMAL AND MOISTURE PROTECTION**

**DIVISION 7**

**OPENINGS**

**DIVISION 8**

**FINISHES**

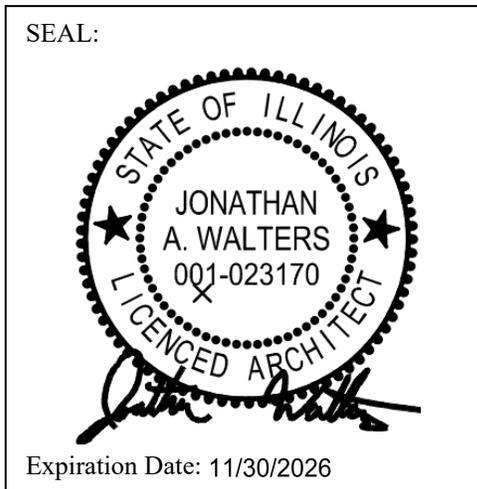
**DIVISION 9**

**SPECIALTIES**

**DIVISION 10**

SIGNATURE –  
LICENSED

DATE: 1/31/2025



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CITY OF EVANSTON  
WATER PLANT 4160V ELECTRICAL SYSTEM RELIABILITY PROJECT

**DESCRIPTION**

**PLUMBING**

**HEATING VENTILATING AND AIR CONDITIONING**

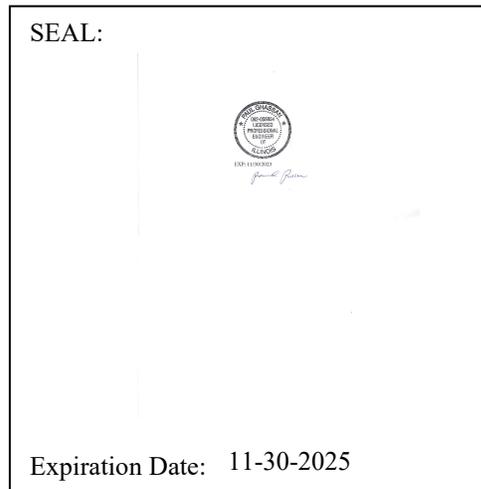
**DIVISION**

**DIVISION 22**

**DIVISION 23**

SIGNATURE –  
LICENSED

DATE: 1/31/2025



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CITY OF EVANSTON  
WATER PLANT 4160V ELECTRICAL SYSTEM RELIABILITY PROJECT

**DESCRIPTION**

**ELECTRICAL**

**ELECTRONIC SAFETY AND SECURITY**

**DIVISION**

**DIVISION 26**

**DIVISION 28**

SIGNATURE –  
LICENSED

DATE: 1/31/2025

SEAL:



Expiration Date: 11/30/2025

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CITY OF EVANSTON  
WATER PLANT 4160V ELECTRICAL SYSTEM RELIABILITY PROJECT

**DESCRIPTION**

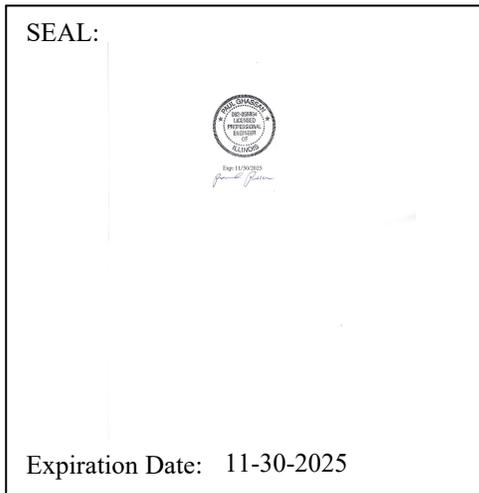
**PROCESS INTEGRATION**

**DIVISION**

**DIVISION 40**

SIGNATURE –  
LICENSED

DATE: 1/31/2025



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CITY OF EVANSTON  
WATER PLANT 4160V ELECTRICAL SYSTEM RELIABILITY PROJECT

**DESCRIPTION**

**DIVISION**

**EXISTING CONDITIONS**

**DIVISION 2**

SELECTIVE DEMOLITION

02 41 19

**CONCRETE**

**DIVISION 3**

**METALS**

**DIVISION 5**

STRUCTURAL STEEL FRAMING

05 12 00

STEEL DECKING

05 31 00

**EARTHWORK**

**DIVISION 31**

EXCAVATION SUPPORT AND PROTECTION

31 50 00

HELICAL PILE-ANCHOR DEEP FOUNDATIONS

31 66 00

SIGNATURE -  
LICENSED

DATE: 1/31/2025



(NO TEXT FOR THIS PAGE)

CITY OF EVANSTON  
WATER PLANT 4160V ELECTRICAL SYSTEM RELIABILITY PROJECT

**DESCRIPTION**

**EXISTING CONDITIONS**

ASBESTOS ABATEMENT  
LEAD BASED PAINT ABATEMENT  
HAZARDOUS MATERIAL ABATEMENT

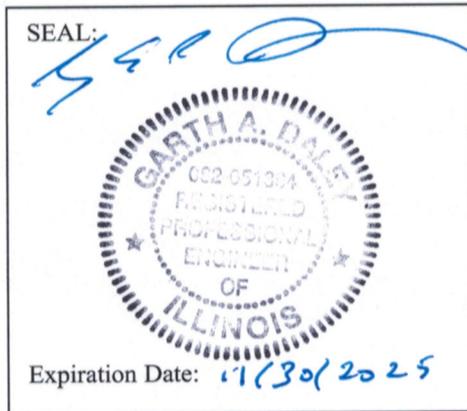
**DIVISION**

**DIVISION 2**

02 82 13  
02 83 19  
02 84 16

SIGNATURE –  
LICENSED

DATE: 1/31/2025



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SECTION 01 11 00  
SUMMARY OF WORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Description of Work
- B. Constraints
- C. Work By Others
- D. CONTRACTOR's Use of Site
- E. Work Sequence
- F. Owner Occupancy

1.2 DESCRIPTION OF WORK

- A. Location of Work:
  - 1. Work is to be performed under this Contract at the following Sites:
    - a. Water Treatment Plant at 555 Lincoln St, Evanston, IL
    - b. North Standpipe Pump Station at 2536 Gross Point Rd, Evanston, IL
    - c. South Standpipe Pump Station at 640 Hartrey Ave, Evanston, IL
- B. Work Included in the Contract
  - 1. Contract Name: Water Plant 4160V Electrical System Reliability Project
  - 2. Work Description: Work Description: The Work includes all work as shown on the Contract Drawings, specified herein, and as required for a complete job. The following is a general description only and shall not be construed as a complete description of the work to be performed.
  - 3. Principal Items of Work
    - a. Replacement of existing electrical distribution equipment including the following:

- (1) Transformer Room 4160V switchgear
  - (2) Transformer Room 4160V:480V substation transformers
  - (3) Transformer Room 480V switchgear
  - (4) Uninterruptable power supplies
  - (5) Miscellaneous general-purpose transformers and panelboards
- b. Replacement of the existing standby generator system
- (1) Associated structural, architectural, electrical, civil, and mechanical works
- c. Miscellaneous electrical improvements including the following:
- (1) Addition of 4160V temporary generator connection cabinet
  - (2) Modifications and refurbishment to circuit breakers at the main switchgear
  - (3) Addition of 480V temporary generator connection cabinet
  - (4) 4160V and 480V feeder replacements
  - (5) Addition of switchgear network cabinet and integration to existing SCADA system.
  - (6) Addition of electrical vehicle chargers
  - (7) Testing and maintenance of 480V motor control centers at the North and South Standpipe Pump Stations
- d. Renovation and extension of existing Garage 4
- (1) Associated structural, architectural, electrical, civil, and mechanical works
- e. Replacement of the Garage 4, 5, and 6 retaining wall
- f. Replacement of Garage 4, 5, and 6 ramps

C. The Work includes:

1. Furnishing of all labor, material, superintendence, plant, power, light, heat, fuel, water, tools, appliances, equipment, supplies, services and other means of construction necessary or proper for performing and completing the Work.

2. Sole responsibility for adequacy of plant and equipment.
  3. Maintaining the Work area and site in a clean and acceptable manner.
  4. Maintaining existing facilities in service at all times except where specifically provided for otherwise herein.
  5. Protection of finished and unfinished Work.
  6. Repair and restoration of Work damaged during construction.
  7. Furnishing as necessary proper equipment and machinery, of a sufficient capacity, to facilitate the Work and to handle all emergencies normally encountered in Work of this character.
  8. Furnishing, installing, and protecting all necessary guides, track rails, bearing plates, anchor and attachment bolts, and all other appurtenances needed for the installation of the devices included in the equipment specified. Make anchor bolts of appropriate size, strength and material for the purpose intended. Furnish substantial templates and shop drawings for installation.
  9. Acquisition and payment for necessary permits.
- D. Implied and Normally Required Work: It is the intent of these Specifications to provide the OWNER with complete operable systems, subsystems and other items of Work. Any part or item of Work which is reasonably implied or normally required to make each installation satisfactorily and completely operable is deemed to be included in the Work and the Contract Amount. All miscellaneous appurtenances and other items of Work incidental to meeting the intent of these Specifications are included in the Work and the Contract Amount even though these appurtenances may not be specifically called for in these Specifications.
- E. Quality of Work: Regard the apparent silence of the Contract Documents as to any detail, or the apparent omission from them of a detailed description concerning any Work to be done and materials to be furnished as meaning that only the best general practice is to prevail and that only materials and workmanship of the best quality are to be used. Interpretation of these specifications will be made upon this basis.

### 1.3 CONSTRAINTS

- A. Work on this Contract must be coordinated with the operation of the water treatment plant and standpipe pump stations. These facilities must be maintained in full operation. Refer to constraints set forth in Section 01 12 16 – Construction Work Sequence and Limitations.

#### 1.4 WORK BY OTHERS

- A. Work on other projects, which may take place concurrently with this CONTRACT and which is excluded from this CONTRACT, is as follows:
  - 1. East Filter Area Refurbishment
  - 2. Pump Station Improvements
  - 3. Miscellaneous Site Improvements
- B. For contracts to be started while this Project is in progress, the contract documents, when completed for bidding purposes, will be available for inspection by the Contractor.

#### 1.5 CONTRACTOR'S USE OF SITE

- A. Limit use of site and premises for work and storage in accordance with the General Provisions and as follows:
  - 1. Coordination of the Work under this CONTRACT with the work of the other contractors where Work under this CONTRACT encroaches on the Work of other contractors.
  - 2. OWNER occupancy and access to operate existing facilities during entire period of construction as necessary to maintain normal operations.
  - 3. Responsibility for protection and safekeeping of products under this CONTRACT.
  - 4. Providing additional off-site storage at no additional cost to OWNER as needed.

#### 1.6 WORK SEQUENCE

- A. Construct Work in stages to accommodate OWNER's use of premises during construction period and in accordance with the limitations on the sequence of construction specified in Section 01 12 16 – Construction Work Sequence and Limitations. Coordinate construction schedules and operations with the ENGINEER.
- B. Coordinate Work of all subcontractors.
- C. Coordinate Work with utility service providers.

#### 1.7 OWNER OCCUPANCY

- A. OWNER will occupy premises during entire period of construction in order to maintain normal operations. Cooperate with OWNER's representative in all construction operations to minimize conflict, and to facilitate OWNER usage.

- B. Conduct operations so as to inconvenience the general public in the least.

## PART 2 PRODUCTS

Not Used

## PART 3 EXECUTION

- A. Starting Work: Start Work within 10 days following the date stated in the Notice to Proceed and execute with such progress as may be required to prevent delay to other contractors or to the general completion of the project. Execute Work at such items and in or on such parts of the project, and with such forces, material and equipment, as to complete the Work in the time established by the Contract. At all times, schedule and direct the Work so that it provides an orderly progression to completion within the specified time for completion.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 01 12 16

### CONSTRUCTION WORK SEQUENCE AND LIMITATIONS

#### PART 1 GENERAL

##### 1.1 SCOPE OF WORK

- A. Construct this Project in phases in accordance with the phasing requirements listed in this Specification Section and as shown on the Contract Drawings.
- B. Provide items, articles, materials, operations and methods including permits, labor, equipment, supplies, materials, and incidentals necessary for completion of the Work under this Contract.
- C. Apparatus, appliance, material or Work not shown on the Contract Drawings, but mentioned in the Specification Sections, or vice versa, or any incidental accessories necessary to make the Work complete and ready for operation, even though not specified in these Specification Sections or shown on the Contract Drawings must be furnished and installed without additional expense to the OWNER.
- D. Should there be any discrepancies or a question of intent, refer the matter to the OWNER for decision before ordering any equipment, materials or before starting any related Work.
- E. The Evanston Water Plant operates 24 hours per day, 7 days per week, and 365 days per year. Work under this Contract must not at any time interfere, stop or prevent the Evanston Water Plant from processing water at sufficient capacity.
- F. Submit the detailed construction phasing plan to the OWNER and ENGINEER for review a minimum of 30 days prior to starting that phase of Work.
- G. The OWNER reserves the right to change the sequence dependent on current Water Treatment Plant operating conditions.
- H. Train OWNER staff on new equipment prior to final acceptance of new equipment.
- I. Provide all Work in accordance with Section 01 11 00 – Summary of Work.
- J. The costs for all temporary facilities, maintenance of services, and all other work specified in these specifications shall be borne by the CONTRACTOR unless specifically stated otherwise. The costs for all the aforementioned work is deemed included in the lump sum bid price.

## 1.2 RELATED DOCUMENTS

- A. Work under this Section is subject to requirements of the Contract Documents.

## 1.3 RELATED WORK

- A. Section 01 11 00 – Summary of Work

## 1.4 SUBMITTALS

- A. Submit a Critical Path Method (CPM) schedule.
- B. Include a detailed breakdown of the project phases included in this Specification Section.
- C. Electrical one line diagrams-construction phasing.
  - 1. As the construction phasing progresses, provide an electrical one line diagram for that portion of Work. The following equipment requires electrical single line diagrams:
    - a. Existing Transformer Room 4160V Switchgear.
    - b. New 4160V Switchgear.
    - c. New 4160V:480V Substation Transformers.
    - d. New 480V Switchgear.
    - e. Temporary Stand-By Power Systems.
    - f. Permanent Stand-By Power Systems.
  - 2. Display the framed or laminated electrical one line diagrams at the equipment for the OWNER's personnel to understand how the new and existing electrical systems are operating.

## 1.5 REFERENCES

Not Used.

## 1.6 SPARE PARTS

Not Used.

## 1.7 DEFINITIONS

Not Used.

1.8 QUALITY ASSURANCE

Not Used.

1.9 WARRANTY

Not Used.

1.10 GENERAL CONSTRAINTS

- A. The Contract Documents are intended to allow the CONTRACTOR flexibility in construction of the Work, however, the following constraints apply:
1. The CONTRACTOR shall establish a sequence of construction to maintain uninterrupted operation of existing systems at all times during construction except where specifically allowed.
  2. Work on this Contract must be coordinated with the operation of the water plant. Notify the OWNER, with written notice, of the CONTRACTOR'S planned procedures for each specific alteration or shutdown of existing facilities 14 calendar days before the alteration or shutdown begins. Do not commence with the alteration or shutdown until specific permission has been granted by the OWNER. The making of connections to existing facilities or other operations that interfere with the operation of the existing equipment must be completed as quickly as possible and with as little delay as possible. Prior to commencing with the work all required components, tools, and equipment are to be on-site. Work multiple or extended shifts to complete the work within the specified amount of time. The costs for any additional labor, equipment, and material to complete the required modifications within the specified amount of time are to be included in the associated Bid Item and no separate payment will be made therefore.
  3. Any operational functions of the existing water plant that are required to be done to facilitate the work of the CONTRACTOR must be performed by the OWNER's personnel only as identified in approved planning documents.
  4. If it is necessary for the proper operation or maintenance of the water plant, the CONTRACTOR must reschedule their operation so that their work will not conflict with necessary operation or maintenance of the plant.
- B. In this Section, the recommended sequence and shutdown of units, which are to be taken out-of-service, are presented. The operational status of new or existing units other than the designated units shall not be interrupted by the General Contractor or Subcontractors during the specified time periods. New units may only be used after the specified testing and acceptance of the new units.

- C. Access to Project Site: An unobstructed traffic route at the entrance must be maintained at all times. Vehicular access to all treatment units and buildings must be maintained at all times. Any work requiring the temporary closing of a road to traffic must be coordinated with the OWNER.
- D. Contractor is required to maintain proper egress to all occupied spaces within the facility in accordance with applicable codes, including but not limited to NFPA 101 life safety code and the Illinois Building Code.
- E. Contractor Access
  - 1. Contractor cannot mobilize on-site until the final approval of the generator procurement submittal.
  - 2. Contractor shall contain all construction activities to defined primary scope of work areas and staging areas. Work within secondary scope of work areas as defined in the Contract Drawings will have limited access that requires 14-day prior approval by the OWNER.
  - 3. Contractor movement between staging and work areas shall be limited to Contractors Path as shown on the Contract Drawings.
- F. Personnel Access
  - 1. OWNER Personnel must have safe access to all areas remaining in operation throughout the construction period. Construction work and staging areas shall be maintained in a neat and workmanlike condition. This includes but is not limited to rubbish removal, cutting grass and removing weeds on a regular basis, grading to eliminate potholes, ponding, ruts, etc., as well as dust control and proper material and equipment storage.
  - 2. Contractor shall maintain code compliant access routes and egress routes to the Lower Level Workshop, Garage No.3, and the Lower Level Boiler Room.
  - 3. The Contractor shall maintain access to the Garage 1 exterior door throughout construction, except for a 5-day period to allow for pavement restoration. 14-day notice shall be provided prior to interruption to Garage 1 access.
  - 4. Contractor shall maintain access to the Central Stairs and the East Stairs, such that at no time will both stairs be simultaneously inaccessible from the parking lot, garages, or any other occupied spaces remaining in use during construction.
  - 5. Ramp Drive Access to Garage Nos. 3, 5, and 6: Restrictions to access must be coordinated with the Owner a minimum of 30 days in advance. Extended interruptions of access to Garage 6 are subject to Liquidated Damages.

G. Standby Power Generation

1. Contractor is required to provide 480V and 4160V temporary standby power generation systems during construction. A primary and redundant secondary means of power must be maintained for both the 4160V and 480V switchgears. The cost of rental, fuel, and maintenance is included in the lump sum bid price.
- H. Low voltage (<600V) load interruptions
1. Contractor must submit schedule for all load transfers. Maximum of 3 load transfers are permitted at a time and requires minimum 3-week advanced notice and approval by the OWNER. Plant staff must initiate all load interruptions and may need to be present for associated critical tasks. May include work outside of normal working hours.
- I. High voltage load interruptions
1. Electrical outages required for 4160 MCC shall be limited to 4 hours, occurring only between 8am and 12pm.
- J. SCADA Interruptions
1. SCADA outages shall be limited to 1 hour and no more than 6 total outages of the SCADA system shall be permitted. Minimum of 16 hours required between SCADA outages.
- K. Water Plant Treatment Systems
1. All existing water plant treatment, pumping, chemical feed, SCADA, and associated systems must be kept in operation at all times. Unscheduled outages or outages extending beyond planed durations are subject to Liquidated Damages.
  2. All power transfers for water plant treatment systems must be coordinated with the OWNER with a minimum 14-day notice.
- L. Building and Campus Utility Systems
1. The existing potable and non-potable water systems shall be kept in operation at all times. All connections to the plant potable and non-potable water systems shall be approved by the OWNER prior to installation. All potable water system connections shall contain protective devices as required by the Health Department or applicable code.
  2. Existing fire hydrants within the plant site shall be operational at all times.
  3. Storm drainage on the site shall be operational at all times.

4. Electric power, lighting service and communication systems shall be maintained in uninterrupted operation mode in all areas remaining in operation. Temporary power shall be provided where required.

M. Backwash Pumping

1. Outages to backwash pumps require prior authorization by the OWNER. Backwash outages cannot extend more than 1 week and must be coordinated with the OWNER with a minimum 14-day notice.

N. Chemical Delivery and Storage

1. The Contractor shall maintain access for all chemical deliveries at all times, with the exception of Garage 6.
2. Semi truck access for chemical deliveries to Garage 6 must not be interrupted for more than 120 consecutive days. Interruptions of greater than 120 consecutive days are subject to Liquidated Damages. At least 2 weeks of open access are required between interruptions in access to Garage 6.

O. Work Hours

1. Normal work hours for Contractors shall be from 7 A.M. to 3 P.M. weekdays except for holidays.
2. Any CONTRACTOR's activities during the period of 3 P.M. to 7 A.M. must have prior approval of the OWNER.
3. No work shall be performed during the following holidays: New Year's Day, Martin Luther King Jr. Day, Memorial Day, Juneteenth, Fourth of July, Labor Day, Thanksgiving, day following Thanksgiving, or Christmas Day

P. Contractor Deliveries and Hauling

1. Deliveries are permitted between the hours of 8:00 A.M. and 4:00 P.M.
2. All deliveries must be made to the Contractor Staging Area off of Lincoln Street unless it is coordinated with the Owner with 3-day prior notice.
3. No deliveries will be accepted by the Owner or Water Plant staff.
4. Contractor shall comply with the posted truck route and permitting provided by the City of Evanston listed in Figure 1 of this section. Further information on truck route may be found at the City of Evanston website: <https://www.cityofevanston.org/government/departments/police/traffic-bureau/truck-route-map>. Truck traffic is not permitted on Lincoln Street west of Sheridan Road.

5. No vehicles shall idle on Lincoln Street
6. No more than 2 vehicles shall be staged on Lincoln Street at any time.
7. Deliveries or hauling shall not impact traffic on Lincoln Street between 7:30-9:30 A.M. and 3:30-5:30 P.M. Any activities impacting traffic must utilize flaggers at each side of the activity.
8. No deliveries or hauling to or from the project site shall be allowed during the following periods based on Northwestern University academic calendars for the duration of the project:
  - a. Homecoming weekend including the week before and after.
  - b. Commencement weekend including the week before and after.

#### 1.11 WORK SEQUENCE

##### A. Procurement/Pre-Construction Phase

1. Within 30 days after receipt of the Notice To Proceed (NTP) and before beginning the Work, provide to the OWNER the list of all equipment and materials required for the continuous and expeditious execution of the Work.
2. Provide evidence to substantiate that equipment and materials must be available to perform this Work.
3. Mobilize on site to perform this Work.
4. Obtain shop drawing approvals, permits, utility coordination, and schedule approval prior to commencement of the Work.
5. Coordinate any required permitting for road and sidewalk closures with the City of Evanston.

##### B. Phase 0

1. Install 4160V mobile generator termination cabinet and relocate existing 480V temporary generator.
2. The fabrication of major equipment must include, but is not limited to, the following:
  - a. Medium-voltage switchgear.
  - b. Factory witness test – medium-voltage switchgear.
  - c. Substation transformers.

- d. Factory witness test – substation transformers.
- e. Medium-voltage generators and generator master control panel
- f. Factory witness test – medium-voltage generators and generator master control panel.
- g. Two (2) Reduced Voltage Soft Starters (RVSSs).
- h. Factory witness test – RVSS.
- i. Low-voltage switchgear.
- j. Factory witness test – low-voltage switchgear.
- k. Power distribution panelboards.
- l. Mimic panel
- m. Uninterruptible Power Supply (UPS) systems.
- n. Switchgear Supervisory Control and Data Acquisition (SCADA) Network Cabinet.

C. Phase I

- 1. Reroute utilities within Garage 4.
- 2. Demolish mezzanine walkway.
- 3. Garage 4 demolition including floor slab and drains.
- 4. Underpin existing foundations, install new floor drains and construct new foundations.
- 5. Construct 2<sup>nd</sup> floor build-out within Garage 4.

D. Phase II

- 1. Temporary removal and reinstallation of stair tower.
- 2. Demolish retaining wall and associated pavement and utilities.
- 3. Construct Garage 4 extension foundations, retaining wall, and ramp replacement.
- 4. Demolish drainage system in Garage 3 and install new drainage system.

5. Construct Garage 4 extension build-out.
6. Provide trailer mounted 480V and 4160V generators.
7. Demolish existing generator.
8. Garage 4 install equipment pads and floor slab.
9. Construct new Generator Room walls.

E. Phase III

1. Install new substation transformers.
2. Install new MV switchgear and backwash RVSS.
3. Provide temporary connections for existing LV switchgear.
4. Demolish existing MV switchgear.
5. Demolish existing substation transformers.
6. Construct switchgear room partition walls.

F. Phase IV

1. Transformer Room modifications.
2. Generator Room build-out.
3. Install new generators.
4. Install new mimic panel.

G. Phase V

1. Install new LV switchgear.
2. Miscellaneous transformer and panel replacements.
3. Install new UPS system, transfer, and demolish existing UPS systems.

H. Phase VI

1. Remainder of electrical installations and architectural finishes in Garage 4 and throughout plant.

2. Fire alarm system commissioning.
3. HVAC system commissioning.

I. Project Closeout and Demobilization Phase

1. Project Closeout and Demobilization Work may begin upon approval by the OWNER.
2. Project Closeout and Demobilization Work must include, but is not limited to, the following:
  - a. Ensure that all punch list Work is completed, tested, and accepted by the OWNER.
  - b. The demobilization process may be performed; remove the temporary facilities and equipment; disconnect and remove all temporary services; and restore the site to original condition including the Contractor's Staging Area.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

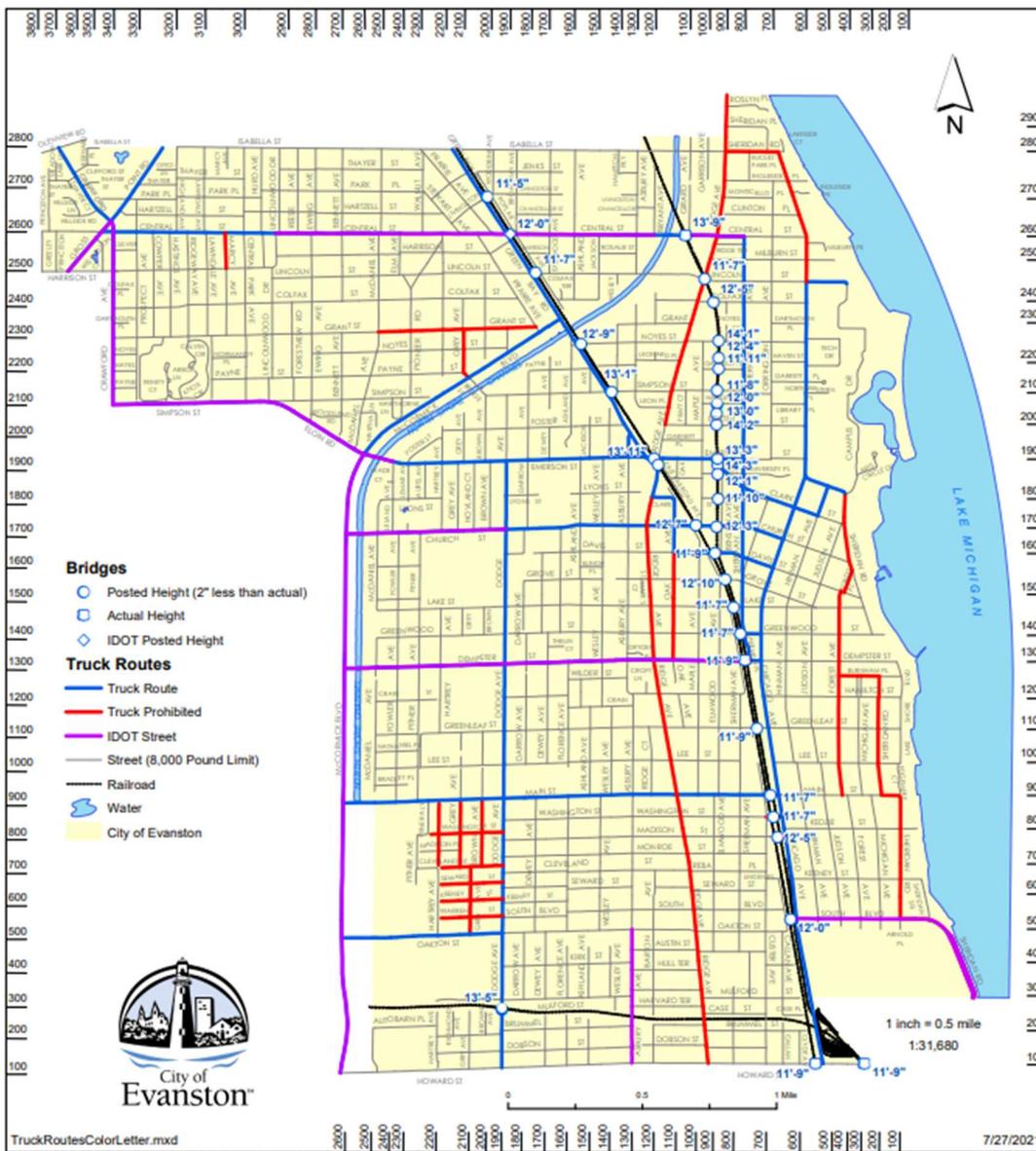
3.1 PROTECTING INSTALLED AND EXISTING CONSTRUCTION

- A. Do not place any materials or equipment, other than that shown on the Contract Drawings to be installed in its permanent position, nor operate any construction equipment, on any existing or previously placed floors or roofs.
- B. Should the Contractor find it necessary to place any materials or equipment, other than that shown on the Contract Drawings to be installed in its permanent position, or operate any construction equipment on existing or previously placed floors or roofs, it must be at the Contractor's own risk.
- C. Floor loading capacities, where provided on the Contract Drawings, identify the maximum amount that can be loaded on the existing floor. Should loading exceed the identified loading during construction activities, design a shoring system for required loads subject to approval by the OWNER. Submit design calculations for shoring system signed and sealed by a Licensed Structural Engineer in the State of Illinois.

- D. Repair any damage to existing construction to the satisfaction of the OWNER at no additional cost.

FIGURE 1

# City of Evanston Truck Routes



This map is provided "as is" without warranties of any kind. See [www.cityofevanston.org/mapdisclaimers.html](http://www.cityofevanston.org/mapdisclaimers.html) for more information.

END OF SECTION

SECTION 01 26 00

CHANGE ORDER, WORK CHANGE DIRECTIVE AND FIELD ORDER  
PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Definitions
- B. Change Orders
- C. Work Change Directives
- D. Field Orders

1.2 DEFINITIONS

- A. Change Order: Refer to the Change Order definition in Article 1 of the General Conditions.
- B. Work Change Directive: Refer to the Work Change Directive definition in Article 1 of the General Conditions.
- C. Overhead: Overhead is defined as the cost of administration, field office and home office costs, general superintendence, office engineering and estimating costs, other required insurance, materials used in temporary structures (not including form work), additional premiums on the performance bond of the CONTRACTOR, the use of small tools, scheduling costs, and all other costs incidental to the performance of the change or the cost of doing business.
- D. Field Orders: Refer to the Field Order definition in Article 1 of the General Conditions.

1.3 CHANGE ORDERS

- A. Initiation of Proposals:
  - 1. From time to time, the OWNER or the ENGINEER may issue a request for a Change Order proposal. The request will contain a description of the intended change with supplementary or revised Drawings and Specifications as applicable, and the projected time for accomplishing the change.
  - 2. The CONTRACTOR may propose a change in the Work by submittal of a Change Order request to the ENGINEER describing the proposed change

with a statement of the reason for the change and the effect on the Contract times and price, along with supporting documentation.

B. Execution of a request for a Change Order Proposal:

1. When a proposal is requested for changed work, submit proposal within 14 days following receipt of the request from OWNER or ENGINEER. State the increase or decrease, if any, in Contract Completion times and Contract Price.
2. Explain proposal in sufficient detail to permit review by OWNER.
3. For omitted work, the decrease in the Contract Price will be determined by the ENGINEER and will include appropriate amounts for profit and overhead.
4. The OWNER and ENGINEER will review the proposal and may request additional information and documentation. Provide these items upon request.
5. If the OWNER decides to proceed with the change, the OWNER will issue a Change Order for signature first by the CONTRACTOR and then by the OWNER.
6. The CONTRACTOR will promptly complete the approved change in the Work on receipt of the executed Change Order.
  - a. Failure to sign the Change Order does not relieve the CONTRACTOR from performing the Work if the Change Order is signed by the OWNER.

C. Execution of a change order request:

1. The OWNER and ENGINEER will review the request and may request additional information and documentation. Provide these items upon request.
2. For omitted work, the decrease in the Contract Price will be determined by the ENGINEER and will include appropriate amounts for profit and overhead.
3. If the OWNER decides to proceed with the change, the OWNER will issue a Change Order for signature first by the CONTRACTOR and then by the OWNER.
4. The CONTRACTOR will promptly complete the approved change in the Work on receipt of the executed Change Order.

- a. Failure to sign the Change Order does not relieve the CONTRACTOR from performing the Work if the Change Order is signed by the OWNER.
- D. Compute the cost of both additive and deductive changes in the Work in accordance with Article 12 of the General Conditions and as follows:
1. Include the costs of labor crew foreman and general foreman performing or directly supervising the changed Work on the site. Include travel and subsistence, but only to the extent incurred.
  2. To the labor cost add all net premium for Workman's Compensation, taxes pursuant to the Federal Social Security Act, and payments required under State and Federal unemployment laws.
  3. Add necessary extra materials, delivered at the site.
  4. Include rent for plant and equipment at unit rental costs for similar rentals from an independent firm (i.e. a firm which is not owned in whole or in part by the CONTRACTOR). If equipment is owned by CONTRACTOR or rented from a firm in which the CONTRACTOR has an interest, calculate the rent in accordance with the applicable provisions and terms of the current "Cost Reference Guide for Construction Equipment" published by Dataquest.

#### 1.4 WORK CHANGE DIRECTIVES

- A. Initiation by OWNER: OWNER may issue a Work Change Director with a Notice to Proceed without a prior request for a Change Order Proposal or the CONTRACTOR's signature.
- B. Payment Determination: The OWNER will designate the method of determining the amount of compensation or credit, if any, based on one of the methods contained in Article 12 of the General Conditions.
- C. Timing: Proceed with the change in the Work immediately upon receipt of the Work Change Directive.
- D. Addition to Contract: The Work Change Directive Orders will be incorporated into the Contract Documents via a Change Order at a later date.

#### 1.5 FIELD ORDERS

- A. The ENGINEER may issue a written order at any time during the course of construction.

- B. Field Orders serve as documentation of minor changes in the work not involving a change in the Contract Price or Times.
- C. Proceed with the change described in the Field Order immediately upon receipt of the field order.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 29 00

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Schedule of Values
- B. Application for Payment
- C. Contract Items

1.2 REFERENCES

- A. Reference the Contract Front End and General Provisions.

1.3 SCHEDULE OF VALUES

- A. Approval of Schedule: Submit for approval a schedule of values, in duplicate, for the Work. A schedule of values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work. Submit schedule of values within 10 calendar days after date established in Notice to Proceed.
- B. Format: Utilize a format similar to the Bid Form. Identify each line item with number and title in accordance with the Contract Items listed in this Section. Identify site mobilization, bonds, and insurance. Include within each line item, a direct proportional amount of CONTRACTOR's overhead and profit.
- C. Revisions: With each Application for Payment revise schedule to list approved Change Orders.

1.4 APPLICATION FOR PAYMENT

- A. Required Copies: Submit three copies of each application on EJCDC Form C-620 Contractors Application for Payment or approved equal. Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. Present required information in typewritten form or on electronic media printout. Use data from approved Schedule of Values and include the following items with each Application for Payment:

1. Certified Statement / Sworn affidavit
  2. Pay request
  3. Waivers
  4. Certificate of payroll and detailed certified payroll
  5. Subcontract payment details
  6. DBE Monthly Utilization Report
  7. Illinois Works Apprenticeship Initiative Periodic Report
  8. Updated construction schedule
  9. Surety consent
  10. Change orders enacted during payment application period
  11. Survey coordinates and elevations in .dwg base files signed and sealed by a land surveyor registered in the State of Illinois of the items specified in this Section for which payment is being requested in accordance with the requirements of Section 01 78 00. Identify the location of the area for which the .dwg record data is being submitted, such as by street name or area map. Revise .dwg base files based on comments provided and include revisions marked in proceeding submittals.
  12. Red lines of "Record Drawings" updated for the Work for which payment is being requested in accordance with the requirements of Section 01 78 00.
  13. A separate schedule for Materials Stored showing line item, description, previous value received, value incorporated into the Work and present value. Include a bill of sale, invoice, or other documentation in the Application for Payment warranting that OWNER has received the materials and equipment free and clear of Liens, and evidence that the materials and equipment are covered by property insurance, a warehouse bond, or other arrangements to protect OWNER's interest therein. Materials and equipment stored offsite must be stored in a licensed, bonded warehouse and subject to inspection by the ENGINEER with one working days' notice.
  14. A list of each authorized Change Order as an extension on continuation sheet, listing Change Order number and dollar amount as for an original item of Work.
- B. Submit application for payment to ENGINEER on, or before, the first of each month.
- C. Execute certification by signature of authorized officer.

- D. The payment will be reduced by the amount of the retainage set forth in the contract agreement.
- E. Final Payment: The final Application for Payment must be accompanied (except as previously delivered) by:
  - 1. All documentation called for in the Contract Documents;
  - 2. Consent of the surety, if any, to final payment;
  - 3. Satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.
  - 4. A list of all duly pending Change Proposals and Claims; and
  - 5. Complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.

## 1.5 CONTRACT ITEMS

### A. Contract Item LS-1 – Work Result

- 1. Description: The work under Contract Item LS-1 includes all labor, materials, equipment and services, and perform all work for the construction, maintenance, testing and placing in trouble-free operation all structures and equipment. The work includes digging all excavations, constructing all structures, furnishing and installing all equipment, placing all backfill and embankment, and all general, structural, architectural, mechanical, heating, ventilating, air conditioning, and electrical work complete and in place, together with all appurtenant work as shown and specified, except for work specifically included under other Contract Items. All work associated with Mobilization, furnishing of Medium Voltage Equipment, Low Voltage Equipment, and Packaged Engine Generator Systems, Foundations and Piles, Low Voltage and Medium Voltage MCC Maintenance and Testing, Site Restoration, Contaminated Soil Disposal, Tuckpointing, SCADA Integration and not specifically included in Contract Items LS-2 through LS-8, UP-1, UP-2, AL-1, and AL-2 is to be included as part of Contract Item LS-1 lump sum project work.
- 2. Payment: Payment for Structures and Equipment work will be made at the lump sum price for Contract Item LS-1.

### B. Contract Item LS-2 – Mobilization

- 1. Description: The work under Contract Item LS-2 includes all labor, materials, equipment, services, submittals, and activities relating to the Mobilization for this Project. The work includes site preparation and remediation associated

with the temporary trailers, staging, parking areas, etc. together with all appurtenant work as shown and in accordance with Specification Section 01 50 00, Paragraph 1.15.

2. Payment: Payment for Mobilization work will be made at the lump sum price for Contract Item LS-2. Payment will be made according to the following schedule:
  - a. Upon approval of all Mobilization Submittals listed in these Specifications, 75 percent of the pay item will be paid.
  - b. When 10% of the original contract amount is earned, an additional 15% of the pay item will be paid.
  - c. When Final Completion and Final Acceptance of the Work has been established, the remaining 10% of the pay item will be paid.

B. Contract Item LS-3 – Medium Voltage Equipment

1. Description: The work under Contract Item LS-3 includes furnishing medium voltage equipment specified in Sections 26 12 16, 26 13 00, 26 14 00, 26 18 16, 26 24 14, and 26 33 00.
2. Payment: Payment for furnishing equipment will be made at the lump sum price for Contract Item LS-3.

C. Contract Item LS-4 – Low Voltage Equipment

1. Description: The work under Contract Item LS-4 includes furnishing low voltage equipment specified in Sections 26 22 00, 26 23 00, 26 24 13, 26 24 16, 26 29 23, 26 29 53, and 26 33 53.
2. Payment: Payment for furnishing equipment will be made at the lump sum price for Contract Item LS-4.

D. Contract Item LS-5 – Packaged Engine Generator System

1. Description: The work under Contract Item LS-3 includes furnishing packaged engine generator systems specified in Section 26 32 13.
2. Payment: Payment for furnishing equipment will be made at the lump sum price for Contract Item LS-5.

E. Contract Item LS-6 – Foundations and Piles

1. Description: The work under Contract Item LS-6 includes furnishing and installing foundations and piles specified in Section 31 66 00.

2. Payment: Payment for furnishing equipment will be made at the lump sum price for Contract Item LS-6.
- F. Contract Item LS-7 – Low Voltage and Medium Voltage MCC Maintenance and Testing
1. Description: The work under Contract Item LS-8 includes all labor, materials, equipment and services to perform all work related to the Low Voltage and Medium Voltage MCC Maintenance and Testing specified in Section 26 24 19 and Section 26 14 00.
  2. Payment: Payment for furnishing equipment will be made at the lump sum price for Contract Item LS-7.
- G. Contract Item LS-8 – Site Restoration
1. Description: The work under Contract Item LS-8 includes all labor, materials, equipment and services to perform all work related to site restoration as shown on Contract Drawing R1.
  2. Payment: Payment for furnishing equipment will be made at the lump sum price for Contract Item LS-8.
- H. Contract Item UP-1 – Contaminated Soil Disposal
1. Description: The work under Contract Item UP-1 includes contaminated soil disposal specified in Section 31 23 16.
  2. Payment: Payment for contaminated soil disposal will be made at the unit price for Contract Item UP-1.
- I. Contract Item UP-2 – Tuckpointing
1. Description: The work under Contract Item UP-2 includes tuckpointing of existing exterior wall to be enclosed in accordance with Specification 04 01 21 "Brick and Masonry Repair".
  2. Payment: Payment for soil disposal will be made at the unit price for Contract Item UP-2.
- C. Contract Item AL-1 – SCADA Integration
1. Description: Contract Item AL-1 includes allowance for payment to Concentric for Integration of the new Switchgear SCADA Network Cabinet to the existing SCADA system as specified in Specification Section 40 67 17. Contractor must submit invoices from Concentric to the OWNER for approval. All other Contractor's costs associated with coordination is

included under the lump sum cost of Contract Item LS-1. Contractor is not allowed to add insurance, bond, overhead or profit to allowance expenditures.

2. Payment: Allow an amount not to exceed \$50,000.00.

D. Contract Item AL-2 – General Allowance

1. Description: Contract Item AL-2 is an allowance for the sole use of the OWNER to cover unanticipated costs at the sole discretion of the OWNER. The Contractor should assume that this allowance will not be used.
2. Payment: Allow an amount not to exceed \$200,000.00.

E. Contract Item SP-1 – Spare Parts

1. Payment: Upon acceptance of all spare parts by the OWNER, payment will be made at the lump sum price for Contract Item SP-1.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

## SECTION 01 31 00

### COORDINATION AND MEETINGS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Coordination
- B. Preconstruction Conference
- C. Progress Meetings

##### 1.2 COORDINATION

- A. General: Coordinate scheduling, submittals, and Contract work to assure efficient and orderly sequence of installation of interdependent construction elements.
- B. Accessory Placement: Place conduits, saddles, boxes, cabinets, sleeves, inserts, foundation bolts, anchors and other like work in floors, roofs or walls of buildings and structures in conformity with the construction program.

##### 1.3 PRECONSTRUCTION CONFERENCE

- A. General: Prior to commencement of the Work, in accordance with paragraph 2.06 of the General Conditions, the OWNER will conduct a preconstruction conference to be held at a predetermined time and place.
- B. Delineation of Responsibilities: The purpose of the conference is to designate responsible personnel, to establish a working relationship among the parties and to identify the responsibilities of the OWNER, ENGINEER and the CONTRACTOR. Matters requiring coordination will be discussed and procedures for handling such matters, established. The agenda will include:
  - 1. Submittal procedures
  - 2. Partial Payment procedures
  - 3. Maintenance of Records
  - 4. Schedules, sequences and maintenance of facility operations
  - 5. Safety and First Aid responsibilities
  - 6. Change Orders
  - 7. Use of site
  - 8. Housekeeping
  - 9. Equipment delivery

- C. Attendees: The preconstruction conference is to be attended by the representatives of the CONTRACTOR, the OWNER and the ENGINEER who will be associated with the project. Representatives of regulatory agencies, subcontractors, and principal suppliers may also attend when appropriate.
- D. Chair and Minutes: The preconstruction conference will be chaired by the ENGINEER who will also arrange for the keeping and distribution of minutes to all attendees.

#### 1.4 PROGRESS MEETINGS

- A. Meeting Frequency and Format: Schedule progress meetings on at least a monthly basis or more frequently as warranted by the complexity of the Project, to review the Work, discuss changes in schedules, maintain coordination and resolve potential problems. Invite OWNER, ENGINEER and all subcontractors. Suppliers may be invited as appropriate. Minutes of the meeting will be maintained by CONTRACTOR and reviewed by ENGINEER prior to distribution by the CONTRACTOR. Distribute reviewed minutes to attendees within 5 calendar days after each meeting.

### PART 2 PRODUCTS

Not Used

### PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 32 16  
PROGRESS SCHEDULE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Form of Schedules
- B. Content of Schedules
- C. Schedule Revisions
- D. Submittal Requirements

1.2 FORM OF SCHEDULES

- A. Prepare schedules in form of a horizontal bar chart.
  - 1. Provide separate horizontal bar for each trade or operation.
  - 2. Utilize a horizontal time scale and identify first work day of each week.
  - 3. Utilize scale and spacings to allow space for notations and future revisions.
- B. Utilize a listing format which chronologically indicates the order of start of each item of work.
- C. Identify each listing by major specification section numbers.

1.3 CONTENT OF SCHEDULES

- A. Completion Dates: Show the beginning and ending contract dates stated in documents. Schedules showing completion prior to the contract completion date will be accepted but in no event will they be considered basis for a claim for delay against the OWNER by the CONTRACTOR for the period between the early completion date and the completion date provided in the Contract Documents.
- B. Show complete sequence of construction by activity.
- C. Show dates for beginning and completion of each major element of construction and installation dates for major items of equipment. Elements shall include, but not be limited to, the following:

1. Shop drawing receipt from supplier/manufacturer submitted to ENGINEER, review and return to supplier/manufacturer
2. Material and equipment order, manufacturer, delivery, installation, and checkouts
3. Performance tests and supervisory services activity
4. Construction of various facilities
5. Demolition
6. Excavation, sheeting, shoring, dewatering
7. Concrete placement sequence
8. Structural steel erection
9. Wall and roof construction
10. Piping and equipment installation
11. Electrical work activity
12. Heating, ventilating, and air conditioning work activity
13. Plumbing work activity
14. Sewer installation
15. Connection to existing sewers
16. Water main installation
17. Miscellaneous concrete placement
18. Subcontractor's items of work
19. Backfilling, grading, seeding, sodding, landscaping, fence construction, and paving
20. Final cleanup
21. Allowance for inclement weather
22. Coordination with concurrent Work on site

- D. Show projected percentage of completion for each item as of first day of each month.

#### 1.4 SCHEDULE REVISIONS

- A. As a minimum, revise construction schedule every 30 calendar days to reflect changes in progress of Work for duration of Contract.
- B. Indicate progress of each activity at date of submittal.
- C. Show changes occurring since previous submittal of schedule.
  - 1. Major change in scope
  - 2. Activities modified since previous submittal
  - 3. Revised projections of progress and completion
  - 4. Other identifiable changes
- D. Provide a written report as needed to define:
  - 1. Problem areas, anticipated delays, and impact on schedule
  - 2. Corrective action recommended and its effect
  - 3. Effect of changes on schedules of other Contractors

#### 1.5 SUBMITTAL REQUIREMENTS

- A. Schedule: The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
- B. For preliminary and final submittal of construction progress schedule and subsequent revisions thereof, furnish three copies to ENGINEER.

### PART 2 PRODUCTS

Not Used

### PART 3 EXECUTION

Not Used

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 01 33 00

### SUBMITTALS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Description
- B. Definitions
- C. Submittal Procedures
- D. ENGINEER'S Actions on Submittals
- E. Repetitive Reviews
- F. Example Format for CONTRACTOR's Approval and Certification Stamp
- G. CONTRACTOR's Submittal Transmittal Form

##### 1.2 DESCRIPTION

- A. This Section specifies procedural requirements for submittals made by the CONTRACTOR to the ENGINEER. Specific submittals required for individual elements of the Work are specified in the associated, individual Specification Sections. Except as otherwise indicated in other Specification Sections, comply with the requirements specified herein for each type of submittal.

##### 1.3 DEFINITIONS

- A. Shop Drawings: All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents. Shop Drawings include all "Action Submittals" and "Information Submittals" as defined below.
- B. Action Submittals: The following submittals require approval by the ENGINEER as described in Subsection 3.2 of this Section:
  - 1. Manufacturer's Documents: Technical data, drawings and other similar information specially prepared for this Project by product manufacturers and suppliers, including fabrication and installation drawings, diagrams, actual performance curves, data sheets, schedules, templates, patterns, reports,

instructions, design mix formulas, measurements, and similar information not in standard printed form.

2. Product Data: Stock or standard printed information on materials and equipment that has not been specially prepared for this Project, including specifications, installation instructions, catalog cuts, wiring diagrams, and color charts.
3. Working Drawings: Technical data, drawings and other similar information specially prepared for this Project by the CONTRACTOR or Subcontractors, including fabrication and installation drawings, diagrams, and other similar information.
4. Samples: Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged
5. Mock-Ups: Special types of samples that are too large or otherwise inconvenient for handling in the manner specified for transmittal of sample submittals.
6. "Or Equal" or Substitution Requests: Wherever a proprietary item is identified by the product, manufacturer or supplier name and/or model number, an "Or Equal" ("equal to" or "equivalent") item may be submitted unless the description of the item contains a prohibition against an "Or Equal".
  - a. An item may be determined "Or Equal" only at the sole discretion of the ENGINEER, based upon the following criteria:
    - (1) The item is equal in quality, durability, appearance, strength, and design characteristics.
    - (2) The item will perform to meet the design concept.
    - (3) No changes to other work will be required to accommodate the item.
    - (4) No addition to the Contract Price or Contract Times will be required as a result of the use of the item.
    - (5) OWNER will not incur any additional cost as a result of the use of the item.
  - b. If the ENGINEER, at its sole discretion, determines that a proposed item is not an "Or Equal", the proposed item may be considered as a "Substitute" item.

- C. Information Submittals: The following submittals require acknowledgement by the ENGINEER as described in Subsection 3.2 of this Section:
1. CONTRACTOR's Licensed Professional Submittals: Certificates and other documents required by the Contract Documents to be prepared and submitted by the CONTRACTOR's Licensed Professionals.
  2. Inspection and Test Reports
  3. Mill reports
  4. Guarantees
  5. Warranties
  6. Certifications
  7. Experience records
  8. Maintenance agreements
  9. Operation and maintenance manuals
  10. Survey data and reports: property surveys, building or structure condition surveys, field measurements, quantitative records of actual Work, damage surveys, photographs, and similar data required by Specification sections.
  11. Physical work records
  12. Quality testing and certifying reports
  13. Industry standards
  14. Record drawings
- D. Other Submittals: For submittals concerning the following refer to the indicated Contract Document Section:
1. Listing of manufacturers – Section 01 60 00
  2. Construction progress schedule – Section 01 32 16
  3. Schedule of shop drawing submissions - Refer to the Contract Front End and General Provisions.
  4. Bonds – Refer to the Contract Front End and General Provisions.
  5. Schedule of values – Section 01 29 00

6. Payment applications– Section 01 29 00
7. Insurance certificates - Refer to the Contract Front End and General Provisions.

E. Clarifications and Interpretations:

1. The CONTRACTOR is responsible to review the Contract Documents, determine the type and extent of the Work and make all necessary field measurements before starting the Work. If any conflict, error, ambiguity, or discrepancy is discovered the CONTRACTOR is to submit a written request for interpretation or clarification from ENGINEER. The ENGINEER will issue a written clarification or interpretation of the requirements of the Contract Documents as ENGINEER may determine necessary, consistent with the intent of and reasonably inferable from the Contract Documents. Such written clarifications and interpretations will be binding on the CONTRACTOR.
1. If the CONTRACTOR submits a written request for information that does not, in the sole discretion of the ENGINEER, require clarification or interpretation of the Contract Documents, ENGINEER will notify CONTRACTOR that such information is contained (or could otherwise be reasonably determined) in the Contract Documents. The CONTRACTOR shall reimburse OWNER for ENGINEER's charges for evaluating and responding to such a request for information.

## PART 2 PRODUCTS

Not Used

## PART 3 EXECUTION

### 3.1 SUBMITTAL PROCEDURES

A. Scheduling:

1. Submit a preliminary schedule of submittals, in duplicate, for acceptance by the ENGINEER. ENGINEER will review no submittals until an acceptable schedule of submittals has been submitted. If the CONTRACTOR intends to request a substitute(s) for the materials or equipment specified, schedule substitution request(s), along with any related, subsequent submittals, in the schedule of submittals and submit as scheduled.

2. Schedule, prepare and transmit each submittal to ENGINEER sufficiently in advance of scheduled performance of related Work and other applicable activities.

B. Coordination:

1. Coordinate the preparation and processing of submittals with the performance of the Work. Coordinate each submittal with other submittals and related activities, such as substitution requests, testing, purchasing, fabrication, delivery, and similar activities that require sequential performance. Coordinate submissions for different items of interrelated work so that one submittal will not be delayed by ENGINEER's need to review a related submittal.
2. ENGINEER may return any submittal requiring coordination with other submittals without review and marked "Revise and Resubmit". This type of returned submittal will be counted as a submittal subject to the provisions of 3.3 –REPETITIVE REVIEWS of this Section.
3. The ENGINEER will not hold a submittal awaiting additional information from the CONTRACTOR.

C. Submittal Preparation:

1. All Submittals: Review each submittal to determine, as applicable, that:
  - a. The submittal is required by the Contract Documents. The ENGINEER will only review submittals required by the Contract Documents.
  - b. The materials and equipment depicted in the submittal are intended for incorporation into the Work.
  - c. The submittal is complete and in sufficient detail to allow ready determination of compliance with the Contract Documents.
  - d. The items depicted in the submittal will fit in the space available.
  - e. The information in the submittal has been coordinated with the requirements of the Contract Documents; work to be performed by all trades involved; field measurements and other requirements of the Work.
  - f. The submittal does not contain standard printed information unless full identification of the project-specific portions and any project-specific supplementary information is shown thereon in ink or typewritten form.

- g. The submittal does not encompass more than one Section of the Specifications.
- h. The submittal presents, where applicable, such data as dimensions, weights, and performance characteristics on drawings for mechanical and electrical equipment. Show conformance with the performance characteristics and other criteria included in the Contract Documents.
- i. Variations from the Contract Documents have been specifically noted on the Submittal Transmittal Form and highlighted on all relative documents within the submittal that are affected by the variation.
- j. The submittal is in compliance with the Contract Documents and a completed approval and certification stamp has been placed on each submittal document. Use a rubber stamp containing the information shown in the sample stamp at the end of this section. ENGINEER will rely upon CONTRACTOR's certification of compliance that the CONTRACTOR has reviewed and approved the submittal and has confirmed that the submittal conforms to all the requirements of the Contract Documents except for variations specifically noted on the Submittal Transmittal Form and all attached documents. Submittals will be returned to CONTRACTOR without action if certification is not provided and the submittal will be counted as a submittal subject to the provisions of 3.3 –REPETITIVE REVIEWS of this Section.

2. Manufacturer's Documents and Working Drawing submittals:

- a. Accurately and distinctly present the following:
  - (1) Graphical information at accurate scale
  - (2) Name, address and telephone number of manufacturer or supplier
  - (3) Materials and equipment that are to be included in the Work
  - (4) Compliance with standards
  - (5) All dimensions, clearly identifying those dimensions based on field measurement
  - (6) Arrangements and sectional views
  - (7) Necessary details, including complete information on making connections between Work in this project, work in other related projects and existing facilities

- (8) Electrical wiring connections between all equipment provided including all internal wiring between internal components of equipment
  - (9) Kinds of materials and finishes
  - (10) Parts list and descriptions thereof
  - (11) Spare parts, lubricants or special tools required by the Contract Documents
- b. Include the following on each drawing or page:
- (1) Preparation date and revision dates
  - (2) Project name
  - (3) Specification Section number and page number
  - (4) Identification of equipment or materials
  - (5) Name of CONTRACTOR (and Subcontractor if applicable)
  - (6) Name of Supplier and/or Manufacturer
  - (7) Field dimensions, clearly identified
  - (8) Standards or industry specification references
  - (9) Identification of variations from the Contract Document requirements
  - (10) Physical location and location relative to other facilities that the Work-related equipment or materials are to be installed adjacent to or connected with
  - (11) Provide 8-inch wide by 3-inch high blank space for CONTRACTOR's and ENGINEER's stamps
- c. Submit 3 blue or black line prints, or 2 reverse-sepia reproducibles with 1 blue or black line print. One reproducible or one print will be returned with review comments.
3. Product Data:
- a. Assemble all data into a single submittal for each element of work or system. Where product data has been printed to include information on several similar products, some of which are not required for use on

the subject Project, clearly mark copies to show such information is not applicable.

- b. Where data must be specially prepared for required materials or equipment because standard printed data are not suitable for use, submit the data as a Manufacturer's Document and not as Product Data.
- c. Submit product data with appropriate Manufacturer's Document or Working Drawing, when applicable.
- d. Submit 3 copies.

4. Samples:

- a. Whenever possible, provide samples physically identical with the materials proposed for incorporation into the Work. Where variations in color, pattern or texture and the like are inherent in materials represented by samples, submit multiple samples (not less than 3) showing the approximate range of variations.
- b. Submit samples for visual review of generic kind, color, pattern, texture, and for a final check of coordination of these characteristics with other related elements of the Work and existing facilities.
- c. Include information with each sample to provide a generic description of the item, and its name, manufacturer, limitations, and compliance with standards.
- d. Submit 3 sets of samples, where specifications indicate selection of color, pattern, texture or similar characteristics from manufacturer's range of standard choices is necessary.

5. Mock-Ups:

- a. Mock-ups and similar samples are recognized as special types of samples. Comply with samples submittal requirements to the greatest extent possible. Process Submittal Transmittal Forms to provide a record of activity.

6. Requests for "Or Equal" or Substitution

- a. ENGINEER will, at its sole discretion, determine if the item is "Or Equal" or an acceptable Substitution. Prepare submittals as described above. CONTRACTOR shall reimburse OWNER for ENGINEER's Charges for evaluating a proposed "Or Equal" submittal that receives a negative determination. CONTRACTOR shall reimburse OWNER for ENGINEER's charges for evaluating a proposed Substitution,

whether or not a positive determination is made or the CONTRACTOR withdraws the request for Substitution, and for changes resulting from an approved Substitution.

- b. For Substitution Requests submit sufficient written information including the following:
  - (1) Certify that the proposed Substitution is functionally equivalent to the specified item and its performance characteristics, when it is incorporated into the Work, will be equivalent to the specified item.
  - (2) State the extent, if any, to which the use of the proposed Substitution will affect the performance of the construction work and/or the characteristics of the completed work.
  - (3) Describe all differences between the proposed Substitution and the specified item.
  - (4) Describe the sources of supplies, replacement parts, repair services and technical support.
  - (5) Provide an itemized estimate of all costs or credits directly or indirectly attributable to the use of such Substitution, including redesign engineering, construction and energy costs.
  - (6) Furnish additional information as requested by the ENGINEER.
  - (7) CONTRACTOR may be required to furnish a guarantee or other surety for any Substitution at no addition to the Contract Time or Price.
- c. Substitute means, methods, techniques, sequences, or procedures of construction may be used in place of those required by the Contract Documents if approved by ENGINEER, at ENGINEER's sole discretion. Follow the procedure described in b. above, submitting appropriate information.
- d. Provide sufficient time for ENGINEER to evaluate each "Or Equal" and Substitution Request. Do not order, install or utilize any "Or-Equal" or Substitution until ENGINEER's determination is complete. ENGINEER's approval will be in the form of an approved submittal for an "Or Equal" item or in the form of a Change Order for a Substitution. CONTRACTOR will be advised in writing of any negative determination.

- e. Provide all information and documents in support of any proposed “Or-Equal” or Substitution at no addition to the Contract Times or Price.
7. CONTRACTOR’s Licensed Professional Submittals
- a. Submit 3 copies of certificates and other documents required by the Contract Documents to be prepared and submitted by the CONTRACTOR’s Licensed Professionals.
8. Inspection and Test Reports:
- a. Identify each inspection and test report as either specially prepared for the Project or a standard publication of workmanship control testing at point of production. Submit in accordance with the requirements for Manufacturer’s Documents or Product Data, respectively as described in this Section.
9. Mill Test Reports, Experience Records, Physical Work Records, Guarantees, Warranties, and Maintenance Agreements:
- a. Refer to the Contract Documents sections for specific requirements.
10. Survey Data:
- a. Refer to the various Contract Documents for specific requirements. Furnish 2 copies. Provide 10 copies of final property survey (if any).
11. Certifications, Quality Testing and Certifying Reports:
- a. Refer to Specification sections for specific requirements on submittal of certifications. Submit 7 copies. Certifications are submitted for review of conformance with specified requirements and information. Submittal is final when reviewed and returned by ENGINEER with no further action required.
12. Closeout Submittals:
- a. Refer to Specification sections and Section 01 78 00 for specific requirements on submittal of closeout information, materials, tools, and similar items such as:
    - (1) Warranties and Bonds
    - (2) Record Drawings
    - (3) Special Tools

13. Operation and Maintenance Manuals:

- a. Submit Operation and Maintenance Manuals in accordance with Section 01 78 23

D. Submittal Transmittal Form: Use the Submittal Transmittal Form found at the end of this Section to forward each specific submittal package to the ENGINEER. Provide all the information indicated on the Form and answer each question. Submittals with incomplete information on the Submittal Transmittal Form will be returned to the CONTRACTOR marked "Revise and Resubmit" and will be counted as a submittal subject to the provisions of 3.3 –REPETITIVE REVIEWS of this Section.

E. Submittal Numbering:

1. Number all submittals as follows:

(A) - (B)

Where:

(A) = Specification Section Number

(B) = Consecutive submittal number for the Specification Section Number listed in (A), with an alphabetic suffix indicating the sequential version of the submittal.

Examples: 01 13 00-001A indicates the initial version of submittal number 001 for Specification Section 01 13 00.

01 13 00-001B indicates the second version of submittal number 001 for Specification Section 01 13 00.

01 13 00-002A indicates the initial version of submittal number 002 for Specification Section 01 13 00.

2. When a document(s) is resubmitted for any reason, use a new Submittal Transmittal Form with the same submittal number and a new, sequential alphabetic suffix.

F. Resubmittal Preparation:

1. Comply with the requirements described in the Submittal Preparation subsection above. In addition:
  - a. Identify on the Submittal Transmittal Form that submittal is a resubmission.

- b. Make and clearly identify any corrections or changes required by ENGINEER's notations on the previous, returned submittal.
- c. Respond to ENGINEER's notations:
  - (1) On the Submittal Transmittal Form or on a separate page(s) attached to the Submittal Transmittal Form, answer or acknowledge, in writing, all notations or questions indicated by ENGINEER on the ENGINEER's response to the previous submittal.
  - (2) Identify each response by the corresponding question or notation number established by ENGINEER.
  - (3) If CONTRACTOR does not respond to each notation or question, the ENGINEER will return the resubmission without action. Additional resubmittals will be required until the CONTRACTOR provides a written response to all of the ENGINEER's notations or questions.
- d. Indicate CONTRACTOR initiated revisions or variations:
  - (1) On the Submittal Transmittal Form identify variations or revisions from the previously reviewed submittal, other than those called for by ENGINEER.

#### G. Distribution

- 1. Manufacturer's Documents, Working Drawings, Product Data and Samples and Mock-ups:
  - a. After a submittal is stamped "Approved" (See Subsection 3.2), place the date of approval on five additional copies of the submittal and transmit to the ENGINEER together with one copy of a Submittal Transmittal Form indicating the submittal is a "Distribution of Approved Submittal". For Mockups, distribute a Submittal Transmittal Form only.  
  
After a submittal is stamped "Approved as Noted" (See Subsection 3.2), make the changes noted by ENGINEER and place the date of approval on five additional copies of the submittal and transmit to the ENGINEER together with one copy of a Submittal Transmittal Form indicating the submittal is a "Distribution of Approved as Noted Submittal".
  - b. If changes other than those marked by the ENGINEER are made, follow the requirements of Paragraph 3.1, F to obtain ENGINEER approval.

- c. Unless required elsewhere, provide distribution of "Approved" and "Approved as Noted" submittals to subcontractors, suppliers, governing authorities, and others as necessary for proper performance of the Work.
- d. Maintain one set of "Approved" and revised "Approved as Noted" submittals at the Project site, available for use by the ENGINEER and others.
- e. Maintain returned final set of samples at the Project site, in suitable condition and available for quality control comparisons throughout the course of performing the Work. Incorporate only undamaged samples into the Work, when permitted by the Contract Documents.

#### H. CONTRACTOR's Licensed Professional Submittals

- a. After a submittal is acknowledged by the ENGINEER (See Subsection 3.2,2), place the date of acknowledgement on five additional copies of the submittal and transmit to the ENGINEER together with one copy of a Submittal Transmittal Form indicating the submittal is a "Distribution of Acknowledged Submittal".
- b. Maintain one set of submittals at the Project site, available for use by the ENGINEER and others.

### 3.2 ENGINEER'S ACTIONS ON SUBMITTALS

#### A. General:

1. ENGINEER's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the requirements of the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole. ENGINEER's review or approval of any submittal does not authorize a change to the Contract Time or Price.
2. ENGINEER's review and approval of Action Submittals will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) nor to safety precautions or programs incident thereto. The review and approval of a separate item will not indicate approval of the assembly in which the item is a part.
3. ENGINEER will stamp each Action Submittal except Requests for Interpretation or Clarification with an appropriate action stamp.

B. ENGINEER's Action

1. Stamps:

a. Approved:

- (1) Where submittals are stamped "Approved", Work covered by submittal may proceed PROVIDED THE WORK COMPLIES WITH THE CONTRACT DOCUMENTS. Acceptance of Work will depend upon that compliance.

b. Approved As Noted:

- (1) When submittals are stamped "Approved as Noted", Work covered by submittal may proceed PROVIDED IT COMPLIES WITH ENGINEER'S NOTATIONS AND CORRECTIONS ON SUBMITTAL AND WITH THE CONTRACT DOCUMENTS. Acceptance of Work will depend on that compliance.

c. Revise and Resubmit:

- (1) When submittals are stamped "Revise and Resubmit" do not proceed with Work covered by submittal. Do not permit Work covered by submittal to be used at Project site or elsewhere where Work is in progress.
- (2) Revise submittal in accordance with ENGINEER's notations and corrections and resubmit in accordance with Subsection 3.1F of this Section.

2. Acknowledgements of Information Submittals

- a. When Information Submittals conform to the format requirements in the Contract Documents ENGINEER will acknowledge such submittals via a response transmittal.
- b. If an Information Submittal does not conform to the format requirements of the Contract Documents, ENGINEER will return the submittal with comments or questions. Do not proceed with Work covered by the submittal and do not permit Work covered by the submittal to be used at Project site or elsewhere where Work is in progress. Resubmit the Information Submittal until the ENGINEER acknowledges that the submittal conforms to the format required.

3.3 REPETITIVE REVIEWS

- A. Cost of Repetitive Reviews: Submittals will be reviewed no more than twice at the OWNER's expense. All subsequent reviews will be performed at times convenient

to the ENGINEER and at the CONTRACTOR's expense based on the ENGINEER's then prevailing rates including all direct and indirect costs and fees. Reimburse the OWNER for all such costs and fees invoiced to the OWNER by the ENGINEER for third and subsequent submittals.

- B. Time Extension: Any need for more than one resubmission, or any other delay in ENGINEER's review of submittals, will not entitle CONTRACTOR to an extension of the Contract Time.

3.4 EXAMPLE FORMAT FOR CONTRACTOR'S APPROVAL AND CERTIFICATION STAMP

- A. An example format for the CONTRACTOR's approval and certification stamp is as follows:

<i>CONTRACTOR'S NAME</i>
_____ Approved and Certified to comply with the Contract Documents.
_____ Approved and Certified to comply with the Contract Documents, except for variations specifically noted on the Submittal Transmittal Form and the associated documents.
PRINTED NAME: _____
TITLE: _____
SIGNATURE: _____
DATE: _____

3.5 CONTRACTOR'S SUBMITTAL TRANSMITTAL FORM

- A. The format for the CONTRACTOR's Submittal Transmittal Form is as follows:

*CONTRACTOR'S NAME*  
**SUBMITTAL TRANSMITTAL FORM**  
*Project Name*

TO: \_\_\_\_\_ DATE: \_\_\_\_\_  
 ATTN: \_\_\_\_\_ SITE: \_\_\_\_\_  
 FROM: \_\_\_\_\_ SPEC. REF. NO. \_\_\_\_\_  
 DRAWING REF. NO. \_\_\_\_\_  
 SUBMITTAL NO. \_\_\_\_\_

1. The following documents are forwarded for your review:

No. of Repros/Copies	Document Originator	Description	Document No.	Date
/				
/				
/				
/				
/				
/				

2. Will item submitted for review fit in space provided in the Contract Documents? \_\_\_\_\_ Yes \_\_\_\_\_ No \_\_\_\_\_ Not Applicable

3. Has work indicated in this submittal been coordinated with all trades? \_\_\_\_\_ Yes \_\_\_\_\_ No \_\_\_\_\_ Not Applicable

4. Has the Contractor approved submittal and affixed completed approval and certification stamp? \_\_\_\_\_ Yes \_\_\_\_\_ No

5. Contractor's description and justification for variations from the Contract Documents. (Use additional pages, if necessary)

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

6. Remarks: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Printed Name: \_\_\_\_\_

Signature: \_\_\_\_\_

END OF SECTION

## SECTION 01 35 53

### SITE SECURITY

#### PART 1 GENERAL

##### 1.1 SECURITY PROGRAM

###### A. The CONTRACTOR shall:

1. Protect WORK, existing premises, and OWNER'S operations from theft, vandalism, and unauthorized entry following the Contractor's Site Security program.
2. Maintain a secure work site perimeter that maintains the integrity of the Water Plant perimeter security.
3. Monitor access of all Contractor personnel and visitors to the work site and account for all personnel and visitors at all times.
4. Initiate program in coordination with OWNER'S existing security system at mobilization.
5. Maintain program throughout construction period until OWNER'S occupancy.

##### 1.2 IDENTIFICATION

- A. All of Contractor's employees, all tiers of subcontractor's staff, manufacturer's representatives, technicians, delivery drivers, and all other people associated with the Work that are to enter the Owner's property are required to possess and carry a valid and current Driver's License, Identification Card (issued by the Department of Motor Vehicles), or current driver's license from another State in the United States. This identification must include a photograph and signature of the holder and shall be presented to Owner staff upon request. Personnel without such identification will be denied access.
- B. All Contractor personnel that enter water plant property for work shall comply with the following items.
  1. At least 3 days in advance of accessing water plant property, the Contractor shall submit to the Engineer for approval a list of all Contractors' staff, all tiers of subcontractor's staff, manufacturer's representatives, technicians, and all other personnel intended to work at the site. The list shall include the name, employer (Contractor and subcontractor), and work phone number of

each. Upon approval by the Engineer, the Engineer will provide the Contractor with the City of Evanston hard- hat stickers for distribution.

2. The Engineer will provide City of Evanston hard-hat stickers for use by Contractor's staff, all tiers of subcontractor's staff, manufacturer's representatives, technicians, and all other personnel employed at the site.
  3. Planned occasional site access – The Contractor shall plan all occasional visits to the site. The Contractor shall notify the Engineer of the name and company of the temporary worker or visitor at least 24 hours in advance of each visit. After sign-in, the Engineer will issue a hard hat sticker to the temporary worker or visitor.
  4. Emergency (unplanned) occasional site access – For emergency access as determined by Contractor and approved by the Engineer, the Contractor's designee shall verify the identity of the temporary worker or visitor to the Engineer. After sign- in, the Engineer will issue a hard hat sticker to the temporary worker or visitor.
  5. The Engineer shall provide and issue City of Evanston hard hat stickers to all temporary workers and visitors as listed above on a daily basis. Returning personnel may retain possession of hard hat stickers. Contractor shall ensure that all Contractors' employees and all other workers display City of Evanston hard hat sticker in plain view at all times while on site. Any Contractor employee or worker who does not display a City of Evanston hard hat sticker while on site shall be required to leave the site or will be denied access until such time as they have an approved City of Evanston hard hat sticker.
  6. Contractor shall keep a written record of the name, employer and work telephone number of each person issued a City of Evanston hard hat sticker.
  7. All hard hat stickers shall be removed at the completion of the work.
- C. Contractor shall submit to the Engineer vehicle information (make, model, color, license plate identification) for all vehicles used by Contractor and subcontractor staff that will be parked at the project site. Vehicles not included on the list provided to the Engineer in advance of parking may be subject to towing at the vehicle-owner's expense.

### 1.3 ENTRY CONTROL

A. The CONTRACTOR shall:

1. Restrict entry of persons and vehicles into Site and existing facilities.
2. Allow entry only to authorized persons with proper identification.

3. Maintain log of workmen and visitors and make log available to OWNER on request.
  4. Coordinate access of OWNER'S personnel to Site in coordination with OWNER'S security.
- B. The OWNER will control the entrance of persons and vehicles to those related to the OWNER'S operations.
- C. Contractor shall utilize, maintain, and secure the gate on the Lincoln Street curve and the associated Contractors Staging Area.. The contractor shall maintain a flagger to monitor the entrance at the construction gate to direct traffic and pedestrians whenever the construction gate is open. The construction gate is to be closed at all times when it is not in active use. Contractor shall close and lock gate at the end of all working days.
- D. Contractor's access to the work site:
1. Contractor's access to the work site for personnel, materials, and equipment shall be through the double leaf gate on the north end of the Contractor's Staging Area, with passage to the primary work area along the designated Contractor Path.
  2. The gate between the Contractor's Staging Area and the Water Plant must remain locked at all times when it is not in active use.
  3. Access for each individual entering the water plant through the gate must be strictly monitored by the Contractor. Only personnel with City of Evanston hard hat stickers will be permitted to enter any work area or water plant property.
  4. All Contractor personnel must sign in and out of the water plant whenever passing through the gate. Sign-in must be legible and include first name, last name, employer name, time in, and time out.
  5. Any worker that enters the water plant without signing in, proper identification, and a City of Evanston hard hat sticker will be immediately removed from the premises and not allowed back on site.
  6. Access to the work site within the water plant gated perimeter is only allowed Monday through Friday, except for holidays, during normal working hours, unless otherwise authorized in advance by the owner.
  7. Access into the water plant through the main Water Plant Lincoln Street gate shall be prohibited to contractor vehicles unless other wise approved by the ENGINEER and OWNER in writing. Gate clearance is 12'-0''.

- E. The contractor shall maintain a flagger to monitor the gate to direct traffic and pedestrians whenever if prior approval has been granted to utilize the Lincoln Street Gate.

#### 1.4 DELIVERIES TO THE WATER PLANT SITE

- A. United States Postal Service, Federal Express, UPS or similar mail and small parcel deliveries may be addressed to the Contractor or any subcontractor or supplier for drop off at the Construction Site or Construction Trailer. No items shall be delivered to the Water Treatment Plant.
- B. Deliveries of freight and bulk (larger packages, crates, equipment, or materials) are not permitted to enter the water plant grounds through the water plant gate. All deliveries shall be made at the Contractor's gate.
- C. No deliveries will be accepted by water plant staff.

#### 1.5 PRODUCTIVITY LOST FOR NON-COMPLIANCE WITH SECURITY MEASURES

- A. Costs incurred by the Contractor due to non-compliance with security measures (e.g., deliveries to the water plant, refusal of package deliveries, etc.) shall not be cause for additional Contract Time or additional compensation for the Contractor.
- B. The Contractor shall anticipate additional time and costs for employee arrivals, deliveries, and departures to and from the site.
- C. Failure to comply with these security measures may lead to stop of work with no additional Contract Time or additional compensation granted to the Contractor.

#### 1.6 RESTRICTIONS

- A. The CONTRACTOR shall not allow cameras on water plant property outside of the Contractor's primary work areaperimeter or photographs taken except by written approval of OWNER.

### PART 2 PRODUCTS

Not Used

### PART 3 EXECUTION

Not Used

END OF SECTION

## SECTION 01 42 00

### REFERENCES

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Reference Abbreviations
- B. Abbreviations
- C. Reference Standards
- D. Definitions

##### 1.2 RELATED SECTIONS

- A. Information provided in this section is used where applicable in individual Specification Sections, Divisions 01 through 32.

##### 1.3 REFERENCE ABBREVIATIONS

- A. Reference to a technical society, trade association or standards setting organization, may be made in the Specifications by abbreviations in accordance with the following list:

AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ACI	American Concrete Institute
ADC	Air Diffusion Council
AFBMA	Anti-friction Bearing Manufacturers Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	Association of Home Appliance Manufacturers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
APA	American Plywood Association
ARI	American Refrigeration Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers

ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWI	Architectural Woodwork Institute
AWPA	American Wood Preservers Association
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders' Hardware Manufacturers Association
BIA	Brick Institute of American
CABO	Council of American Building Officials
CAGI	Compressed Air and Gas Institute
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers Association of America
CRD	U.S. Corps of Engineers Specifications
CRSI	Concrete Reinforcing Steel Institute
CTI	Cooling Tower Institute
DHI	Door and Hardware Institute
DOH	Department of Health
DOT	Department of Transportation
FCC	Federal Communications Commission
Fed. Spec.	Federal Specifications
FGMA	Flat Glass Marketing Association
FM	Factory Mutual
HMI	Hoist Manufacturing Institute
HPMA	See HPVA
HPVA	Hardwood Plywood Veneer Association
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
IFI	Industrial Fasteners Institute
ISO	International Standards Organization
MIL	Military Specifications
MSS	Manufacturer's Standardization Society
NAAMM	National Association of Architectural Metal Manufacturers
NACM	National Association of Chain Manufacturers
NBS	National Bureau of Standards, See NIST
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NETA	National Electrical Testing Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NFPA	National Fluid Power Association
NIST	National Institute of Standards and Technology
NLMA	National Lumber Manufacturers Association
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Act
PCI	Prestressed Concrete Institute
PDI	Plumbing and Drainage Institute
SAE	Society of Automotive Engineers

SCPRF	Structural Clay Products Research Foundation
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SPI	Society of the Plastics Industry
SSPC	Steel Structures Painting Council
STI	Steel Tank Institute
TCA	Tile Council of American
TIMA	Thermal Insulation Manufacturers' Association
UL	Underwriters' Laboratories, Inc.
USBR	U. S. Bureau of Reclamation
USBS	U. S. Bureau of Standards, See NIST

#### 1.4 ABBREVIATIONS

- A. Abbreviations which may be used in individual Specification Sections Divisions 01 through 32 are as follows:

alternating current..... ac  
 American wire gauge.....AWG  
 ampere(s).....amp  
 ampere-hour(s) ..... AH  
 annual .....ann  
 Ampere Interrupting  
   Capacity.....AIC  
 atmosphere(s) .....atm  
 average.....avg  
  
 biochemical oxygen demand .....BOD  
 Board Foot ..... FBM  
 brake horsepower .....bhp  
 Brinell Hardness ..... BH  
 British thermal unit(s).....Btu  
  
 calorie (s) .....cal  
 carbonaceous biochemical  
   oxygen demand ..... CBOD  
 Celsius (centigrade)..... C  
 Center to Center ..... C to C  
 centimeter(s)..... cm  
 chemical oxygen demand.....COD  
 coefficient, valve flow ..... C<sub>v</sub>  
 condensate return .....CR  
 cubic ..... cu  
 cubic centimeter(s).....cc  
 cubic feet per day .....cfd  
 cubic feet per hour.....cfh  
 cubic feet per minute.....cfm  
 cubic feet per minute,  
   standard conditions ..... scfm  
 cubic feet per second .....cfs  
 cubic foot (feet).....cu ft  
 cubic inch(es) .....cu in  
 cubic yard(s) .....cu yd  
  
 decibels .....dB  
 decibels (A scale).....dBa  
 degree(s) .....deg  
 dewpoint temperature.....dpt  
 diameter .....dia  
 direct current.....dc  
 dissolved oxygen .....DO  
 dissolved solids .....DS  
 dry-bulb temperature.....dbt  
  
 efficiency .....eff

elevation ..... el  
 entering water temperature .....ewt  
 entering air temperature.....eat  
 equivalent direct radiation.....edr  
  
 face area ..... fa  
 face to face.....f to f  
 Fahrenheit..... F  
 feet per day.....fpd  
 feet per hour .....fph  
 feet per minute .....fpm  
 feet per second.....fps  
 foot (feet) .....ft  
 foot-candle.....fc  
 foot-pound .....ft-lb  
 foot-pounds per minute .....ft-lb/min  
 foot-pounds per second .....ft-lb/sec  
 formazin turbidity unit(s).....FTU  
 frequency .....freq  
 fuel oil .....FO  
 fuel oil supply .....FOS  
 fuel oil return .....FOR  
  
 gallon(s).....gal  
 gallons per day .....gpd  
 gallons per day per  
   cubic foot .....gpd/cu ft  
 gallons per day per  
   square foot.....gpd/sq ft  
 gallons per hour..... gph  
 gallons per minute .....gpm  
 gallons per second.....gps  
 gas chromatography and  
   mass spectrometry .....GC-MS  
 gauge.....ga  
 grain(s) .....gr  
 gram(s) .....g  
 grams per cubic centimeter.....gm/cc  
  
 Heat Transfer Coefficient.....U  
 height.....hgt  
 Hertz ..... Hz  
 horsepower ..... hp  
 horsepower-hour .....hp-hr  
 hour(s) ..... hr  
 humidity, relative ..... rh  
 hydrogen ion concentration .....pH

inch(es).....	in	parts per billion.....	ppb
inches per second.....	ips	parts per million .....	ppm
inside diameter .....	ID	percent .....	pct
Jackson turbidity unit(s).....	JTU	phase (electrical) .....	ph
kelvin.....	K	pound(s).....	lb
kiloamperes .....	kA	pounds per cubic foot.....	pcf
kilogram(s) .....	kg	pounds per cubic foot	
kilometer(s) .....	km	per hour.....	pcf/hr
kilovar (kilovolt-amperes		pounds per day.....	lbs/day
reactive).....	kvar	pounds per day per	
kilovolt(s) .....	kV	cubic foot.....	lbs/day/cu ft
kilovolt-ampere(s) .....	kVA	pounds per day per	
kilowatt(s).....	kW	square foot .....	lbs/day/sq ft
kilowatt-hour(s) .....	kWh	pounds per square foot .....	psf
linear foot (feet).....	lin ft	pounds per square foot	
liter(s).....	L	per hour .....	psf/hr
megavolt-ampere(s) .....	MVA	pounds per square inch .....	psi
meter(s) .....	m	pounds per square inch	
micrograms per liter.....	ug/L	absolute .....	psia
miles per hour.....	mph	pounds per square inch	
milliampere(s) .....	mA	gauge.....	psig
milligram(s).....	mg	power factor .....	PF
milligrams per liter .....	mg/L	pressure drop or	
milliliter(s).....	mL	difference.....	dp
millimeter(s).....	mm	pressure, dynamic	
million gallons .....	MG	(velocity) .....	vp
million gallons per day.....	mgd	pressure, vapor .....	vp pr
millisecond(s) .....	ms	quart(s) .....	qt
millivolt(s).....	mV	Rankine.....	R
minute(s) .....	min	relative humidity .....	rh
mixed liquor suspended		resistance .....	res
solids .....	MLSS	return air .....	ra
nephelometric turbidity		revolution(s) .....	rev
unit .....	NTU	revolutions per minute .....	rpm
net positive suction head.....	NPSH	revolutions per second.....	rps
noise criteria .....	nc	root mean squared .....	rms
noise reduction coefficient.....	NRC	safety factor .....	sf
number.....	no	second(s) .....	sec
ounce(s) .....	oz	shading coefficient .....	SC
outside air .....	oa	sludge density index.....	SDI
outside diameter.....	OD	Sound Transmission	
		Coefficient.....	STC
		specific gravity .....	sp gr
		specific volume .....	Sp Vol

sp ht at constant pressure .....	Cp	
square .....	sq	yard(s).....yd
square centimeter(s).....	sq cm	year(s) .....
square foot (feet) .....	sq ft	
square inch (es) .....	sq in	
square meter(s) .....	sq m	
square yard(s).....	sq yd	
standard.....	std	
static pressure .....	st pr	
supply air.....	sa	
suspended solids .....	SS	
temperature.....	temp	
temperature difference .....	TD	
temperature entering.....	TE	
temperature leaving .....	TL	
thousand Btu per hour.....	Mbh	
thousand circular mils .....	kcmil	
thousand cubic feet .....	Mcf	
threshold limit value .....	TLV	
tons of refrigeration .....	tons	
torque.....	TRQ	
total dissolved solids.....	TDS	
total dynamic head .....	TDH	
total kjeldahl nitrogen .....	TKN	
total oxygen demand .....	TOD	
total pressure.....	TP	
total solids.....	TS	
total suspended solids.....	TSS	
total volatile solids.....	TVS	
vacuum.....	vac	
viscosity .....	visc	
volatile organic chemical .....	VOC	
volatile solids .....	VS	
volatile suspended solids.....	VSS	
volt(s).....	V	
volts-ampere(s) .....	VA	
volume .....	vol	
watt(s) .....	W	
watthour(s).....	Wh	
watt-hour demand .....	WHD	
watt-hour demand meter .....	WHDM	
week(s) .....	wk	
weight .....	wt	
wet-bulb .....	WB	
wet bulb temperature .....	WBT	

- B. Use ASME Y1.1-1989, "Abbreviations for use on Drawings and in Text" for abbreviations for units of measure not included herein in Paragraph 1.4.

## 1.5 REFERENCE STANDARDS

- A. Latest Edition: Construe references to furnishing materials or testing, which conform to the standards of a particular technical society, organization, or body, to mean the latest standard, code, or specification of that body, adopted and published as of the date of bidding this Contract. Standards referred to herein are made a part of these Specifications to the extent which is indicated or intended.
- B. Precedence: The duties and responsibilities of the OWNER, CONTRACTOR or ENGINEER, or any of their consultants, agents or employees are set forth in the Contract Documents, and are not changed or altered by any provision of any referenced standard specifications, manuals or code, whether such standard manual or code is or is not specifically incorporated by reference in the Contract Documents. Any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority, to undertake responsibility contrary to the powers of the ENGINEER as set forth in the Contract Documents cannot be assigned to the ENGINEER or any of the ENGINEER's consultants, agents or employees.

## 1.6 DEFINITIONS

- A. In these Contract Documents the words furnish, install and provide are defined as follows:
  - 1. Furnish (materials): to supply and deliver to the project ready for installation and in operable condition.
  - 2. Install (services or labor): to place in final position, complete, anchored, connected in operable condition.
  - 3. Provide: to furnish and install complete. Includes the supply of specified services. When neither furnish, install or provide is stated, provide is implied.

## PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 45 00  
QUALITY CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Inspection Services
- B. Inspection of Materials
- C. Quality Control
- D. Costs of Inspection
- E. Acceptance Tests
- F. Failure to Comply with Contract

1.2 RELATED SECTIONS

Related Work Specified in Other Sections Includes, But is Not Limited to, the Following

- A. Section 01 33 00 - Submittals: Specific Submittal Requirements

1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
- B. Certificate Submittals: Furnish the ENGINEER authoritative evidence in the form of Certificates of Manufacture that the materials and equipment to be used in the Work have been manufactured and tested in conformity with the Contract Documents. Include copies of the results of physical tests and chemical analyses, where necessary, that have been made directly on the product or on similar products of the manufacturer.

1.4 INSPECTION SERVICES

- A. OWNER's Access: At all times during the progress of the Work and until the date of final completion, afford the OWNER and ENGINEER every reasonable, safe, and proper facility for inspecting the Work at the site. The observation and inspection of any work will not relieve the CONTRACTOR of any obligations to perform proper and satisfactory work as specified. Replace work rejected due to

faulty design, inferior, or defective materials, poor workmanship, improper installation, excessive wear, or nonconformity with the requirements of the Contract Documents, with satisfactory work at no additional cost to the OWNER. Replace as directed, finished or unfinished work found not to be in strict accordance with the Contract, even though such work may have been previously approved and payment made therefor.

- B. Rejection: The OWNER and the OWNER's Authorized Representatives have the right to reject materials and workmanship which are defective or require correction. Promptly remove rejected work and materials from the site.
- C. Inferior Work Discoveries: Failure or neglect on the part of the OWNER or the OWNER's Authorized Representatives to condemn or reject bad or inferior work or materials does not imply an acceptance of such work or materials. Neither is it to be construed as barring the OWNER or the OWNER's Authorized Representatives at any subsequent time from recovering damages or a sum of money needed to build anew all portions of the Work in which inferior work or improper materials were used.
- D. Removal for Examination: Should it be considered necessary or advisable by the OWNER or the OWNER's Authorized Representatives, at any time before final acceptance of the Work, to make examinations of portions of the Work already completed, by removing or tearing out such portions, promptly furnish all necessary facilities, labor, and material, to make such an examination. If such Work is found to be defective in any respect, defray all expenses of such examination and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the Contract, the cost of examination and restoration of the Work will be considered a change in the Work to be paid for in accordance with applicable provisions of the Contract.
- E. Operation Responsibility: Assume full responsibility for the proper operation of equipment during tests and instruction periods. Make no claim for damage which may occur to equipment prior to the time when the OWNER accepts the Work.
- F. Rejection Prior to Warranty Expiration: If at anytime prior to the expiration of any applicable warranties or guarantees, equipment is rejected by the OWNER, repay to the OWNER all sums of money received for the rejected equipment on progress certificates or otherwise on account of the Contract lump sum prices, and upon the receipt of the sum of money, OWNER will execute and deliver a bill of sale of all its rights, title, and interest in and to the rejected equipment. Do not remove the equipment from the premises of the OWNER until the OWNER obtains from other sources, equipment to take the place of that rejected. The OWNER hereby agrees to obtain other equipment within a reasonable time and the CONTRACTOR agrees that the OWNER may use the equipment furnished by the CONTRACTOR without rental or other charge until the other new equipment is obtained.

## 1.5 INSPECTION OF MATERIALS

- A. Premanufacture Notification: Give notice in writing to the ENGINEER sufficiently in advance of the commencement of manufacture or preparation of materials especially manufactured or prepared for use in or as part of the permanent construction. When required, notice to include a request for inspection, the date of commencement, and the expected date of completion of the manufacture or preparation of materials. Upon receipt of such notice, ENGINEER will arrange to have a representative present at such times during the manufacture or testing as may be necessary to inspect the materials, or will notify CONTRACTOR that the inspection will be made at a point other than the point of manufacture or testing, or that the inspection will be waived. Comply with these provisions before shipping any materials. Such inspection will not constitute a release from the responsibility for furnishing materials meeting the requirements of the Contract Documents.
  
- B. Testing Standards: Tests of electrical and mechanical equipment and appliances shall be conducted in accordance with recognized, applicable test codes except as may otherwise be stated herein.

## 1.6 QUALITY CONTROL

- A. Testing
  - 1. Field and Laboratory
    - a. Provide personnel to assist the ENGINEER in performing the following periodic observation and associated services.
      - (1) Soils: Observe and test excavations, placement and compaction of soils. Determine suitability of excavated material. Observe subgrade soils and foundations.
      - (2) Concrete: Observe forms and reinforcement; observe concrete placement; witness air entrainment tests, facilitate concrete cylinder preparation and assist with other tests performed by ENGINEER.
      - (3) Masonry: Sample and test mortar and grout; inspect brick and block samples and sample panels; inspect placement of reinforcement and grouting.
      - (4) Structural Steel: Verify that all welders are certified; visually inspect all structural steel welds; mechanically test high-tensile bolted connections.
    - b. When specified in Divisions 2 through 16 of the Contract Documents, provide an independent laboratory testing facility to perform required

testing. Qualify the laboratory as having performed previous satisfactory work. Prior to use, submit to the ENGINEER for approval.

- c. Cooperate with the ENGINEER and laboratory testing representatives. Provide at least 24 hours notice prior to when specified testing is required. Provide labor and materials, and necessary facilities at the site as required by the ENGINEER and the testing laboratory.
  - d. Provide an independent testing agency, a member of the National Electrical Testing Association, to perform inspections and tests specified in Division 16 of these Specifications.
2. Equipment: Coordinate and demonstrate test procedures as specified in the Contract Documents or as otherwise required during the formal tests.
  3. Pipeline and Other Testing: Conform to test procedures and requirements specified in the appropriate Specification Section.

#### B. Reports

1. Certified Test Reports: Where transcripts or certified test reports are required by the Contract Documents, meet the following requirements:
  - a. Before delivery of materials or equipment submit and obtain approval of the ENGINEER for all required transcripts, certified test reports, certified copies of the reports of all tests required in referenced specifications or specified in the Contract Documents. Perform all testing in an approved independent laboratory or the manufacturer's laboratory. Submit for approval reports of shop equipment tests within thirty days of testing. Transcripts or test reports are to be accompanied by a notarized certificate in the form of a letter from the manufacturer or supplier certifying that tested material or equipment meets the specified requirements and the same type, quality, manufacture and make as specified. The certificate shall be signed by an officer of the manufacturer or the manufacturer's plant manager.
2. Certificate of Compliance: At the option of the ENGINEER, or where not otherwise specified, submit for approval a notarized Certificate of Compliance. The Certificates may be in the form of a letter stating the following:
  - a. Manufacturer has performed all required tests
  - b. Materials to be supplied meet all test requirements

- c. Tests were performed not more than one year prior to submittal of the certificate
- d. Materials and equipment subjected to the tests are of the same quality, manufacture and make as those specified
- e. Identification of the materials

#### 1.7 COSTS OF INSPECTION

- A. OWNER's Obligation: Initial inspection and testing of concrete, mortar, grout, backfill and structural steel furnished under this Contract will be performed by the OWNER or his authorized Representatives or inspection bureaus without cost to the CONTRACTOR. If subsequent testing is necessary due to failure of the initial tests or because of rejection for noncompliance, reimburse the OWNER for expenditures incurred in making such tests.
- B. CONTRACTOR's Obligation: Include in the Contract Price, the cost of all shop and field tests of equipment and other tests required by the Contract Documents except those tests described above under "OWNER's Obligation". The OWNER may perform tests on any material or equipment furnished under this Contract at any time during the Contract. If tests performed by the OWNER result in failure or rejection for noncompliance, reimburse the OWNER for expenditures incurred in making such tests. Tests performed by the OWNER shall prevail in determining compliance with Contract requirements.
- C. Reimbursements to OWNER:
  - 1. Materials and equipment submitted by the CONTRACTOR as the equivalent to those specifically named in the Contract may be tested by the OWNER for compliance. Reimburse the OWNER for expenditures incurred in making such tests on materials and equipment which are rejected for noncompliance.
  - 2. Reimburse OWNER for the costs of any jobsite inspection between the hours of 7:00 p.m. and 6:00 a.m.
  - 3. Reimburse OWNER for all costs associated with Witness Tests which exceed 5 Calendar Days per kind of equipment.

#### 1.8 ACCEPTANCE TESTS

- A. Preliminary Field Tests: As soon as conditions permit, furnish all labor and materials and services to perform preliminary field tests of all equipment provided under this Contract. If the preliminary field tests disclose that any equipment furnished and installed under this Contract does not meet the requirements of the Contract Documents, make all changes, adjustments and replacements required prior to the acceptance tests.

- B. Final Field Tests: Upon completion of the Work and prior to final payment, subject all equipment, piping and appliances installed under this Contract to specified acceptance tests to demonstrate compliance with the Contract Documents.
1. Furnish all labor, fuel, energy, water and other materials, equipment, instruments and services necessary for all acceptance tests.
  2. Conduct field tests in the presence of the ENGINEER. Perform the field tests to demonstrate that under all conditions of operation each equipment item:
    - a. Has not been damaged by transportation or installation
    - b. Has been properly installed
    - c. Has been properly lubricated
    - d. Has no electrical or mechanical defects
    - e. Is in proper alignment
    - f. Has been properly connected
    - g. Is free of overheating of any parts
    - h. Is free of all objectionable vibration
    - i. Is free of overloading of any parts
    - j. Operates as intended
  3. Operate work or portions of work for a minimum of 100 hours or 14 days continuous service, whichever comes first. For those items of equipment which would normally operate on wastewater or sludge, plant effluent may be used if available when authorized by ENGINEER. If water can not properly exercise equipment, conduct 100-hour test after plant startup. Conduct test on those systems which require load produced by weather (heating or cooling) exercise only when weather will produce proper load.
- C. Failure of Tests: If the acceptance tests reveal defects in material or equipment, or if the material or equipment in any way fails to comply with the requirements of the Contract Documents, then promptly correct such deficiencies. Failure or refusal to correct the deficiencies, or if the improved materials or equipment, when tested again, fail to meet the guarantees or specified requirements, the OWNER, notwithstanding its partial payment for work and materials or equipment, may reject said materials or equipment and may order the CONTRACTOR to remove the defective work from the site at no addition to the Contract Price, and replace it with material or equipment which meets the Contract Documents.

#### 1.9 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.
- B. Delegated-Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

#### 1.10 FAILURE TO COMPLY WITH CONTRACT

- A. Unacceptable Materials: If it is ascertained by testing or inspection that the material or equipment does not comply with the Contract, do not deliver said material or equipment, or if delivered remove it promptly from the site or from the Work and replace it with acceptable material without additional cost to the OWNER. Fulfill all obligations under the terms and conditions of the Contract even though the OWNER or the OWNER's Authorized Representatives fail to ascertain noncompliance or notify the CONTRACTOR of noncompliance.

### PART 2 PRODUCTS

Not Used

### PART 3 EXECUTION

Not Used

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 01 50 00

### CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. General Requirements
- B. Temporary Utilities
- C. Temporary Construction
- D. Barricades and Enclosures
- E. Fences
- F. Security
- G. Temporary Controls
- H. Traffic Regulation
- I. Field Offices and Sheds
- J. Engineer's Field Office

##### 1.2 GENERAL REQUIREMENTS

- A. Plant and Facilities: Furnish, install, maintain and remove all false work, scaffolding, ladders, hoistways, braces, pumping plants, shields, trestles, roadways, sheeting, centering forms, barricades, drains, flumes, and the like, any of which may be needed in the construction of any part of the Work and which are not herein described or specified in detail. Accept responsibility for the safety and efficiency of such works and for any damage that may result from their failure or from their improper construction, maintenance or operation.
- B. First Aid: Maintain a readily accessible, completely equipped first aid kit at each location where work is in progress.
- C. Safety Responsibility: Accept sole responsibility for safety and security at the site. Indemnify and hold harmless the OWNER and the OWNER's Authorized Representatives, including Greeley and Hansen, for any safety violation, or noncompliance with governing bodies and their regulations, and for accidents,

deaths, injuries, or damage at the site during occupancy or partial occupancy of the site by CONTRACTOR's forces while performing any part of the Work.

- D. Hazard Communication: Furnish two copies of the CONTRACTOR's Hazard Communication Program required under OSHA regulations before beginning on site activities. Furnish two copies of amendments to Hazard Communications Program as they are prepared.

### 1.3 TEMPORARY UTILITIES

- A. Water: Provide all necessary and required water without additional cost, unless otherwise specified. If necessary, provide and lay water lines to the place of use; secure all necessary permits; pay for all taps to water mains and hydrants and for all water used at the established rates.
- B. Light and Power: Provide without additional cost to the OWNER temporary lighting and power facilities required for the proper construction and inspection of the Work. If, in the ENGINEER's opinion, these facilities are inadequate, do NOT proceed with any portion of the Work affected thereby. Maintain temporary lighting and power until the Work is accepted.
- C. Heat: Provide temporary heat, whenever required, for work being performed during cold weather to prevent freezing of concrete, water pipes, and other damage to the Work or existing facilities.
- D. Sanitary Facilities: Provide sufficient sanitary facilities for construction personnel. Prohibit and prevent nuisances on the site of the Work or on adjoining property. Discharge any employee who violates this rule. Abide by all environmental regulations or laws applicable to the Work.
- E. Connections to Existing Utilities:
  - 1. Unless otherwise specified or indicated, make all necessary connections to existing facilities including structures, drain lines, and utilities such as water, sewer, gas, telephone, and electricity. In each case, obtain permission from the OWNER or the owning utility prior to undertaking connections. Protect facilities against deleterious substances and damage.
  - 2. Thoroughly plan in advance all connections to existing facilities. Have on hand at the time of undertaking the connections, all material, labor and required equipment. Proceed continuously to complete connections in minimum time. Arrange for the operation of valves or other appurtenances on existing utilities, under the direct supervision of the owning utility.

### 1.4 TEMPORARY CONSTRUCTION

- A. Bridges: Design and place suitable temporary bridges where necessary for the maintenance of vehicular and pedestrian traffic. Assume responsibility for the

sufficiency and safety of all such temporary work or bridges and for any damage which may result from their failure or their improper construction, maintenance, or operation. Indemnify and save harmless the OWNER and the OWNER's representatives, including Greeley and Hansen, from all claims, suits or actions, and damages or costs of every description arising by reason of failure to comply with the above provisions.

## 1.5 BARRICADES AND ENCLOSURES

- A. Protection of Workmen and Public: Effect and maintain at all times during the prosecution of the Work, barriers and lights necessary for the protection of Workmen and the Public. Provide suitable barricades, lights, "danger" or "caution" or "street closed" signs and watchmen at all places where the Work causes obstructions to normal traffic, excavation sites, or constitutes in any way a hazard to the public.
- B. Barricades and Lights:
  - 1. Protect all streets, roads, highways, excavations and other public thoroughfares which are closed to traffic; use effective barricades which display acceptable warning signs. Locate barricades at the nearest public highway or street on each side of the blocked section.
  - 2. Statutory Requirements: Install and maintain all barricades, signs, lights, and other protective devices within highway rights-of-way in strict conformity with applicable statutory requirements by the authority having jurisdiction.

## 1.6 FENCES

- A. Existing Fences: Obtain written permission from the OWNER prior to relocating or dismantling fences which interfere with construction operations. Reach agreements with the fence owner as to the period the fence may be left relocated or dismantled. Install adequate gates where fencing must be maintained. Keep gates closed and locked at all times when not in use.
- B. Restoration: Restore all fences to their original or better condition and to their original location on completion of the Work.

## 1.7 SECURITY

- A. Preservation of Property:
  - 1. Preserve from damage, all property along the line of the Work, in the vicinity of or in any way affected by the Work, the removal or destruction of which is not called for by the Drawings. Preserve from damage, public utilities, trees, lawn areas, building monuments, fences, pipe and underground structures, and public streets. Note: Normal wear and tear of

streets resulting from legitimate use by the CONTRACTOR are not considered as damage. Whenever damages occur to such property, immediately restore to its original condition. Costs for such repairs are incidental to the Contract.

2. In case of failure on the part of the CONTRACTOR to restore property or make good on damage or injury, the OWNER may, upon 24 hours written notice, proceed to repair, rebuild, or otherwise restore such property as may be deemed necessary, and the cost thereof will be deducted from any moneys due or which may become due the CONTRACTOR under this Contract. If removal, repair or replacement of public or private property is made necessary by alteration of grade or alignment authorized by the OWNER and not contemplated by the Contract Documents, the CONTRACTOR will be compensated, in accordance with the General Conditions, provided that such property has not been damaged through fault of the CONTRACTOR or the CONTRACTOR's employees.

B. Public Utility Installations and Structures:

1. Public utility installations and structures include all poles, tracks, pipes, wires, conduits, vaults, manholes, and other appurtenances and facilities, whether owned or controlled by public bodies or privately owned individuals, firms or corporations, used to serve the public with transportation, gas, electricity, telephone, storm and sanitary sewers, water, or other public or private utility services. Facilities appurtenant to public or private property which may be affected by the Work are deemed included hereunder.
2. The Contract Documents contain data relative to existing public utility installations and structures above and below the ground surface. Existing public utility installations and structures are indicated on the Drawings only to the extent such information was made available to, or found by, the ENGINEER in preparing the Drawings. These data are not guaranteed for completeness or accuracy, and the CONTRACTOR is responsible for making necessary investigations to become fully informed as to the character, condition, and extent of all public utility installations and structures that may be encountered and that may affect the construction operations.
3. Contact utility locating service sufficiently in advance of the start of construction to avoid damage to the utilities and delays to the completion date.
4. Remove, replace, relocate, repair, rebuild, and secure any public utility installations and structures damaged as a direct or indirect result of the Work under this Contract. Costs for such work are incidental to the Contract. Be responsible and liable for any consequential damages done to or suffered by any public utility installations or structures. Assume and accept

responsibility for any injury, damage, or loss which may result from or be consequent to interference with, or interruption or discontinuance of, any public utility service.

5. Repair or replace any water, electric, sewer, gas, or other service connection damaged during the Work with no addition to the Contract price.
  6. At all times in performance of the Work, employ proven methods and exercise reasonable care and skill to avoid unnecessary delay, injury, damage, or destruction to public utility installations and structures. Avoid unnecessary interference with, or interruption of, public utility services. Cooperate fully with the owners thereof to that end.
  7. Give written notice to the owners of all public utility installations and structures affected by proposed construction operations, sufficiently in advance of breaking ground in any area or on any unit of the Work, to obtain their permission before disrupting the lines and to allow them to take measures necessary to protect their interests. Advise the Chiefs of Police, Fire and Rescue Services of any excavation in public streets or the temporary shut-off of any water main. Provide at least 24 hours notice to all affected property owners whenever service connections are taken out of service.
- C. Miscellaneous Structures: Assume and accept responsibility for all injuries or damage to culverts, building foundations and walls, retaining walls, or other structures of any kind met with during the prosecution of the Work. Assume and accept liability for damages to public or private property resulting therefrom. Adequately protect against freezing all pipes carrying liquid.
- D. Protection of Trees and Lawn Areas:
1. Protect with boxes, trees and shrubs, except those ordered to be removed. Do not place excavated material so as to cause injury to such trees or shrubs. Replace trees or shrubs destroyed by accident or negligence of the CONTRACTOR or CONTRACTOR's employees with new stock of similar size and age, at the proper season, at no additional cost to the OWNER.
  2. Leave all existing lawn areas in as good condition as before the start of the Work. Restore all existing lawn areas damaged, removed or destroyed during the Work and that are to remain lawn areas by seeding or sodding.

## 1.8 TEMPORARY CONTROLS

### A. During Construction:

1. Keep the site of the Work and adjacent premises free from construction materials, debris, and rubbish. Remove this material from any portion of the

site if such material, debris, or rubbish constitutes a nuisance or is objectionable.

2. Remove from the site all surplus materials and temporary structures when they are no longer needed.
3. Neatly stack construction materials such as concrete forms and scaffolding when not in use. Promptly remove splattered concrete, asphalt, oil, paint, corrosive liquids, and cleaning solutions from surfaces to prevent marring or other damage.
4. Properly store volatile wastes in covered metal containers and remove from the site daily.
5. Do not bury or burn on the site or dispose of into storm drains, sanitary sewers, streams, or waterways, any waste material. Remove all wastes from the site and dispose of in a manner complying with applicable ordinances and laws.

B. Smoke Prevention:

1. Strictly observe all air pollution control regulations.
2. Open fires will be allowed only if permitted under current ordinances.

C. Noises:

1. Maintain acceptable noise levels in the vicinity of the Work. Limit noise production to acceptable levels by using special mufflers, barriers, enclosures, equipment positioning, and other approved methods.
2. Supply written notification to the OWNER sufficiently in advance of the start of any work which violates this provision. Proceed only when all applicable authorizations and variances have been obtained in writing.

D. Hours of Operation:

1. Operation of construction equipment between the hours of 7:00 p.m. and 6:00 a.m. the following day is prohibited. For operation of this equipment during this period obtain written consent from the OWNER.
2. Do not carry out nonemergency work, including equipment moves, on Sundays without prior written authorization by the OWNER.

- E. Dust Control:
1. Take measures to prevent unnecessary dust. Keep earth surfaces exposed to dusting moist with water or a chemical dust suppressant. Cover materials in piles or while in transit to prevent blowing or spreading dust.
  2. Adequately protect buildings or operating facilities which may be affected adversely by dust. Protect machinery, motors, instrument panels, or similar equipment by suitable dust screens. Include proper ventilation with dust screens.
- F. Temporary Drainage Provisions:
1. Provide for the drainage of stormwater and any water applied or discharged on the site in performance of the Work. Provide adequate drainage facilities to prevent damage to the Work, the site, and adjacent property.
  2. Supplement existing drainage channels and conduits as necessary to carry all increased runoff from construction operations. Construct dikes as necessary to divert increased runoff from entering adjacent property (except in natural channels), to protect the OWNER's facilities and the Work, and to direct water to drainage channels or conduits. Provide ponding as necessary to prevent downstream flooding.
  3. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- G. Erosion Control: Provide erosion control in accordance with Section 31 25 00 - Erosion Control.
- H. Pollution: Prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris, and other substances resulting from construction activities. Do not permit sanitary wastes to enter any drain or watercourse other than sanitary sewers. Do not permit sediment, debris, or other substances to enter sanitary sewers. Take reasonable measures to prevent such materials from entering any drain or watercourse.

## 1.9 TRAFFIC REGULATION

- A. Parking: Provide and maintain suitable parking areas for the use of all construction workers and others performing work or furnishing services in connection with the Contract, to avoid any need for parking personal vehicles where they may interfere with public traffic or construction activities.
- B. Access: Conduct Work to interfere as little as possible with public travel, whether vehicular or pedestrian. Provide and maintain suitable and safe bridges, detours, or other temporary expedients for the accommodation of public and private travel. Whenever it is necessary to cross, obstruct, or close roads, driveways, and walks,

whether public or private, give reasonable notice to owners of private drives before interfering with them. Such maintenance of traffic will not be required when the CONTRACTOR has obtained permission from the owner or tenant of private property, or from the authority having jurisdiction over the public property involved, to obstruct traffic at the designated point.

#### 1.10 FIELD OFFICES AND SHEDS

- A. CONTRACTOR's Office: Erect, furnish, and maintain a field office with a telephone. Have an authorized agent present at this office at all times while the Work is in progress. Keep readily accessible copies of the Contract Documents, required record documents, and the latest approved shop drawings at this field office.
- B. Material Sheds and Temporary Structures: Provide material sheds and other temporary structures of sturdy construction and neat appearance.
- C. Location: Coordinate location of field offices, material sheds and temporary structures with ENGINEER and OWNER.

#### 1.11 ENGINEER'S FIELD OFFICE

- A. General: Provide and maintain an ENGINEER'S field office trailer, together with all foundations, steps, landings, handrails, furniture, office equipment, computer equipment, utilities and all other appurtenances required for a complete and functional installation. Provide the ENGINEER'S trailer at the project site for the duration of the construction project. CONTRACTOR will maintain this space. Specifically, janitorial services and supplies; phone if not through the internet; office supplies; bottled water; parking, snow removal; security, sanitary services if no sewer connection. Coordinate the location of the ENGINEER'S trailer with the OWNER. Make the completed field office trailer available for occupancy by the ENGINEER no later than the first day that the CONTRACTOR is on site to begin other construction activities.
- B. Type and Size: Provide a new mobile, tandem-axle field office trailer of not less than 48-foot exterior body length and 12-foot exterior body width.
- C. Arrangement: Arrange trailer's floor plan to provide two offices (one office at each end of the trailer,) sized at 11'-0" x 13'-0" and 11'-0" x 10'-0", one washroom, one 4'-0" x 5'-0" storage room and the remainder of the open area in the center of the trailer. Provide a night light over each outside door. Provide privacy locks on the interior door for the washroom and passage locks for all other doors. Provide each window with an operable sash, screen and venetian blinds. Provide an electric furnace with 2-ton air conditioner complete with heating/cooling thermostat. Provide ductwork and regulator type grills in each room. Provide 100 ampere, 120/240 volt electrical service. Provide complete internal connections for single exterior water supply and single exterior sanitary sewer. Provide an electric water heater with 17 gallon minimum capacity. Provide one bottled water cooler

with hot and cold taps and refrigerated storage compartment of approximately one cubic foot capacity. Provide one small refrigerator with freezer. Provide ten gallons of bottled water per week. Provide washroom with lavatory, water closet, cabinet with mirror, toilet tissue holder, paper towel dispenser, wastebasket and an electrical outlet at the lavatory. Provide one fully-equipped standard first-aid cabinet. Provide a stock of paper towels and toilet paper throughout the construction period.

Provide a security alarm system that utilizes motion detection to monitor all windows and doors. Provide a battery back up for the security alarm system.

Have the field office suitably blocked or otherwise installed in accordance with local ordinances. Enclose the air space beneath the trailer with exterior grade plywood panel siding. Provide hinged access doors at utility connection area.

D. Furnishings: Provide the following:

- Two 30-inch by 60-inch flattop desks with drawers
- Two swivel office chairs
- Eight straight-back office chairs
- One conference table
- Three four-drawer, legal-size, steel filing cabinets with locks and keys
- Two plan racks with aluminum plan holders
- Four wastebaskets
- One desktop computer
- Two printers
- One fax machine
- One copier
- One power surge protector for all electronic equipment
- One digital camera
- One software package – preloaded into computer and fully operational

E. Utility Connections: Connect the water and sanitary sewer to existing lines.

Arrange for the local power company to provide separate, complete and metered electrical service to the field office. Provide a suitable meter installation as approved. Connect the electrical service to the trailer to provide a complete operating installation. Pay each monthly power cost for the ENGINEER'S field office.

Arrange with the local telephone company to provide four incoming telephone lines for the field office. Provide two lines for telephone, one line for a fax machine and one line for the desktop computer. Provide two telephones. Pay each monthly telephone charge.

Arrange with the local internet service provider to provide either DSL or cable modem service to the field office. Pay each monthly internet connection charge.

- F. Final Ownership: At the completion of construction, the computer equipment will become the property of the OWNER. The trailer and all other furnishings shall remain the property of the CONTRACTOR.

G.

## PART 2 PRODUCTS

Not Used

## PART 3 EXECUTION

Not Used

END OF SECTION

## SECTION 01 60 00

### MATERIAL AND EQUIPMENT

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Description
- B. Substitutions
- C. Manufacturer's Written Instructions
- D. Transportation and Handling
- E. Storage, Protection and Maintenance
- F. Manufacturer's Field Quality Control Services
- G. Post Startup Services
- H. Special Tools and Lubricating Equipment
- I. Lubrication

##### 1.2 DESCRIPTION

- A. Proposed Manufacturers List: Within 15 calendar days of the date of the Notice to Proceed, submit to the ENGINEER a list of the names of proposed manufacturers, materialmen, suppliers and subcontractors, obtain approval of this list by OWNER prior to submission of any shop drawings. Upon request submit evidence to ENGINEER that each proposed manufacturer has manufactured a similar product to the one specified and that it has previously been used for a like purpose for a sufficient length of time to demonstrate its satisfactory performance.
- B. Furnish and install Material and Equipment which meets the following:
  - 1. Conforms to applicable specifications and standards.
  - 2. Complies with size, make, type, and quality specified or as specifically approved, in writing, by ENGINEER.
  - 3. Will fit into the space provided with sufficient room for operation and maintenance access and for properly connecting piping, ducts and services, as applicable. Make the clear spaces that will be available for operation and maintenance access and connections equal to or greater than those shown

and meeting all the manufacturers' requirements. Make all provisions for installing equipment furnished at no increase in Contract Price.

4. Manufactured and fabricated in accordance with the following:
  - a. Design, fabricate, and assemble in accordance with best engineering and shop practices.
  - b. Manufacture like parts of duplicate units to standard sizes and gauges, to be interchangeable.
  - c. Provide two or more items of same kind identical, by same manufacturer.
  - d. Provide materials and equipment suitable for service conditions.
  - e. Adhere to equipment capabilities, sizes, and dimensions shown or specified unless variations are specifically approved, in writing, in accordance with the Contract Documents.
  - f. Adapt equipment to best economy in power consumption and maintenance. Proportion parts and components for stresses that may occur during continuous or intermittent operation, and for any additional stresses that may occur during fabrication or installation.
  - g. Working parts are readily accessible for inspection and repair, easily duplicated and replaced.
5. Use material or equipment only for the purpose for which it is designed or specified.

### 1.3 SUBSTITUTIONS

#### A. Substitutions:

1. CONTRACTOR'S requests for changes in equipment and materials from those required by the Contract Documents are considered requests for substitutions and are subject to CONTRACTOR'S representations and review provisions of the Contract Documents when one of following conditions are satisfied:
  - a. Where request is directly related to an "or equal" clause or other language of same effect in Specifications.
  - b. Where required equipment or material cannot be provided within Contract Time, but not as result of CONTRACTOR'S failure to pursue Work promptly or to coordinate various activities properly.

- c. Where required equipment or material cannot be provided in manner compatible with other materials of Work, or cannot be properly coordinated therewith.

2. CONTRACTOR'S Options:

- a. Where more than one choice is available as options for CONTRACTOR'S selection of equipment or material, select option compatible with other equipment and materials already selected (which may have been from among options for other equipment and materials).
- b. Where compliance with specified standard, code or regulation is required, select from among products which comply with requirements of those standards, codes, and regulations.
- c. "Or Equal": For equipment or materials specified by naming one or more equipment manufacturer and "or equal", submit request for substitution for any equipment or manufacturer not specifically named.

B. Conditions Which are Not Substitution:

- 1. Requirements for substitutions do not apply to CONTRACTOR options on materials and equipment provided for in the Specifications.
- 2. Revisions to Contract Documents, where requested by OWNER or ENGINEER, are "changes" not "substitutions".
- 3. CONTRACTOR'S determination of and compliance with governing regulations and orders issued by governing authorities do not constitute substitutions and do not constitute basis for a Change Order, except as provided for in Contract Documents.

1.4 MANUFACTURER'S WRITTEN INSTRUCTIONS

- A. Instruction Distribution: When the Contract Documents require that installation, storage, maintenance and handling of equipment and materials comply with manufacturer's written instruction's, obtain and distribute printed copies of such instructions to parties involved in installation, including six copies to ENGINEER.
  - 1. Maintain one set of complete instructions at jobsite during storage and installation, and until completion of work.
- B. Manufacturer's Requirements: Store, maintain, handle, install, connect, clean, condition, and adjust products in accordance with manufacturer's written instructions and in conformity with Specifications.

1. Should job conditions or specified requirements conflict with manufacturer's instructions, consult ENGINEER for further instructions.
  2. Do not proceed with work without written instructions.
- C. Performance Procedures: Perform work in accordance with manufacturer's written instructions. Do not omit preparatory steps or installation procedures, unless specifically modified or exempted by Contract Documents.

#### 1.5 TRANSPORTATION AND HANDLING

- A. Coordination with Schedule: Arrange deliveries of materials and equipment in accordance with Construction Progress Schedules. Coordinate to avoid conflict with work and conditions at site.
1. Deliver materials and equipment in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.
  2. Protect bright machined surfaces, such as shafts and valve faces, with a heavy coat of grease prior to shipment.
  3. Immediately upon delivery, inspect shipments to determine compliance with requirements of Contract Documents and approved submittals and that material and equipment are protected and undamaged.
- B. Handling: Provide equipment and personnel to handle material and equipment by methods recommended by manufacturer to prevent soiling or damage to materials and equipment or packaging.

#### 1.6 STORAGE, PROTECTION, AND MAINTENANCE

- A. On-site storage areas and buildings:
1. Conform storage buildings to requirements of Section 01 50 00.
  2. Coordinate location of storage areas with ENGINEER and OWNER.
  3. Arrange on site storage areas for proper protection and segregation of stored materials and equipment with proper drainage. Provide for safe travel around storage areas and safe access to stored materials and equipment.
  4. Store loose granular materials in a well-drained area on solid surfaces to prevent mixing with foreign matter.
  5. Store materials such as pipe, reinforcing and structural steel, and equipment on pallets, blocks or racks, off ground.
  6. Store fabricated materials and equipment above ground, on blocking or skids, to prevent soiling or staining. Cover materials and equipment which

are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.

- B. Interior Storage:
  - 1. Store materials and equipment in accordance with manufacturer's instructions, with seals and labels intact and legible.
  - 2. Store materials and equipment, subject to damage by elements, in weathertight enclosures.
  - 3. Maintain temperature and humidity within ranges required by manufacturer's instructions.
- C. Accessible Storage: Arrange storage in a manner to provide easy access for inspection and inventory. Make periodic inspections of stored materials or equipment to assure that materials or equipment are maintained under specified conditions and free from damage or deterioration.
  - 1. Perform maintenance on stored materials or equipment in accordance with manufacturer's instructions, in presence of OWNER or ENGINEER.
  - 2. Submit a report of completed maintenance to ENGINEER with each Application for Payment.
  - 3. Failure to perform maintenance, to notify ENGINEER of intent to perform maintenance or to submit maintenance report may result in rejection of material or equipment.
- D. OWNER'S Responsibility: OWNER assumes no responsibility for materials or equipment stored in buildings or on-site. CONTRACTOR assumes full responsibility for damage due to storage of materials or equipment.
- E. CONTRACTOR'S Responsibility: CONTRACTOR assumes full responsibility for protection of completed construction. Repair and restore damage to completed Work equal to its original condition.
- F. Special Equipment: Use only rubber tired wheelbarrows, buggies, trucks, or dollies to wheel loads over finished floors, regardless if the floor has been protected or not. This applies to finished floors and to exposed concrete floors as well as those covered with composition tile or other applied surfacing.
- G. Surface Damage: Where structural concrete is also the finished surface, take care to avoid marking or damaging surface.

## 1.7 MANUFACTURER'S FIELD QUALITY CONTROL SERVICES

### A. General:

1. Provide manufacturer's field services in accordance with this subsection for those tasks specified in other sections.
2. Provide training as specified in Section 01 79 00.
3. Include and pay all costs for suppliers' and manufacturers' services, including, but not limited to, those specified.

### B. Installation Instruction: Provide instruction by competent and experienced technical representatives of equipment manufacturers or system suppliers as necessary to resolve assembly or installation procedures which are attributable to, or associated with, the equipment furnished.

### C. Installation Inspection, Adjustments and Startup Participation:

1. Provide competent and experienced technical representatives of equipment manufacturers or system suppliers to inspect the completed installation as follows.
  - a. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or for other conditions which may cause damage.
  - b. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
  - c. Verify that wiring and support components for equipment are complete.
  - d. Verify that equipment or system is installed in accordance with the manufacturer's recommendations, approved shop drawings and the Contract Documents.
  - e. Verify that nothing in the installation voids any warranty.
2. Provide manufacturer's representatives to perform initial equipment and system adjustment and calibration conforming to the manufacturer's recommendations and instructions, approved shop drawings and the Contract Documents.
3. Obtain ENGINEER'S approval before start-up of equipment. Execute start-up under supervision of applicable manufacturer's representative in accordance with manufacturers' instructions.

4. Furnish ENGINEER with three copies of the following. When training is specified, furnish the copies at least 24 hours prior to training.
  - a. "Certificate of Installation, Inspection and Start-up Services" by manufacturers' representatives for each piece of equipment and each system specified, certifying:
    - (1) That equipment is installed in accordance with the manufacturers' recommendations, approved shop drawings and the Contract Documents.
    - (2) That nothing in the installation voids any warranty.
    - (3) That equipment has been operated in the presence of the manufacturer's representative.
    - (4) That equipment, as installed, is ready to be operated by others.
  - b. Detailed report by manufacturers' representatives, for review by ENGINEER of the installation, inspection and start-up services performed, including:
    - (1) Description of calibration and adjustments if made; if not in Operation and Maintenance Manuals, attach copy.
    - (2) Description of any parts replaced and why replaced.
    - (3) Type, brand name, and quantity of lubrication used, if any.
    - (4) General condition of equipment.
    - (5) Description of problems encountered, and corrective action taken.
    - (6) Any special instructions left with CONTRACTOR or ENGINEER.
- D. Field Test Participation: Provide competent and experienced technical representatives of all equipment manufacturers and system suppliers as necessary to participate in field testing of the equipment specified in Section 01 45 00.
- E. Trouble-Free Operation: Provide competent and experienced technical representatives of all equipment manufacturers and system suppliers as necessary to place the equipment in trouble-free operation after completion of start-up and field tests.

## 1.8 POST START-UP SERVICES

- A. General: Provide Post Start-up Services in accordance with this subsection for equipment specified in other sections.
- B. Site Visit: Provide the services of an authorized service representative for each equipment manufacturer or system supplier to make a final site visit after the equipment or system has been in operation for at least 6 months, but no longer than 11 months. Furnish assistance to OWNER's operating personnel in making adjustments and calibrations required to determine that the equipment and system is operating in conformance with design, manufacturer's, and specification requirements. Instruct the personnel in a review of proper operation and maintenance procedures.
- C. Certificate: Furnish "Certificate of Post Start-up Services" cosigned by ENGINEER and the manufacturer's representative, certifying that this service has been performed. Use form provided in this section, and furnish OWNER with three copies.

## 1.9 SPECIAL TOOLS AND LUBRICATING EQUIPMENT

- A. General: Furnish, per manufacturer's recommendations, special tools required for checking, testing, parts replacement, and maintenance. (Special tools are those which have been specially designed or adapted for use on parts of the equipment, and which are not customarily and routinely carried by maintenance mechanics.)
- B. Time of Delivery: Deliver special tools and lubricating equipment to OWNER when unit is placed into operation and after operating personnel have been properly instructed in operation, repair, and maintenance of equipment.
- C. Quality: Provide tools and lubricating equipment of a quality meeting equipment manufacturer's requirements.

## 1.10 LUBRICATION

- A. General: Where lubrication is required for proper operation of equipment, incorporate in the equipment the necessary and proper provisions in accordance with manufacturer's requirements. Where possible, make lubrication automated and positive.
- B. Oil Reservoirs: Where oil is used, supply reservoir of sufficient capacity to lubricate unit for a 24-hour period.

## PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

**CERTIFICATE OF INSTALLATION, INSPECTION AND START-UP SERVICES**

Project \_\_\_\_\_

Equipment \_\_\_\_\_

Specification Section \_\_\_\_\_

Contract \_\_\_\_\_

I hereby certify that the named equipment has been inspected, adjusted and operated by the Manufacturers' Representative and further certify:

1. That the equipment is installed in accordance with the manufacturer's recommendations, approved shop drawings and the Contract Documents.
2. That nothing in the installation voids any warranty.
3. That equipment has been operated in the presence of the manufacturer's representative.
4. That equipment, as installed, is ready to be operated by others.

**MANUFACTURERS' REPRESENTATIVE**

Signature \_\_\_\_\_ Date \_\_\_\_\_

Name (print) \_\_\_\_\_

Title \_\_\_\_\_

Representing \_\_\_\_\_

**CONTRACTOR**

Signature \_\_\_\_\_ Date \_\_\_\_\_

Name (print) \_\_\_\_\_

Title \_\_\_\_\_

Attach the detailed report called for by Specification Section 01 60 00.

Complete and submit three copies of this form with the detailed report to ENGINEER as specified.

**CERTIFICATE OF POST START-UP SERVICES**

Project \_\_\_\_\_

Equipment \_\_\_\_\_

Specification Section \_\_\_\_\_

Contract \_\_\_\_\_

I hereby certify the Manufacturers' Representative has inspected this equipment, made adjustments and calibrations, and that it is operating in conformance with the design, specifications, and manufacturer's requirements. Detailed notation of improper operation with corresponding recommendations, if any, are made and attached to this form.

**MANUFACTURERS' REPRESENTATIVE**

Signature \_\_\_\_\_ Date \_\_\_\_\_

Name (print) \_\_\_\_\_

Title \_\_\_\_\_

Representing \_\_\_\_\_

**CONTRACTOR**

Signature \_\_\_\_\_ Date \_\_\_\_\_

Name (print) \_\_\_\_\_

Title \_\_\_\_\_

**ENGINEER**

Signature \_\_\_\_\_ Date \_\_\_\_\_

Name (print) \_\_\_\_\_

Title \_\_\_\_\_

**COMMENTS:**

Complete and submit three copies of this form to OWNER upon completion of 6 to 11 months reinspection as required by Specification Section 01 60 00.

(NO TEXT FOR THIS PAGE)

SECTION 01 71 23  
LINES AND GRADES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General
- B. Surveys
- C. Datum Plane
- D. Protection of Survey Data

1.2 GENERAL

- A. Construct all work in accordance with the lines and grades shown on the Drawings. Assume full responsibility for keeping all alignment and grade.

1.3 SURVEYS

- A. Control Points: Base horizontal and vertical control points will be established or designated by the CONTRACTOR and approved by the ENGINEER and used as datum for the Work. Perform all additional survey, layout, and measurement work.
  - 1. Keep ENGINEER informed, sufficiently in advance, of the times and places at which work is to be performed so that base horizontal and vertical control points may be established and any checking deemed necessary by ENGINEER may be done, with minimum inconvenience to the ENGINEER and at no delay to CONTRACTOR. It is the intention not to impede the Work for the establishment of control points and the checking of lines and grades set by the CONTRACTOR. However, when necessary, suspend working operations for such reasonable time as the ENGINEER may require for this purpose. Costs associated with such suspension are deemed to be included in the Contract Price, and no time extension or additional costs will be allowed.
  - 2. Provide an experienced survey crew including an instrument operator, competent assistants, and any instruments, tools, stakes, and other materials required to complete the survey, layout, and measurement of work performed by the CONTRACTOR.

1.4 DATUM PLANE

- A. All elevations indicated or specified refer to the Mean Sea Level Datum Plane, 1929 General Adjustment, of the United States Coast and Geodetic Survey and are expressed in feet and decimal parts thereof, or in feet and inches.

1.5 PROTECTION OF SURVEY DATA

- A. General: Safeguard all points, stakes, grade marks, known property corners, monuments, and bench marks made or established for the Work. Reestablish them if disturbed, and bear the entire expense of checking reestablished marks and rectifying work improperly installed.
- B. Records: Keep neat and legible notes of measurements and calculations made in connection with the layout of the Work. Furnish copies of such data to the ENGINEER for use in checking the CONTRACTOR's layout. Data considered of value to the OWNER will be transmitted to the OWNER by the ENGINEER with other records on completion of the Work.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

## SECTION 01 73 29

### CUTTING AND PATCHING

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. General Requirements
- B. Scheduling of Shutdown

##### 1.2 RELATED SECTIONS

Related Work Specified in Other Sections Includes, But is Not Limited to, the Following

- A. Section 01 11 00 - Summary of Work

##### 1.3 GENERAL REQUIREMENTS

- A. Coordination: Perform all cutting, fitting or patching of the Work that may be required to make the several parts thereof join in accordance with the Contract Documents. Perform restoration with competent workmen skilled in the trade.
- B. Improperly Timed Work: Perform all cutting and patching required to install improperly timed work, to remove samples of installed materials for testing, and to provide for alteration of existing facilities or for the installation of new Work in the existing construction.
- C. Limitations: Except when the cutting or removal of existing construction is specified or indicated, do not undertake any cutting or demolition which may affect the structural stability of the Work or existing facilities without the ENGINEER's concurrence.

##### 1.4 SCHEDULING OF SHUTDOWN

- A. Connections to Existing Facilities: If any connections, replacement, or other work requiring the shutdown of an existing facility is necessary, schedule such work at times when the impact on the OWNER's normal operation is minimal. Overtime, night and weekend work without additional compensation from the OWNER, may be required to make these connections, especially if the connections are made at times other than those specified.
- B. Request for Shutdowns: Submit a written request for each shutdown to the OWNER and the ENGINEER sufficiently in advance of any required shutdown.

## PART 2 PRODUCTS

Not Used

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Safeguards: Provide all shoring, bracing, supports, and protective devices necessary to safeguard all work and existing facilities during cutting and patching operations.
- B. Location of Embedments: Employ impulse radar (non x-ray type) nondestructive testing prior to core drilling or cutting of existing walls, floors and ceilings to identify location of embedded pipes or conduits.
- C. Material Removal: Cut and remove all materials to the extent shown or as required to complete the Work. Remove materials in a careful manner with no damage to adjacent facilities. Remove materials which are not salvageable from the site.

### 3.2 RESTORATION

- A. Final Appearance and Finish: Restore all work and existing facilities affected by cutting operations, with new materials, or with salvaged materials acceptable to the ENGINEER, to obtain a finished installation with the strength, appearance, and functional capacity required. If necessary, patch and refinish entire surfaces.

END OF SECTION

## SECTION 01 74 00

### CLEANING

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Final Cleaning
- B. Final Inspection

##### 1.2 FINAL CLEANING

- A. Requirements: At the completion of work and immediately prior to final inspection, clean the entire project as follows:
  - 1. Thoroughly clean, sweep, wash, and polish all work and equipment provided under the Contract, including finishes. Leave the structures and site in a complete and finished condition to the satisfaction of the ENGINEER.
  - 2. Direct all subcontractors to similarly perform, at the same time, an equivalent thorough cleaning of all work and equipment provided under their contracts.
  - 3. Remove all temporary structures and all debris, including dirt, sand, gravel, rubbish and waste material.
  - 4. Should the CONTRACTOR not remove rubbish or debris or not clean the buildings and site as specified above, the OWNER reserves the right to have the cleaning done at the expense of the CONTRACTOR.
- B. Employ experienced workers, or professional cleaners, for final cleaning.
- C. Use only cleaning materials recommended by manufacturer of surface to be cleaned.
- D. In preparation for substantial completion or occupancy, conduct final inspection of sight-exposed interior and exterior surfaces, and of concealed spaces.
- E. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior finished surfaces. Polish surfaces so designated to shine finish.
- F. Repair, patch, and touch up marred surfaces to specified finish, to match adjacent surfaces.

- G. Remove snow and ice from access to buildings.
- H. Replace air-handling filters if units were operated during construction.
- I. Clean ducts, blowers, and coils, if air-handling units were operated without filters during construction.
- J. Vacuum clean all interior spaces, including inside cabinets.
- K. Handle materials in a controlled manner with as few handlings as possible. Do not drop or throw materials from heights.
- L. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly-painted surfaces.
- M. Clean interior of all panel cabinets, pull boxes, and other equipment enclosures.
- N. Wash and wipe clean all lighting fixtures, lamps, and other electrical equipment which may have become soiled during installation.
- O. Perform touch-up painting.
- P. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.
- Q. Remove erection plant, tools, temporary structures and other materials.
- R. Remove and dispose of all water, dirt, rubbish or any other foreign substances.

### 1.3 FINAL INSPECTION

- A. After cleaning is complete the final inspection may be scheduled. The inspection will be done with the OWNER and ENGINEER.

## PART 2 PRODUCTS

Not Used

## PART 3 EXECUTION

Not Used

END OF SECTION

## SECTION 01 78 00

### CONTRACT CLOSE OUT

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Warranties and Bonds
- B. Record Drawings
- C. Special Tools

##### 1.2 WARRANTIES AND BONDS

Prior to final payment deliver to the OWNER the original and one copy of all bonds, warranties, guarantees and similar documents, including those customarily provided by manufacturers and suppliers which cover a period greater than the one year correction period. Show OWNER as beneficiary of these documents.

##### 1.3 RECORD DRAWINGS

At the site keep and maintain one record copy of all Contract Documents, reference documents and all technical documents submitted in good order. On mylar tracing media, and using drafting symbols and standards consistent with the original documents, annotate Contract Drawings to show all changes made during the construction period. Annotated drawings are to be made available to ENGINEER for reference at all times.

At completion of the CONTRACT and before final payment is made, deliver to the ENGINEER one set of clearly readable, reproducible Contract Drawings reflecting all changes made during construction. Mark each drawing "Record Drawing" in ink.

##### 1.4 SPECIAL TOOLS

Special tools are considered to be those tools which, because of their limited use, are not normally available but which are necessary for maintenance of particular equipment.

For each type of equipment provided under this CONTRACT, furnish a complete set of all special tools including grease guns and other lubricating devices, which may be needed for the adjustment, operation, maintenance, and disassembly of such equipment. Furnish only tools of high grade, smooth forged alloy tool steel. Manufacture grease guns of the lever type.

Furnish and erect one or more neat and substantial steel wall cases or cabinets with flat key locks and clips or hooks to hold each special tool in a convenient arrangement.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

## SECTION 01 78 23

### OPERATION AND MAINTENANCE MANUALS

#### PART 1 GENERAL

##### 1.1 DESCRIPTION

- A. Scope: Furnish to the ENGINEER 10 copies of an Operation and Maintenance Manual for all equipment and associated control systems furnished and installed.

##### 1.2 QUALITY ASSURANCE

- A. Reference Codes and Specifications: No current government or commercial specifications or documents apply.

##### 1.3 SUBMITTALS

- A. Prior to the Work Reaching 50 Percent Completion, submit to the ENGINEER for approval two copies of the manual with all specified material. Submit the approval copies with the partial payment request for the specified completion. Within 30 days after the ENGINEER's approval of the two-copy submittal, furnish to the ENGINEER the remaining 8 copies of the manual. Provide space in the manual for additional material. Submit any missing material for the manual prior to requesting certification of substantial completion.

##### 1.4 FORMAT AND CONTENTS

- A. Prepare and arrange each copy of the manual as follows:
  1. One copy of an equipment data summary (see sample form) for each item of equipment.
  2. One copy of an equipment preventive maintenance data summary (see sample form) for each item of equipment.
  3. One copy of the manufacturer's operating and maintenance instructions. Operating instructions include equipment start-up, normal operation, shutdown, emergency operation and troubleshooting. Maintenance instructions include equipment installation, calibration and adjustment, preventive and repair maintenance, lubrication, troubleshooting, parts list and recommended spare parts.
  4. List of electrical relay settings and control and alarm contact settings.

5. Electrical interconnection wiring diagram for equipment furnished including all control and lighting systems.
  6. One valve schedule giving valve number, location, fluid, and fluid destination for each valve installed. Group all valves in same piping systems together in the schedule. Obtain a sample of the valve numbering system from the ENGINEER.
  7. Furnish all O&M Manual material on 8-1/2 by 11 commercially printed or typed forms or an acceptable alternative format.
- B. Organize each manual into sections paralleling the equipment specifications. Identify each section using heavy section dividers with reinforced holes and numbered plastic index tabs. Use 3-ring, slant ring, hard-back binders Type No. AVE-VS11 as manufactured by Avery Company, or equal. Binder size shall be 3-inch maximum. Punch all loose data for binding. Arrange composition and printing so that punching does not obliterate any data. Print on the cover and binding edge of each manual the project title, and manual title, as furnished and approved by the ENGINEER.
- C. Leave all operating and maintenance material that comes bound by the equipment manufacturer in its original bound state. Cross-reference the appropriate sections of the CONTRACTOR's O&M manual to the manufacturers' bound manuals.
- D. Label binders Volume 1, 2, and so on, where more than one binder is required. Include the table of contents for the entire set, identified by volume number, in each binder.

## PART 2 PRODUCTS

Not Used

## PART 3 EXECUTION

Not Used

END OF SECTION

City of Evanston

Water Plant 4160V Electrical System Reliability Project

Equipment Data Summary

Equipment Name: Specification Reference:

Manufacturer:

Name:

Address:

Telephone:

Number Supplied: Location/Service:

Model No: Serial No:

Type:

Size/Speed/Capacity/Range (as applicable):

Power Requirement (Phase/Volts/Hertz):

Local Representative:

Name:

Address:

Telephone:

NOTES:

City of Evanston

Water Plant 4160V Electrical System Reliability Project

Preventive Maintenance Summary

Equipment Name:

Location:

Manufacturer:

Name:

Address:

Telephone:

Model No:

Serial No:

Maintenance Task	Lubricant/Part	D	W	M	Q	SA	A	O&M Manual Reference
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NOTES:

\*D-Daily W-Weekly M-Monthly Q-Quarterly SA-Semi-Annual A-Annual

SECTION 01 79 00

TRAINING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Training

1.2 TRAINING

A. Training: Provide the services of knowledgeable, technically competent, factory trained specialists to instruct Pump Station personnel in the operation and maintenance of the equipment and system components listed in Paragraph B. The OWNER will furnish training classroom space.

1. Coordinate services with the OWNER, with a minimum of 30 days prior notice.
2. Provide a combination of classroom and "hands-on" instruction designed to completely familiarize operating and maintenance personnel with the systems theory, standard operating procedures, safety features and emergency procedures, and general maintenance of all components.
3. Conduct all training at the Pump Station during regular hours on weekdays.

B. Provide training for the following:

<u>Specification</u>	<u>Equipment Name</u>	<u>Minimum Hours</u>
23 34 23	HVAC Fans	8
23 74 16	Packaged Rooftop Unit	8
23 81 26	Split-System Air Conditioner	8
26 09 13	Electrical Monitoring System	16
26 13 00	Medium Voltage Switchgear	16
26 14 00	Medium Voltage Motor Controllers	16
26 23 00	480V Switchgears	16
26 29 23	Adjustable Frequency Drives	8
26 32 13	Packaged Engine Generator	16
26 33 53	Uninterruptible Power Supply	16

## Systems

28 31 00	Signaling and Alarm	8
40 67 17	Control Panels SCADA Switchgear Network Panel	4

- C. Length of Training: The minimum lengths of training sessions are listed in Paragraph B. above.
- D. Credentials: Submit for approval, credentials of equipment manufacturer representatives who are to be course instructors at least 14 days prior to a proposed training session.
- E. Scheduling: Submit training outline and other information described in paragraphs G through K for approval at least 14 days prior to the proposed date for the training sessions. Verify scheduling with the OWNER at least 14 days prior to the training sessions.
- F. Number of Copies: For each training class, provide instructional material for at least ten attendees plus five extra copies, plus duplicate copies of all audio-visual aids utilized during each training course.
- G. Training Outline Submission: Provide a proposed training outline including the topics presented in Paragraph K. Identify specific components and procedures in the proposed training outline.
- H. Training Topic Detail: Detail specific training topics. Describe "hands-on" demonstrations planned for the training. Reference training aids to be utilized in the training (i.e. video tapes, slides, transparencies) and attach where applicable.
- I. Training Handouts: Attach training handouts to the proposed training outline.
- J. Training Segment Duration: Indicate the duration of each training segment.
- K. Training Outline:
  - 1. Equipment Operation
    - a. Describe equipment's operating (process) function.
    - b. Describe equipment's fundamental operating principles and dynamics.
    - c. Identify equipment's mechanical, electrical and electronic components and features.
    - d. Identify all support equipment associated with the operation of the subject equipment.

2. Detailed Component Description
  - a. Identify and describe in detail each component's function.
  - b. Where applicable, group related components into subsystems.
  - c. Identify, and describe in detail, equipment safety features and control interlocks.
3. Equipment Preventive Maintenance
  - a. Describe preventive maintenance inspection procedures required to perform and inspect the equipment in operation, and spot potential trouble symptoms (anticipate breakdowns).
  - b. Outline recommended routine lubrication and adjustments (preventive maintenance).
4. Equipment Troubleshooting
  - a. Define recommended systematic troubleshooting procedures.
  - b. Provide component specific troubleshooting checklists.
  - c. Describe applicable equipment testing and diagnostic procedures to facilitate troubleshooting.
5. Equipment Corrective Maintenance
  - a. Describe recommended equipment preparation requirements.
  - b. Identify and describe the use of special tools required for maintenance of the equipment.
  - c. Describe component removal/installation and disassembly/ assembly procedures.
  - d. Perform at least two "hands-on" demonstrations of common corrective maintenance repairs.
  - e. Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
  - f. Define recommended torquing, mounting, calibration, and alignment procedures and settings, as appropriate.

- g. Describe recommended procedures to check/test equipment following corrective repair.
  
- L. Certificate: Provide "Certificate of Instructional Services" signed by ENGINEER and equipment representative, verifying that training has been accomplished to satisfaction of all parties. Use form provided in this section, and furnish ENGINEER with three copies.
  
- M. Substantial Completion: Training provided by manufacturers' representative, ENGINEER and OWNER does not constitute substantial completion.
  
- N. Equipment Use: Use of equipment for training will not void manufacturers' or contract warranties.

## PART 2 PRODUCTS

Not Used

## PART 3 EXECUTION

Not Used

END OF SECTION

**CERTIFICATE OF INSTRUCTIONAL SERVICES**

Project \_\_\_\_\_

Equipment \_\_\_\_\_

Specification Section \_\_\_\_\_

Contract \_\_\_\_\_

I hereby certify the equipment Manufacturers' Representative has instructed OWNER's personnel in startup operation and maintenance of this equipment as required in the Contract Documents.

**MANUFACTURER'S REPRESENTATIVE**

Signature \_\_\_\_\_

Name: (print) \_\_\_\_\_

Title: \_\_\_\_\_

Representing \_\_\_\_\_

**CONTRACTOR**

Signature \_\_\_\_\_ Date \_\_\_\_\_

Name (print) \_\_\_\_\_

Title \_\_\_\_\_

**ENGINEER**

Signature \_\_\_\_\_ Date \_\_\_\_\_

Name (print) \_\_\_\_\_

Title \_\_\_\_\_

**COMMENTS:**

Complete and submit three copies of this form to ENGINEER upon completion of training as required by Specification Section 01 79 00.

(NO TEXT FOR THIS PAGE)

## SECTION 02 41 00

### DEMOLITION

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: All work necessary for the removal and disposal of buildings, portions of building, structures, foundations, piping, equipment and roadways, or any part thereof including masonry, steel, reinforced concrete, plain concrete, electrical facilities, and any other material or equipment shown or specified to be removed.
- B. Basic Procedures and Schedule: Carry out demolition so that adjacent structures, which are to remain, are not endangered. Schedule the work so as not to interfere with the day-to-day operation of the existing facilities. Do not block doorways or passageways in existing facilities.
- C. If hazardous materials are discovered during removal operations, stop work, and notify Engineer. Hazardous materials include regulated asbestos containing materials, lead, PCBs, and mercury.
- D. Additional Requirements: Provide dust control and make provisions for safety.

##### 1.2 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, or otherwise indicated to remain the Owner's property, demolished materials become the Contractor's property and shall be removed from the site.
- B. Recycle all recyclable demolition material and dispose at an approved facility all non-recyclable material.

##### 1.3 SUBMITTALS

- A. Provide all submittals, including the following, as specified in Division 1.
- B. Site Inspection: Visit the site and inspect all existing structures. Observe and record any defects which may exist in buildings or structures adjacent to but not directly affected by the demolition work. Provide the Owner with a copy of this inspection record and obtain the Engineer's approval prior to commencing the demolition.
- C. Quality Control Submittals (prior to commencement of onsite demolition):

1. Methods of demolition and equipment proposed to demolish structure. Demolition means and methods must be approved by the Owner and Owner's Structural Engineer.
  2. Waste Management Plan to indicate the types of wastes to be removed from the project and the proposed reuse, recycling, treatment, and disposal locations. Include names and addresses of back-up reuse, recycling, treatment, and disposal facilities.
  3. Copies of any authorizations and permits required to perform the work, including disposal/recycling facility permits.
- D. Pre-Demolition Photographs or Videotapes: Show existing conditions in sufficient detail of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective demolition operations. Submit before Work begins.
- E. Schedule of Demolition Activities:
1. Detailed sequence of demolition and removal work, with early and late starting and finishing dates for each activity. Ensure onsite operations are uninterrupted if applicable.
  2. Interruption of utility services. Indicate how long utility services will be interrupted.
  3. Coordination for shutoff, capping, and continuation of utility services.
  4. Locations of proposed dust-and noise-control temporary partitions and means of egress.
  5. Means of protection for items to remain and items in path of waste removal from building.
- F. Disposal Records: Provide material shipping records and, or waste manifests (i.e., for offsite waste management) indicating receipt and acceptance of solid waste by the disposal facility.

#### 1.4 QUALITY ASSURANCE

- A. Limits: Exercise care to break concrete well for removal in reasonably small masses. Where only parts of a structure are to be removed, cut the concrete along limiting lines with a suitable saw so that damage to the remaining structure is held to a minimum.
- B. Examination of Existing Conditions: Examine the Drawings for demolition and removal requirements and provisions for new Work. Verify all existing conditions and dimensions before commencing Work. Visit the site and examine the existing

conditions and get familiar with the character, extent and type of demolition and removal Work to be performed.

- C. Submit any questions regarding the extent and character of the demolition and removal work in the manner and within the time period established for receipt of such questions during the bidding period.
- D. Demolition Firm Qualifications: Engage an experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- E. Regulatory Requirements: Comply with governing United States Environmental Protection Agency (USEPA) and the Illinois Department of Public Health (IDPH) notification regulations before beginning demolition. Comply with local, state, and federal hauling and reuse, recycling, treatment, and disposal regulations.
- F. Standards: Comply with ANSI A10.6 and NFPA 241.
- G. Pre-demolition Conference: Conduct conference at the Site. Review methods and procedures related to selective demolition including, but not limited to, the following:
  - 1. Inspect and discuss condition of construction to be demolished.
  - 2. Review structural load limitations of existing structure.
  - 3. Review and finalize demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
  - 4. Review requirements of work performed by other trades that rely on substrates exposed by demolition operations.

## 1.5 PROJECT CONDITIONS

- A. The Owner, Engineers assume no responsibility for actual condition of buildings to be demolished.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by the Owner as far as practical.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. All materials required to complete the work under this Section shall conform to the standards and requirements of local codes, ordinances, municipalities, regulatory

agencies, utility companies and other agencies having jurisdiction over the work to be performed.

## PART 3 EXECUTION

### 3.1 EXAMINATION OF EXISTING DRAWINGS

- A. Drawings of existing structures and equipment will be available for inspection at the office of the Engineer.

### 3.2 PROTECTION

- A. General Safety: Provide warning signs, protective barriers, and warning lights as necessary adjacent to the work as approved or required. Maintain these items during the demolition period.
- B. Existing Services: Notify affected utility companies before starting work and comply with their requirements. Mark location and termination of utilities prior to demolition. Undertake no demolition work until all mechanical and electrical services affected by the work have been properly disconnected. Cap, reroute or reconnect interconnecting storm sewers, piping or electrical services that are to remain in service either permanently or temporarily in a manner that will not interfere with the operation of the remaining facilities.
- C. Hazards: Perform testing and air purging where the presence of hazardous chemicals, gases, flammable materials, or other dangerous substances is apparent or suspected and eliminate the hazard before demolition is started.

### 3.3 REGULATORY REQUIREMENTS

- A. The Contractor is solely responsible for obtaining permits or approvals which may be required to perform the work of this section, including all costs, fees and taxes required or levied. Notify and obtain such permits or approvals from all agencies having jurisdiction over demolition prior to starting work including, but not limited to local, state, and federal agencies.
- B. Comply with all applicable federal, state, and local safety and health requirements regarding the demolition of structures and other site features as applicable.
- C. Notify the Engineer immediately upon discovery of any hazardous materials detected on site after Certificate of Abatement has been issued.

### 3.4 DEMOLITION REQUIREMENTS

- A. Explosives: The use of explosives is not permitted.

- B. Protection: Carefully protect all mechanical and electrical equipment against dust and debris.
- C. Removal: Remove all debris from the structures during demolition and do not allow debris to accumulate in piles. Clean adjacent structures, facilities, and improvements of dust, dirt, and debris caused by demolition operations.
- D. Access: Provide safe access to and egress from all working areas at all times with adequate protection from falling material. Access and egress shall include all state and local roadways within the project area.
- E. Protection: Provide adequate scaffolding, shoring, bracing railings, toe boards and protective covering during demolition to protect personnel and equipment against injury or damage. Cover floor openings not used for material drops with material substantial enough to support any loads placed on it. Properly secure the covers to prevent accidental movement.
- F. Lighting: Provide adequate lighting at all times during demolition.
- G. Closed Areas: Close areas below demolition work to anyone while removal is in progress.
- H. Material Drops: Do not drop any material to any point lying outside the exterior walls of the structure unless the area is effectively protected.
- I. Pollution Controls: Use water sprinkling, temporary enclosures, and other suitable methods to limit the amount of dust and dirt rising in the air to the lowest practical level. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.
- J. Project Record Documents: Accurately record actual locations of capped utilities, concealed utilities discovered during demolition, and subsurface obstructions.
- K. Coordinate selective demolition of items shown on the drawings.

### 3.5 SELECTIVE DEMOLITION

- A. Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete Work within limitations of governing regulations and as follows:
  - 1. Perform all demolition in accordance with OSHA regulations.
  - 2. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition work above each floor or tier before disturbing supporting members on lower levels.

- B. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
  - 1. Verify that construction and utility arrangements are as shown.
  - 2. Report discrepancies to Engineer before disturbing existing installation.
  - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- C. Separate areas in which demolition is being conducted from other areas that are still occupied.
  - 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 015000 in locations indicated on drawings.
- D. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
- E. Remove existing work as indicated and as required to accomplish new work.
  - 1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
  - 2. Remove items indicated on drawings.
- F. Services: Remove existing systems and equipment as indicated.
  - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
  - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
  - 3. Verify that abandoned services serve only abandoned facilities before removal.
  - 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- G. Protect existing work to remain.
  - 1. Prevent movement of structure; provide shoring and bracing if necessary.

2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
3. Repair adjacent construction and finishes damaged during removal work.

### 3.6 PIPELINE ABANDONMENT

- A. When requested or required by the Engineer, existing pipeline shall be abandoned.
- B. Pipelines:
  1. Pipelines designated to be abandoned, but not removed, shall be excavated at the main, cut and properly capped or plugged at all open ends.
  2. Fill the abandoned pipeline with flowable fill. Lines to be filled shall be capped or plugged at the downstream end, filled with the approved mixture, and capped or plugged at the upstream end.

END OF SECTION

(NO TEXT ON THIS PAGE)

## SECTION 02 41 18

### PAVEMENT REMOVAL

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Furnishing labor, material, equipment and services necessary for pavements, sidewalk, curb, and base removal and disposal of materials as shown on the Drawings and as required in this Specification Section.
- B. Related Work Specified In Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 02 41 00 - Demolition
  - 2. Section 31 23 16 - Excavation - Earth and Rock
  - 3. Section 31 23 23 - Backfilling
  - 4. Section 32 12 00 - Asphalt Paving
  - 5. Section 32 13 00 - Concrete Paving
- C. Special Requirements:
  - 1. Protection: Provide protection barricades, maintain all lights and signals and other measures as required by federal, state, and municipal laws, for the full period of demolition operations and remove same when directed. In removing Work, perform all Work required to protect and maintain adjacent property, streets, alleys, sidewalks, curbs, and other structures remaining in place.

##### 1.2 REFERENCES

- A. IDOT Standard Specifications for Road and Bridge Construction.
- B. The City of Evanston Municipal Code.

##### 1.3 SUBMITTALS

- A. Submit for review pre-construction photographs or videotape showing existing conditions of adjoining construction and site improvements, including finish surfaces, which might be misconstrued as damage caused by construction operations. Submit before demolition begins.
- B. Submit for review the temporary protective Work plan in accordance with this Specification Section.

#### 1.4 PROJECT CONDITIONS

- A. Demolitions shall be coordinated with all trades and project phasing.
- B. Conduct site-clearing operations to ensure minimum interface with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from the governing agency.
- C. Provide protections necessary to prevent damage to existing improvements, including Owner or County property. Restore any damaged improvements to their original condition.

#### 1.5 EXISTING SERVICES

- A. The indicated locations shown on the drawings are approximate from the best available record drawings. Exact locations shall be determined in the field prior to commencing the work.
- B. Notify, in advance, any affected Utility Company for approval. Arrange and pay for disconnecting, removing, capping and plugging utility services, as required.
- C. Place markers to indicate the location of disconnected services and identify on the Record Documents.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

- A. Backfill materials shall be in accordance with Specification Section 31 23 23.

### PART 3 EXECUTION

#### 3.1 GENERAL

- A. Pavement must be removed in accordance with Section 440 of the IDOT Standard Specifications for Road and Bridge Construction.
- B. All exposed concrete or bituminous concrete pavement to be cut with pavement saw prior to breaking, ensuring that a straight joint remains.
  - 1. The Contractor shall full-depth saw cut for the removal of existing curb, sidewalk, all structure work, and for all pavement patches. The concrete saw shall be equipped with a diamond blade of sufficient size to saw pavements full-depth and be capable of accurately maintaining cutting depth. All saw cuts shall be parallel or perpendicular to the curb & gutter, edge of sidewalk,

or the edge of pavement, with straight, clean, edges, to the satisfaction of the Engineer. This item shall be included with curb & gutter, sidewalk, structure work, and pavement removal. The slurry resulting from the saw cutting work shall be immediately washed away using water to prevent tracking by vehicles or pedestrians to the satisfaction of the Engineer.

2. Saw cuts for all work will not be measured for payment and shall be considered as included in the related contract pay item. No separate payment will be made for saw cuts.
  3. If additional surface is damaged or removed due to negligence on the part of the Contractor, the additional work will not be measured for payment but shall be done at the Contractor's expense. It is Contractor's responsibility to determine the thickness of the existing pavement and whether or not it contains reinforcement.
- C. Equipment and methods for removing pavement or curbs will be such as to prevent cracking, shattering or spalling of the pavement remaining in place.
1. When removing pavement, curb and gutter, shoulder, and/or any other structures, the use of any type of concrete breakers which might damage the underground public or private utilities or property will not be permitted. Pavement openings must be initiated with hydraulic impact/air hammers and the use of excavator buckets to strike and break pavement is strictly prohibited and will result in an immediate deficiency deduction.
- D. The bottoms of all excavations must be properly leveled and all loose materials removed from excavations. All wood, timber and organic materials that are exposed at the bottom of all excavations, to be removed and the area backfilled per Specification Section 31 23 23.
- E. On completion of the demolition Work, excavation Work, and before acceptance by governing agency, clean the areas affected, including areas outside the limits of the Work area where permission to Work has been granted. Remove surplus construction material or debris resulting from the demolition Work and excavation work, and dispose of legally off the site.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 02 41 19

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Demolition and removal of selected portions of building or structure.
  - 2. Demolition and removal of selected site elements.
  - 3. Salvage of existing items to be reused or recycled.

1.2 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
  - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.3 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

- A. Engineering Survey: Submit engineering survey of condition of building.
- B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- C. Schedule of selective demolition activities with starting and ending dates for each activity.
- D. Predemolition photographs or video.
- E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.

1.5 CLOSEOUT SUBMITTALS

- A. Inventory of items that have been removed and salvaged.

## 1.6 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

## 1.7 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
  - 1. Hazardous materials will be removed by Owner before start of the Work.
  - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  - 1. Maintain fire-protection facilities in service during selective demolition operations.
- G. Arrange selective demolition schedule so as not to interfere with Owner's operations.

## 1.8 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Engage a structural engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
- C. Inventory and record the condition of items to be removed and salvaged.

### 3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

### 3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
  - 2. Arrange to shut off utilities with utility companies.
  - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
    - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

- e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
- g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

### 3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
- C. Remove temporary barricades and protections where hazards no longer exist.

### 3.5 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
  - 1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
  - 2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  - 3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
  - 4. Maintain fire watch during and for at least two hours after flame-cutting operations.
  - 5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing. The imposed loads shall not exceed the design loads indicated on the Structural Drawings.
  - 6. Dispose of demolished items and materials promptly.[ Comply with requirements in Section 017419 "Construction Waste Management and Disposal."]

- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
  - 1. Clean salvaged items.
  - 2. Pack or crate items after cleaning. Identify contents of containers.
  - 3. Store items in a secure area until delivery to Owner.
  - 4. Transport items to Owner's storage area designated by Owner.
  - 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
  - 1. Clean and repair items to functional condition adequate for intended reuse.
  - 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
  - 3. Protect items from damage during transport and storage.
  - 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

### 3.6 CLEANING

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
  - 1. Do not allow demolished materials to accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
  - 4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

- C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

## SECTION 02 82 13

### ASBESTOS ABATEMENT

#### PART 1 - GENERAL

##### 1.1 SCOPE OF WORK

- A. The work in this specification must include the provision of all labor, operational equipment, disposal, and incidental materials required to abate all suspect/assumed asbestos-containing material (ACM) as required in this specification.

A limited hazardous material inspection was not completed for this project. This general asbestos abatement specification section is to be followed if suspect/assumed ACM is encountered and will be disturbed during the project.

1. The work must be performed as part of the scheduled renovation. The work area may be occupied and operational during the renovation project. All work must be coordinated to not interfere with building occupants, operations, or other renovation trades.
2. The work must include, but is not limited to the abatement, removal, and disposal of any suspect/assumed ACM that is encountered and will be disturbed during the project.
3. The Contractor must verify all quantities, field conditions, and obstacles to the work in the field before bidding, and provide estimates based on the field conditions inclusive of suspect/assumed ACM that may be encountered and will be disturbed during the project; including suspect/assumed ACM enclosed in chases, walls, cavities, voids, and ceilings.
4. The Contractor must complete removal and disposal of all suspect/assumed ACM components as defined herein.
5. The Contractor must provide all labor, operational equipment, and incidental materials required for suspect/assumed ACM abatement, removal, and disposal as described in this specification, including all labor, operational equipment, and incidental materials required for pre-cleaning, moving of furnishings, establishing the regulated work areas, suspect/assumed ACM abatement and disposal shall be included in the base bid.
6. The work will be performed in a fully contained negative pressure work

environment unless alternatives are approved by the A/E Design Team and Asbestos Project Manager (APM).

7. The work must be performed in accordance with applicable Federal, Local, and State regulations. In case of conflict with applicable regulations and/or the specifications, the Contractor shall comply with the most stringent.
  8. All quantities of suspect/assumed ACM shall be field verified by the Contractor prior to bidding.
  9. Suspect/assumed ACM abatement will be conducted inclusive of pipe chases, wall cavities, floor cavities, ceiling cavities and other areas that may require selective demolition to gain access by the Contractor. The Contractor must be responsible for the selective demolition of ceilings, walls, chases, and enclosed areas to provide access for the abatement of suspect/assumed ACM in the defined work area.
  10. Suspect/assumed ACM abatement of flooring materials shall include all layers inclusive of mastic/adhesives, all floor coverings remaining in place that may be covering ACM flooring materials, and all sub-floor materials as required to leave a clean floor. Suspect/assumed ACM flooring that may extend under partition walls, framed walls or other structures that may cover installed ACM flooring shall be included in the abatement.
- B. The Contractor must complete preparation of the space to create a contained regulated area for all asbestos abatement activities.
  - C. The Contractor must remove non-salvageable non-contaminated materials as required in the specifications.
  - D. The work shall include the removal, demolition and disposal of all non-load bearing or structural interior walls, ceilings and floors, inclusive of all layers, down to masonry and/or structure. Reference architectural demolition drawings and specifications and structural drawings and specifications.
  - E. The City of Evanston will assign a Project Manager (PM) for coordination of work with the A/E Design Team and the Contractor.
  - F. The A/E Design Team will provide the APM, as defined by the Illinois Department of Public Health (IDPH) asbestos regulations referenced in this specification, to provide oversight of asbestos abatement activities during the renovation project. The A/E Design Team will provide the asbestos Air Sampling Professional (ASP), as defined by the IDPH asbestos regulations referenced in this specification, to provide asbestos air sampling during the renovation project.
  - G. The APM/ASP will provide QA/QC functions including but not limited to the following as needed or requested by the A/E Design Team: review of Contractor

submittals; review of Contractor shop drawings; site evaluation during work area preparation; limited and random site evaluation during work; and, site evaluation and review of final air clearance and release of work areas.

- H. The Contractor must also provide all work in accordance with Specification 01 11 00 – SUMMARY OF WORK and with Specification 01 12 16 – CONSTRUCTION WORK SEQUENCE AND LIMITATIONS.

## 1.2 RELATED DOCUMENTS

- A. Work under this specification is subject to the requirements of the contract documents.
- B. The Contractor will abate, remove and dispose all suspect/assumed ACM, lead-based paint (LBP), and other hazardous and non-hazardous waste materials necessary for the renovation project. Abatement will at a minimum comply with this section and all applicable Federal, State and Local environmental regulations.

## 1.3 RELATED WORK

- A. Section 01 11 00 – Summary Of Work
- B. Section 01 12 16 – Construction Work Sequence And Limitations
- C. Section 01 33 00 - Submittals
- D. Section 02 41 19 – Selective Demolition
- E. Section 02 82 13 – Asbestos Abatement
- F. Section 02 83 19 - Lead-Based Paint Abatement
- G. Section 02 84 16 – Hazardous Material Abatement

## 1.4 SUBMITTALS

- A. Failure to comply with the submittal requirements will delay the issuance of the "Notice to Proceed" by the A/E Design Team. No extensions will be allowed due to a delay in the issuance of a "Notice to Proceed" caused by failure of the Contractor to submit proper paperwork. Within one calendar week after "Notice of Award", the Contractor must submit to the A/E Design Team:
  - 1. A complete list of all Subcontractors.
- B. At least 14 calendar days before the start of the project, the Contractor must submit copies of the following items to the A/E Design Team:

1. A copy of the demolition/renovation notice must be submitted as required by EPA, NESHAPS, 40 CFR 61, Subparts A and M, to the appropriate Federal, State, or Local air pollution control agency responsible for the enforcement of the National Emission Standard for Asbestos.
2. The Contractor must provide the name, training, qualifications of the competent person, as defined by OSHA, which will be responsible for the work as defined in this specification.
3. The Contractor must provide a copy of their written personnel protection program, including applicable respiratory protection, fall protection, and other applicable protection requirements that are necessary for the scope of the work provided in this specification, as required by OSHA.
4. The Contractor must submit for review, shop drawings for layout and construction of decontamination enclosure systems and barriers for isolation of the work areas showing location and venting of HEPA units, proposed routing of waste through building and dumpster location as detailed in this specification and required by applicable regulations.
5. The Contractor must provide a written project schedule and phasing plan as applicable. The schedule must be itemized by containment to provide enough information for the A/E Design Team to review and approve/accept the schedule.
  - a. The A/E Design Team estimates that the total abatement schedule for materials covered by specification 02 82 13, 02 83 19, and 02 84 16 must not exceed the project schedule.
  - b. Any schedule duration beyond those estimated above must be justified by the Contractor in the bid for work, including details as to the cause, cost, services that would exceed the estimated schedule and associated cost difference to meet the estimated schedule from the Contractors bid and associated project schedule.
6. When rental equipment is to be used in abatement areas or to transport asbestos contaminated waste, the Contractor must provide a written notification concerning intended use of the rental equipment. The Contractor must provide this to the rental agency.
7. The Contractor must submit copies of notices to police, fire, and emergency medical personnel.

8. The Contractor must submit a copy of the respirator maintenance plan required in this specification. This must also include a copy of the Contractor respirator protection training and fit testing program.
9. The Contractor must provide documentation that arrangements for the transport and disposal of ACM or asbestos contaminated material and supplies have been made. The name and location of the disposal site, a copy of handling procedures, and a list of protective equipment utilized for asbestos disposal at the landfill, prepared and signed by the landfill operator, must be obtained and submitted.
10. The Contractor must provide documentation from a physician that all employees or agents who may be exposed to airborne asbestos in excess of background levels were provided with an opportunity to be medically monitored to determine if physically capable of working while wearing the required respiratory equipment without suffering adverse health effects.
11. The Contractor must provide and submit written documentation that personnel have received medical monitoring as required in OSHA 29 CFR and have received medical clearance to wear appropriate personal protective equipment (PPE) including respirators, which may be required for the work as provided in this specification. The Contractor must provide information to the examining physician about conditions in the workplace environment (for example, high temperature, humidity, chemical contaminants).
12. The Contractor must provide copies of documentation for all workers and supervisors that will be employed on the project, including the current state licensure and the appropriate current training course accreditation certificate for each employee.
13. The Contractor must provide a list of NIOSH approvals for all respiratory protective devices utilized on site. In addition, manufacturer certification of HEPA filtration capabilities for all cartridges and fibers must be submitted.
14. The Contractor must provide documentation that all the Contractor's employees and agents who must enter the work area have passed respirator fit tests and have been assigned respirators which fit. This fit testing must be in accordance with qualitative procedures as detailed in the OSHA standards.
15. The Contractor must provide manufacturer's certification that HEPA vacuums, negative air pressure equipment, and other local exhaust ventilation equipment conform to ANSI Z 9.2 79.
16. The Contractor must provide Material Safety Data Sheet (MSDS) from supplier or manufacturer for all chemicals proposed for use on project.

17. The Contractor must provide shop drawings for layout and construction of decontamination enclosure systems and barriers for isolation of the work area.
- C. During abatement activities, the Contractor must submit to the A/E Design Team the following:
1. Weekly (or as otherwise required by the A/E Design Team) job progress reports must include details on the abatement activities. The progress review must include previously established milestones and schedules, problems and action taken, injury reports, equipment breakdown and bulk material and air sampling results conducted by Contractor's air sampling personnel.
  2. Weekly job progress reports must include copies of all transport manifests, trip tickets, and disposal receipts for all asbestos waste materials removed from the work area during the abatement process.
  3. Daily job progress reports must include copies of work site entry logbooks with information on worker and visitor access.
  4. Daily job progress reports must include documenting filter changes on respirators, HEPA vacuums, negative pressure ventilation units, and other engineering controls.
  5. Daily job progress reports must include results of bulk material analysis and air sampling data collected during the abatement including OSHA air monitoring results.
  6. Weekly job progress reports must include documentation that each asbestos worker present in the abatement area was licensed by the IDPH.

## 1.5 REFERENCES

- A. The following laws, regulations, and standards are incorporated by reference:
1. 29 CFR 1910.134 - US OSHA Respiratory Protection
  2. 29 CFR 1926 - US OSHA Construction Standards
  3. 29 CFR 1926.1101 - US OSHA Asbestos Construction Standards
  4. 29 CFR 1910.132 - Personal Protective Equipment
  5. 29 CFR 1910.20 - Access to Employee Exposure and Medical Records
  6. 29 CFR 1910.1200 - Hazard Communication

7. 29 CFR 1910.151 - Medical and First Aid
  8. 40 CFR Part 61 - US EPA National Emissions Standards for Hazardous Air Pollutants (NESHAP), 11/90 revision
  9. 40 CFR 763 Subpart E - US EPA Asbestos Hazard Emergency Response Act (AHERA) Rules
  10. 40 CFR 763 Subpart E - US EPA Asbestos Model Accreditation Plan Appendix C(MAP): Interim Final Rule
  11. 49 CFR 100 185 – Transportation
  12. 225 ILCS 207 - Illinois Commercial & Public Building Asbestos Abatement Act
  13. 77 IAC Part 855 - Rules and Regulations
- B. If Local requirements are more stringent than Federal or State standards, the Local standards are to be followed.

#### 1.6 DEFINITIONS

- A. Definitions included in documents listed in 1.05 REFERENCES, are incorporated into this specification. Whenever a conflict exists or is discovered, the most protective and stringent definition and rule must apply.

#### 1.7 QUALITY ASSURANCE

- A. All work under this specification must be completed in accordance with applicable Federal, State, and Local regulations, standards and codes governing asbestos abatement and any other trade work done in conjunction with the abatement.
- B. The A/E Design Team will assign an APM/ASP as provided in this specification, to oversee abatement activities, and collect air samples listed in this specification. Additionally, specific air sampling required for OSHA compliance is the responsibility of the Contractor as listed in this specification.
- C. The most recent edition of any relevant regulation, standard, document or code must be in effect. Where there is conflict between the requirements or with this specification, the most stringent requirements must be utilized.
- D. The Contractor must assure compliance with regulations incorporated in 1.05 REFERENCES, and other applicable standards as they are adopted or revised.
- E. All laboratory testing services must be in compliance with the IDPH Asbestos Abatement Act and Rules and Regulations (77 IAC Part 855). All project

oversight and air sampling will be provided by the A/E Design Team APM/ASP, as specified in this specification.

1. The Contractor OSHA compliance air samples must be analyzed by an American Industrial Hygiene Association (AIHA) accredited laboratory which has successfully participated in the NIOSH Proficiency Analytical Testing (PAT) Program.
2. Clearance air monitoring samples must be analyzed by an AIHA accredited laboratory which has successfully participated in the NIOSH PAT Program.
3. Onsite analysis of clearance air samples may be performed if the analyst is proficient in the Asbestos Analyst Registry (AAR).
4. Results of OSHA compliance air sample analysis must be reported verbally and be followed by a written copy.
  - a. Within 24 hours for samples collected during removal must have phase contrast microscopy (PCM) analysis.
5. The final air clearance samples may be analyzed by PCM. The A/E Design Team may provide transmission electron microscopy (TEM) analysis with results within 24 hours for post removal final air clearance samples.
6. The Contractor must be responsible for all personal monitoring as required by OSHA. The Contractor must provide original documents to the A/E Design Team covering the results of the air monitoring. The report must include the following:
  - a. Introduction must indicate location of projects, dates, name of Contractor, area size of projects, and identification of monitoring firm.
  - b. Summary must briefly state conclusions and findings of study.
  - c. Methodology must describe sampling equipment, procedures, and analytical methods used.
  - d. Tables must be provided for sample data and calculations.
  - e. The original of all reports of Contractor's air monitoring must be signed by the person who conducted the monitoring.

F. Air Monitoring

1. The A/E Design Team APM/ASP will be on site during the duration of the abatement work. The APM/ASP may be a single person with licensing as both an APM and ASP.
2. The number of daily air monitoring samples during removal or cleaning will be decided by the A/E Design Team APM/ASP based on the size of the abatement activity. The following are a required minimum:
  - a. A minimum of two area samples inside the contained area.
  - b. A minimum of two area samples outside the work area in uncontaminated areas of the buildings, including one at the entrance to the worker decontamination enclosure.
  - c. A minimum of one area sample at the exhaust of negative pressure ventilation equipment.
3. Removal and/or cleaning activities must be halted when area sample results exceed the following levels:
  - a. The sample outside work area has a total concentration total of 0.01 fibers per cubic centimeter (f/cc) or greater.
  - b. The worker time weighed average exposure has a total concentration total of 0.1 f/cc centimeter or greater.
4. All daily air samples will be analyzed by PCM. Verbal results of daily PCM samples will be available within 24 hours. All results will be followed by a written copy.

G. Clearance air sampling will not begin until the visual inspection is conducted and passed.

1. The A/E Design Team APM/ASP will conduct aggressive air sampling.
2. Clearance air sampling will be conducted in accordance with the IDPH standards.
3. The samples will be analyzed by PCM or TEM based on the criteria cited in this specification.
4. The area will be considered clean if, according to the PCM analysis using NIOSH 7400 procedures, every sample value is at or below 0.01 f/cc.

5. The area will be considered clean if, according to the sample analysis, all inside the work area samples are no more than 70 asbestos structures per square millimeter.
6. The same clearance sampling procedures and criteria apply to glovebag/mini-containment (tent) removal.
7. All cost associated with failure of air clearance sampling are the responsibility of the Contractor, including:
  - a. A/E Design Team APM/ASP time and materials for additional site oversight during re-cleaning and additional clearance air sample analysis cost.
  - b. A/E Design Team time and expenses for delay in project schedule.

#### 1.8 WARRANTY

- A. The Contractor must provide a warranty as required by the terms and conditions of the project.

#### 1.9 PROJECT SITE CONDITIONS

- A. The A/E Design Team and staff are currently expected to be on premises during abatement work.
- B. No construction traffic must occur through occupied portions of the building and isolation barriers must be provided to secure the work areas as required in this specification.
- C. No staff or public must enter the work areas. The Contractor must be responsible to keep the work areas secure and posted with required warning signs.

#### 1.10 SEQUENCING/SCHEDULING

- A. Contractor must provide a written work schedule for review by the A/E Design Team at least 10 working days before commencing work.
  1. The A/E Design Team estimates that the total abatement schedule for materials covered by specifications 02 82 13, 02 83 19, and 02 84 16 must not exceed the project schedule.
  2. Any schedule duration beyond those estimated above must be justified by the Contractor in the bid for work, including details as to the cause, cost, services that would exceed the estimated schedule and associated cost difference to meet the estimated schedule from the Contractors bid and associated project schedule.

- B. The schedule must be itemized by task and area so as to provide enough information for the A/E Design Team to review the schedule.
- C. All sequence and scheduling must be coordinated with the A/E Design Team.

#### 1.11 EMERGENCY PROCEDURES

- A. Emergency planning must be developed prior to abatement initiation and agreed to by Contractor and the A/E Design Team.
- B. Emergency procedures must be in written form and prominently posted in the clean change areas and equipment rooms of the worker decontamination areas. Prior to entering the work area, everyone must read and sign these procedures to acknowledge receipt and understanding of work site layout, location of emergency exits, and emergency procedures. The Contractor is responsible for establishing and maintaining emergency fire exits from work areas.
- C. Emergency planning must include written notification of police, fire and emergency medical personnel of planned abatement activities, work schedules and layout of work areas, particularly barriers that may affect response capabilities and approved means of egress.
- D. Emergency planning must include considerations of fire, explosion, toxic atmospheres, electrical hazards, slips, trips and falls, confined spaces and heat related injuries. Written procedures must be developed and employee training in procedures must be provided.
- E. Employees must be trained in evacuation procedures in the event of workplace emergencies.
- F. For all glove-bag removal, a written contingency plan must be provided to the A/E Design Team that details how an accidental breaking of a glovebag must be cleaned up, decontamination procedures of work area and workers, and any other pertinent information for the renovation project.
- G. The Contractor must prepare and file a written report immediately following any accident or emergency. A copy of each report must be issued to the A/E Design Team.

#### 1.12 PROJECT COORDINATION

- A. The City of Evanston will assign a PM for coordination of the work with the A/E Design Team and the Contractor.
- B. The A/E Design Team will enforce the contract documents.

- C. The A/E Design Team APM/ASP will tour the work areas with the Contractor and agree on pre abatement conditions and make a written record of those conditions. Written record must be provided to the A/E Design Team.
- D. The A/E Design Team APM/ASP will observe activities at all times during the course of abatement.
- E. The A/E Design Team APM/ASP will meet with the Contractor daily to review the work progress and solve problems or adjust procedures as appropriate.
- F. The A/E Design Team APM/ASP will provide air sampling, workplace inspections, and clearance air tests; and provide written documentation of such to the A/E Design Team.
- G. The A/E Design Team APM/ASP will report on abatement activities to the A/E Design Team.
- H. The A/E Design Team APM/ASP will request, review, and maintain a copy of the Contractor submittals. The Contractor must have a complete copy of all submittals on-site at all times for review by the A/E Design Team APM/ASP, the PM, and any regulatory agent.
- I. The A/E Design Team APM/ASP will have the authority to stop any job activities if they are not performed in accordance with applicable regulations or guidelines, or the requirements of the specifications or contract documents. These must be reported to the A/E Design Team with description of activity, reason for stopping it and alternatives for correcting the problems.
- J. The A/E Design Team APM/ASP will conduct ambient air sampling in accordance with the NIOSH Standard Analytical Method for Asbestos in Air Method 7400 or other acceptable methods, including TEM and will follow all applicable codes and regulations, as outlined herein in this specification.
- K. The number, location, and duration of air samples will be determined by the A/E Design Team APM/ASP, and will be conducted for information only, serving to monitor Contractor performance during the project and will not release the Contractor from any responsibility to conduct personnel air sampling for OSHA compliance.
- L. The Contractor must be responsible for daily personnel monitoring as required by OSHA regulations.
- M. Project sequence pre-abatement meeting must be conducted before the start of the work.
- N. Abatement work must not commence until the containments are completely constructed, all decontamination areas and equipment are fully in place and

operable, and the areas have been inspected and approved by the A/E Design Team and the A/E Design Team APM/ASP.

- O. Upon completion of abatement, for each work area, containments must remain in place, with air filtration systems running, until areas have been inspected, approved by the A/E Design Team APM/ASP and the A/E Design Team and clearance air monitoring limits and met as described in this specification.

#### 1.13 TRAINING AND PERSONNEL PROTECTION

- A. Prior to commencement of abatement activities, all personnel who must be required to enter the work areas or handle containerized asbestos containing materials must have valid asbestos worker and/or supervisor licenses issued by the IDPH.
- B. Special onsite training on equipment and procedures unique to this project must be performed as required, such as confined space entry.
- C. Training in emergency response and evacuation procedures must be provided to all workers.
- D. The Contractor must provide respiratory protection to workers in accordance with a submitted written respiratory protection program, and must include all items in OSHA 29 CFR 1910.134. This program must be posted onsite. Workers must be provided with personally issued, individually identified (marked with waterproof designations) respirators approved by NIOSH.
- E. The minimum respiratory protection requirements during abatement must be established by the Contractor in accordance with their written respiratory protection program.
  - 1. The Contractor must provide evidence of exposure monitoring and a written exposure assessment to document the use of the respiratory protection selected.
  - 2. At a minimum the contractor must provide half face air purifying respirator equipped with dual HEPA type filters labeled with NIOSH and Mine Safety and Health Administration (MSHA) certification for work.
  - 3. Workers must perform positive and negative air pressure fit tests each time a respirator is put on, whenever the respirator design so permits.
  - 4. The Contractor's written documentation will be reviewed by the A/E Design Team.
  - 5. The Contractor must not provide lesser protective alternative respiratory protection for the hazards associated with the work.

6. If at any time the Contractor's OSHA monitoring shows the need for more protective respiratory protection, the Contractor must provide the more protective respiratory protection immediately and continue use until continued monitoring indicates that less protective respiratory protection use is acceptable based on the assigned protection factor.
- F. The Contractor must provide, and workers must be given a qualitative fit test in accordance with procedures detailed in the OSHA Standard 29 CFR for all respirators that must be used on this abatement project.
- G. The Contractor must provide documentation of adequate respirator fit and must be provided to the A/E Design Team.
- H. The Contractor must provide additional respirators (minimum of two of each type), and training on their donning and use must be available at the work site for authorized visitors who may be required to enter the work area.
- I. The Contractor must provide protective clothing in accordance with OSHA 29 CFR and the Contractor's written personnel protection program.
- J. The Contractor must provide disposable clothing including head, foot, and full body protection in sufficient quantities and adequate sizes for all workers, A/E Design Team APM/ASP, and all authorized visitors by the A/E Design Team.
- K. The Contractor must provide hard hats, protective eyewear, gloves, rubber boots, and/or other footwear as required for workers and authorized visitors. Safety shoes may be required for some activities.
- L. Non disposable footwear or clothing must remain in the work area and must be disposed as contaminated material at the end of the work activities.

## PART 2 - PRODUCTS

### 2.1 PRODUCTS

- A. The Contractor must deliver all materials in the original packages, containers or bundles bearing the name of the manufacturer and the brand name (where applicable).
- B. The Contractor must provide all equipment and materials completely clean before being brought on the work site.
- C. The Contractor must provide six millimeter polyethylene sheeting utilized for worker decontamination, opaque white or black in color.
- D. The Contractor must provide disposal bags, which must be of six millimeter polyethylene, pre-printed with labels as required by EPA regulation 40 CFR

61.152, OSHA requirement 29 CFR 1910.1001 or 29 CFR 1926.1101 with the following information:

DANGER  
CONTAINS ASBESTOS FIBERS  
AVOID CREATING DUST  
CANCER AND LUNG DISEASE  
HAZARD

- E. The Contractor must provide warning signs as required by OSHA final rules and standards for 29 CFR parts 1910.1001 and 1926.1101 occupational exposure to asbestos, tremolite, anthophyllite and actinolite.
- F. The Contractor must provide Material Safety Data Sheet (MSDS) from supplier or manufacturer and are required for all chemicals proposed for use on the project.
- G. The Contractor must provide a list of chemicals and products that will be introduced to the work area for review and acceptance by the A/E Design Team, including surfactants, encapsulants, solvents, adhesive, glues, etc. and/or other chemicals that may be used in the abatement.
- H. The Contractor must provide a sufficient quantity of negative pressure ventilation units equipped with HEPA filtration and operated in accordance with ANSI Z 9.2 79 (local exhaust ventilation requirements) and EPA guidance document EPA 560/5 85 024 guidance for controlling friable asbestos containing materials in buildings, Appendix J.
- I. Recommended specifications and operating procedures for the use of negative pressure systems for asbestos abatement must be utilized so as to provide one workplace air change every 15 minutes.
- J. The Contractor must increase the air change rate to six times an hour (one air change every 10 minutes) if chemical solvents or removers are to be used in the work areas.
  - 1. The total air flow calculations requirement must be total cubic feet per minute equals volume of work areas (in cubic feet) for 15 minutes.
  - 2. The number of units needed for the abatements must be the number of units needed equals total cubic feet times the unit capacity (in cubic feet).
- K. Respirators and protective gear must comply with this specification.
- L. The Contractor must provide a sufficient supply of disposable mops, rags and sponges for work area decontamination.

- M. The Contractor must provide a sufficient supply of scaffolds, ladders, lifts, and hand tools (for example, scrapers, wire cutters, brushes, utility knives, wire saws, etc.).
- N. The Contractor must provide airless sprayers with pumps capable of providing 125 pounds per square inch at the nozzle tip at a flow rate of two gallons per minute for spraying amended water.
- O. The Contractor must provide rubber dust pans, and rubber squeegees for cleanup.
- P. The Contractor must provide brushes utilized for removing loose asbestos containing material which must have nylon or fiber bristles, not metal.
- Q. The Contractor must provide a sufficient supply of HEPA filtered vacuum systems and must be available during cleanup.

### PART 3 - EXECUTION

#### 3.1 WORK AREA PREPARATION

- A. The Contractor must provide the following full containment measures:
  - 1. The Contractor must have available onsite a list containing the names, addresses, and cellular and office telephone numbers of the Contractor, Supervisor, A/E Design Team and any other personnel who may be required to assist during abatement activities.
  - 2. The Contractor must have available on site a copy of this specification and drawings, the IDPH regulations and any other applicable Federal, State, and Local government regulations.
  - 3. The Contractor must maintain a current and complete copy of all submittals, plans, programs and documentation required by this specification onsite for the duration of the project.
  - 4. The Contractor must post caution signs meeting the specifications of OSHA's latest final rules and standards. Signs must be posted to permit a person to read the signs and take the necessary protective measures to avoid exposure before entering the work area. Additional signs may need to be posted following construction of workplace enclosure barriers.
  - 5. The Contractor shall coordinate the need for and location of temporary power with the A/E Design Team. The Contractor must shut down and lock out electric power to all work areas. The Contractor must provide temporary power and lighting. The Contractor must ensure safe installation (including ground faulting at the power source) of all temporary power sources and equipment by compliance with all applicable electrical code

requirements and OSHA requirements for temporary electrical systems. An electric power source must also be provided, by the Contractor, for the A/E Design Team.

6. The Contractor must seal all intake and exhaust vents in the work areas with duct tape and six-millimeter polyethylene; must seal any seams in system components that pass through the work areas. The Contractor must remove all HVAC system filters and place in labeled six-millimeter polyethylene bags for staging and eventual disposal as asbestos contaminated waste. The Contractor must clean the filter assembly and ductwork using HEPA vacuums or wet cleaning techniques.
7. The Contractor must connect to an existing water system and waste/sewer in coordination with the Coordinating Contractor. Contractor must provide portable water heater for personnel decontamination facility during abatement.
8. The Contractor must pre-clean all movable objects within the work areas using a HEPA filtered vacuum and/or wet cleaning methods as appropriate. After cleaning, these objects must be removed from the work areas and carefully stored in an uncontaminated location.
9. The Contractor must pre-clean all fixed objects in the work areas using HEPA filtered vacuums and/or wet cleaning techniques as appropriate. The Contractor must clean machinery behind grills or gratings if contaminated. The Contractor must clean wall, floor and behind fixed items. After pre-cleaning, the Contractor must enclose fixed objects in six-millimeter polyethylene sheeting and seal securely with tape.
10. The Contractor must pre-clean all surfaces in the work area using HEPA filtered vacuums and/or wet cleaning methods as appropriate. It is prohibited to use any methods that would raise dust such as dry sweeping or vacuuming with equipment not equipped with HEPA filters. The Contractor must not disturb asbestos containing materials during the pre-cleaning phase.
11. The Contractor must seal all windows, doorways, elevator openings, corridor entrances, drains, ducts, grills, grates, diffusers, skylights and any other penetrations of the work areas (including the outside of the building, tunnels and crawl spaces, if any) with six-millimeter polyethylene sheeting and seal with tape. The Contractor must seal all seams in system components that pass through the work areas. Doorways and corridors which must not be used for passage during work must be sealed with barriers.

12. The Contractor must establish additional work area containment using six-millimeter polyethylene sheeting to protect surfaces that are not scheduled for abatement or removal, and/or that cannot be cleaned.
  13. The Contractor must maintain emergency and fire exits from the work areas or establish alternative exits acceptable to the City of Evanston and the local fire department requirements.
  14. The Contractor must provide an adequate number of portable fire extinguishers of the correct rating per containment.
- B. The Contractor must provide Worker Decontamination Enclosure Systems (WDES) at all locations where workers must enter or exit the work areas. These systems may consist of existing rooms outside of the work areas, if the layout is appropriate, that can be enclosed in plastic sheeting and are accessible from the work areas. When this situation does not exist, enclosure systems may be constructed out of metal, wood or plastic support as appropriate.
1. The Contractor must provide shop drawings for construction, including materials and layout, submitted as shop drawings and approved in writing by the A/E Design Team prior to work initiation. WDES constructed at the work areas must utilize six-millimeter opaque black or white polyethylene sheeting or other acceptable materials for privacy. Detailed descriptions of portable, prefabricated units, if used, must be submitted for approval. Submittal must include floor plan with dimensions, materials, size, thickness, plumbing and electrical utilities.
  2. WDES must consist of at least a clean room, a shower room, and an equipment room. The WDES must be sized to allow entry and exit from the work area containment without unnecessary restrictions.
  3. Entry to and exit from all airlocks and WDES chambers must be through curtained doorways consisting of three sheets of overlapping six-millimeter polyethylene sheeting. One sheet must be secured at the top and left side, the second sheet at the top and right side and the third sheet must be attached the same as the first.
  4. All sheets must have weights attached to the bottom to ensure that they hang straight and maintain a seal over the doorway when not in use. Doorway designs, providing equivalent protection and acceptable to the A/E Design Team may be utilized.
  5. Pathways into (from clean to contaminated) and out from (contaminated to clean) the work areas must be clearly designated.
  6. Clean rooms must be sized to adequately accommodate the clothes and equipment of the work crew.

- a. Benches must be provided as well as hooks for hanging up street clothes. Shelves for storing respirators must also be provided in this work area.
  - b. Clean work clothes (if required under disposables); clean disposable clothing, replacement filters for respirators, towels and other necessary items must be provided in adequate supply in the clean room.
  - c. A location for postings must also be provided in this work area.
  - d. A lockable door must be used to permit access into the clean room from outside the work area.
  - e. Lighting, heat and electricity must be provided as necessary for comfort.
  - f. This space must not be used for storage of tools, equipment or materials, or as office space.
  - g. The Contractor must provide shower rooms at all locations where workers must enter or exit the work area and must contain one or more showers as necessary to adequately accommodate the workers.
  - h. Each showerhead must be supplied with hot and cold water adjustable from inside the shower.
  - i. The shower enclosure must be constructed to ensure against leakage of any kind. An adequate supply of soap, shampoo, and towels must be supplied by the Contractor and must be made available at all times.
  - j. Shower water must be drained, collected and filtered through a system with at least 5.0 micron particle size collection capability.
  - k. A system containing a series of several filters with progressively smaller pore sizes must be used to avoid rapid clogging of filtration system by large particles.
  - l. Filtered wastewater must be discharged to a sanitary sewer.
7. The equipment rooms must be used for storage of equipment and tools at the end of a shift after they have been decontaminated using a HEPA filtered vacuum and/or wet cleaning techniques as appropriate.

- a. Replacement filters (in sealed containers until used) for HEPA vacuums and negative pressure ventilation equipment, extra tools, containers of surfactant and other materials and equipment that may be required during the abatement may also be stored here as needed.
  - b. A walk off pan (a small children's swimming pool or equivalent) filled with water must be located in the work area just outside the equipment room for workers to clean off foot coverings while leaving the work area and to prevent excessive contamination of the WDES.
  - c. A drum lined with a labeled six-millimeter polyethylene bag for collection of disposable clothing must be located in this room.
  - d. Contaminated footwear (for example, rubber boots, and other reusable footwear) must be stored in this area for reuse.
- C. The Contractor must construct waste transfer airlock at some location away from the WDES. Wherever possible, this must be located where there is direct access from the work area to the outside of the buildings.
- 1. This airlock system must consist of an airlock, a container staging area and another airlock with access to outside the work areas.
  - 2. The waste transfer airlock must be constructed in a similar fashion to the WDES using similar materials and airlock and curtain doorway designs. This airlock system must not be used to enter or exit the work area.
  - 3. The waste transfer airlock must be secured to prevent unauthorized entry.
- D. The Contractor must establish emergency exits clearly marked with arrows or other effective designations to permit easy location from anywhere within the work areas. They must be secured to prevent access from uncontaminated areas and still permit emergency exiting. These exits must be properly sealed with six-millimeter polyethylene sheeting that can be cut or otherwise removed to permit egress if needed. These exits may be the WDES, the waste transfer airlock and/or other alternative exits satisfactory to fire officials.
- E. The work areas must be separated from (uncontaminated) occupied areas of the building by the construction of barriers in accordance with the requirements of this specification.
- 1. Walls must be constructed of 2"x4" wood or metal framing to support barriers in all openings larger than 4'x8'.
  - 2. Plywood sheeting material must be applied to the work side of the barrier.
  - 3. Both sides of the partition must be covered with a double layer of four-

millimeter polyethylene sheeting with staggered joints and sealed in place.

- F. Following completion of the construction of all polyethylene barriers and decontamination system enclosures, the Contractor must allow settling to ensure that barriers remain intact and secured to walls and fixtures before beginning actual abatement activities. The settling time is variable based on the size, extent and type of barriers constructed, but must not be less than a minimum of four hours.
- G. The Contractor must provide all polyethylene barriers inside the work area, in the WDES, in the waste transfer airlock and at partitions constructed to isolate the work area from occupied areas, must be inspected at least twice daily, prior to the start of each day's abatement activities and following the completion of the day's abatement activities.
- H. The Contractor must document inspections and observations in the daily project log.
- I. The Contractor must repair damage and defects in the enclosure system immediately upon discovery.
- J. The Contractor must provide smoke tubes to test the effectiveness of the barrier system before abatement work begins and at least once a day thereafter until the work is completed. Results and observations must be documented in the project logbook.
- K. At any time during the abatement activities after barriers have been erected, if visible material or emissions are observed outside of the work area or if damage occurs to barriers, work must immediately stop. The Contractor must repair barriers and must clean up debris/residue using appropriate HEPA vacuuming and wet mopping procedures, prior to resuming abatement activities.
- L. The A/E Design Team will collect air samples outside of the work area during abatement activities. If air samples, indicate airborne fiber concentrations greater than 0.01 f/cc or the pre measured background levels (whichever is lower) determined by PCM, work must immediately stop. The Contractor must inspect and repair barriers, cleanup of surfaces outside of the work area using HEPA vacuums or wet cleaning techniques prior to resuming abatement activities.
- M. The Contractor must install and initiate operation of negative pressure ventilation equipment as needed to provide one air change in the work area every 15 minutes. If chemical solvents or removers are to be used, the Contractor must provide six air changes per hour in the work area.
  - 1. Openings made in the enclosure system to accommodate these units must be made airtight with tape and/or caulking as needed. If more than one unit is installed, they must be turned on one at a time. The Contractor must

- check the integrity of the wall barriers for secure attachment and must provide, where needed, additional reinforcement.
2. The Contractor must ensure that adequate power supply is available to satisfy the requirements of the ventilating units.
  3. Negative pressure ventilation units must be exhausted to the outside of the building away from occupied areas.
  4. 12” diameter extension ducting must be used to reach from the work area to the outside when required.
- N. Careful installation, air monitoring and daily inspections must be done to ensure that the ducting does not release fibers into uncontaminated building areas.
- O. The Contractor must operate negative air pressure systems in accordance with specifications and operating procedures for the use of negative pressure systems for asbestos abatement, guidance for controlling friable asbestos containing materials in buildings, EPA report number 560/5 85 024 (1985).
- P. The Contractor must install and initiate operation of pressure differential recorder to verify maintenance of pressure differential of 0.02 inch of water continuously in containment. The Contractor must keep the recorder tape for project record and provide copies of the recorder tape to A/E Design Team upon request. The A/E Design Team will check the recorder of the manometer on a regular basis during the abatement.
- Q. Once constructed and reinforced as necessary, and with negative pressure ventilation units in operation as required, the Contractor must provide test enclosure for leakage utilizing smoke tubes. Repair or reconstruct as needed.
- R. The Contractor must clearly identify and maintain emergency and fire exits from the work area.
- S. The Contractor must HEPA vacuum or wet clean the WDES and the waste transfer airlock system at the end of each day of abatement activities.
- T. The Contractor must not commence work until:
1. Enclosure systems must be constructed and tested.
  2. Negative pressure ventilation systems must function adequately.

3. All pre abatement submissions, notifications, postings, permits bonds, insurance, etc. must be provided and must be satisfactory by the A/E Design Team.
- U. The Contractor must remove, clean, replace and enclose plastic in plastic sheeting all ceiling mounted objects such as lights and other items that may interfere with the abatement process and were not previously cleaned and sealed off.
- V. The Contractor must utilize localized spraying of amended water and/or HEPA vacuums to reduce fiber dispersal during the removal of these fixtures.
- W. If specified procedures cannot be utilized, and/or the Contractor as an alternate procedure that they wish to utilize, the Contractor must make a request, in writing, to the A/E Design Team.
1. Alternative procedures must provide equivalent or greater protection than procedures that they replace.
  2. Any alternative procedure must be approved in writing by the A/E Design Team, prior to implementation.

### 3.2 WORKPLACE ENTRY AND EXIT PROCEDURES

- A. All the following procedures must be posted in the clean room and equipment room by the Contractor. These procedures must be followed throughout the abatement activities until clearance air monitoring has been performed and documented to the satisfaction of the A/E Design Team.
1. All workers and authorized personnel must enter the work areas through the WDES.
  2. All personnel who enter the work areas must sign the entry log, located in the clean room, upon entry and exit.
  3. All personnel, before entering the work areas, must read and be familiar with all posted regulations, OSHA, EPA – NESHAP, IDPH, NIOSH, personal protection requirements (including workplace entry and exit procedures), and emergency procedures. A sign-off sheet must be used to acknowledge that these have been reviewed and understood by all personnel prior to entry.
  4. All personnel must proceed first to the clean room, remove all street clothes and appropriately don respiratory protection (as deemed adequate for the project conditions) and launderable and/or disposable coveralls, head covering and foot covering. Hard hats, eye protection and gloves must also be utilized if required. Clean respirators and protective clothing must be

provided and utilized by each person for each separate entry into the work areas.

5. Personnel wearing designated personal protective equipment must proceed from the clean room through the shower room and equipment room to the main work areas.
6. Before leaving the work area, all personnel must remove gross contamination from the outside of respirators and protective clothing by brushing and/or wet wiping procedures. Small HEPA vacuums with brush attachments may be utilized for this purpose. However, larger machines may tear the suits. Each person must clean bottoms of protective footwear in the walk off pan just prior to entering the equipment room.
7. Personnel must proceed to equipment room where they remove all protective equipment except respirators. The Contractor must deposit disposable clothing into appropriately labeled containers for disposal.
8. Reusable, contaminated footwear must be stored in the equipment room when not in use in the work areas. Upon completion of each abatement, it must be disposed of as asbestos contaminated waste. Rubber boots may be decontaminated at the completion of the abatement for reuse.
9. Those personnel still wearing respirators, must proceed to the shower areas; must clean the outside of the respirators and the exposed face area under running water prior to removal of respirator; and must shower and shampoo to remove residual asbestos contamination.
  - a. Various types of respirators may require slight modification of these procedures.
  - b. A powered air purifying respirator face piece must be disconnected from the filter/power pack assembly that is not waterproof, upon entering the shower.
  - c. A dual cartridge respirator may be worn into the shower.
  - d. Cartridges must be replaced for each new entry into the work area.
10. After showering and drying off, personnel must proceed to the clean room and don clean disposable clothing if there must be later re-entry into the work area or street clothes if it is the end of the work shift.
11. The Contractor must remove asbestos contaminated waste that has been containerized and must be transported out of the work area through the waste transfer airlock or through the WDES if separate airlocks have not been constructed.

12. Waste pass out procedures must utilize two teams of workers, an inside team and an outside team.
13. The inside team wearing appropriate protective clothing and respirators for inside the work area must clean the outside, including bottoms, of properly labeled containers (bags, drums, or wrapped components) using HEPA vacuums and wet wiping techniques and transport them into the waste container pass out airlock. No worker from the inside team must further exit the work area through this airlock.
14. The outside team, wearing a different color protective clothing and appropriately assigned respirators, must enter the airlock from outside the work area, enclose the drums in clean, labeled, six-millimeter polyethylene bags and remove them from the airlock to the outside. No worker from the outside team must further enter the work area through this airlock.
15. The exit from this airlock must be secured to prevent unauthorized entry.

### 3.3 RESPIRATOR MAINTENANCE

- A. The Contractor must develop a plan for respirator maintenance, covering cleaning procedures, frequency of cleaning, person responsible for cleaning, method and means of storage, location of battery charging station, number of respirators available for use, frequency of cartridge change, compressor placement and length of hose used.
- B. The Contractor must submit copy of maintenance plan to the A/E Design Team.
- C. The Contractor must submit verification of testing conducted in compliance with ANSI commodity specification for air and OSHA final rules and standards for 29 CFR parts and 1926.1101 occupational exposure to asbestos, tremolite, anthophyllite and actinolite.
- D. The Contractor must have available at each work area one spare battery pack and cartridge per person per shift.
- E. The Contractor must develop emergency procedures as required in this specification.
- F. The Contractor must maintain a log documenting all respirator maintenance procedures.

### 3.4 ABATEMENT PROCEDURES

- A. Prior to gross removal within full containment, the Contractor must clean and isolate the work area in accordance with this specification.
1. The Contractor must follow entry and exit procedures in this specification.
  2. Prior to commencement, during and after abatement work, air monitoring is essential as a means of documenting the air quality throughout the removal project. The Contractor must upgrade workers' respiratory protection or modify removal procedures to reduce airborne fiber concentrations as directed by the A/E Design Team.
  3. The Contractor must wet all asbestos containing material with an amended water solution using equipment capable of providing a fine spray mist, to reduce airborne fiber concentrations when the material is disturbed. Saturate the material to the substrate; however, must not allow excessive water to accumulate in the work area.
  4. The Contractor must keep all removed material wet enough to prevent fiber release until it can be containerized for disposal. Maintain a high humidity in the work area by misting or spraying to assist in fiber settling and reduce airborne concentrations. Wetting procedures are not equally effective on all types of asbestos containing materials but must nonetheless be used in all cases.
  5. Saturated asbestos containing material must be removed in manageable sections by a two-person team. Removed material must be containerized before moving to a new location for continuance of the work. Surrounding areas must be periodically sprayed and maintained in a wet condition until visible material is cleaned up.
  6. Material removed from building structures or components must not be dropped or thrown to the floor or ground. Material must be removed as intact sections or components whenever possible and carefully lowered to the floor or ground.
  7. Polyethylene bags (six millimeters thick) must be sealed when full. ACM must be double bagged when six-millimeter polyethylene bags are used for disposal. Bags must not be overfilled. Each bag must be securely sealed to prevent accidental opening and leakage by tying tops of bags in an overhand knot or by taping in goose neck fashion. The bag seal must NOT be with wire or cord. Bags must be decontaminated on exterior surfaces by wet cleaning and HEPA vacuuming.

8. Large components removed intact must be wrapped in two layers of six-millimeter polyethylene sheeting secured with tape for transport to the landfill.
  9. Asbestos containing waste with sharp edged components (for example, steel plate, nails, screws) must tear the polyethylene bags and sheeting. These materials must be placed into burlap bags prior to placement in six-millimeter polyethylene bags and (drums where required) for disposal.
  10. After completion of all stripping work, surfaces from which asbestos containing materials have been removed must be wet brushed with a nylon brush and sponged or cleaned by an approved equivalent method to remove all visible residue and mastic.
  11. Clean up must proceed in accordance with this specification.
  12. After the work area has been rendered free of visible residues and inspected by the A/E Design Team, the Contractor must apply a thin coat of an encapsulating agent approved by the A/E Design Team to all surfaces.
- B. The Contractor must encapsulate the asbestos containing materials in accordance with the following procedures:
1. The Contractor must field test encapsulants prior to use by applying each to a small area to determine suitability for the materials to be encapsulated.
  2. Encapsulants must be applied using airless spray equipment, after gross removal is complete and the area is rendered free of visible residue.

### 3.5 CLEANUP PROCEDURES

- A. The Contractor must remove all visible accumulation of asbestos containing materials and asbestos contaminated debris utilizing rubber dust pans and rubber squeegees to move materials around. The Contractor must NOT use metal brushes or shovels to pick up or move accumulated waste. Special care must be taken to minimize damage to floor finishes.
- B. The Contractor must wet clean all surfaces in the work area using rags, mops and sponges as appropriate. Excess water and wet debris may be picked up with a wet dry shop vacuum.
- C. Residual water must be vacuumed with the HEPA filtered vacuum. This water must be filtered to five micrometers prior to disposal in municipal sewer.
- D. The Contractor must remove at the minimum on a daily basis all containerized waste from the work areas and waste container pass out airlock.

- E. The area must be inspected and approved by the A/E Design Team.
- F. The Contractor must remove the cleaned plastic sheeting from walls and floors, as applicable. Windows, doors, HVAC system vents and all other openings must remain sealed. The negative pressure ventilation units must remain in continuous operation. Decontamination enclosure systems must remain in place and be utilized.
- G. After cleaning of the work area, the Contractor must wait at least four hours to allow fibers to settle. The windows, doors, HVAC system vents and all other openings must remain sealed.
- H. The Contractor must decontaminate all tools and equipment and remove at the appropriate time in the cleaning sequence.
- I. The A/E Design Team APM/ASP will inspect the work areas for visible residue by wiping surfaces with a dark cloth. If any accumulation of residue is observed by the A/E Design Team APM/ASP, it must be assumed to be asbestos and the cleaning/settling period cycle must be repeated.
- J. The Contractor must encapsulate the areas from which asbestos has been removed.
- K. Once the work areas have passed the final visual inspection, clearance air monitoring will be conducted by the A/E Design Team in accordance with this specification. A minimum of four hours after final cleaning must be allowed, prior to start of air sampling. The air in the work area must be agitated during the air monitoring. If the acceptable air quality concentrations are met, barriers may be removed and properly disposed of.
- L. A final inspection must be conducted by the A/E Design Team to assure that no contamination remains in the work area.
- M. All additional cleaning required must be provided at no cost to the City of Evanston as outlined herein in this specification, until the clean-up criteria has been met.
- N. The HEPA units must remain in operation until final clean check criteria have been met.

### 3.6 DISPOSAL

- A. All waste disposal certificates and manifest shall be executed and signed by an authorized City of Evanston representative, prior to any waste leaving the project site. The Contractor shall coordinate all waste removal from the site with the A/E Design Team for execution and signature on any waste manifest, and/or waste disposal certificate.

- B. All waste that departs the site shall be delivered DIRECTLY to an approved landfill, and shall not be stockpiled off-site or co-mingled with waste streams from other projects.
- C. The Contractor must remove all asbestos containing and contaminated materials from the work area must occur as a minimum once daily. None of these materials must remain on site overnight but rather be placed in the required lockable dumpster.
  - 1. Location and placement of the lockable waste dumpster shall be coordinated with the A/E Design Team and the City of Evanston.
- D. As the work progresses, to prevent exceeding available storage capacity on site, sealed and labeled containers of asbestos containing waste must be removed and transported to the prearranged disposal location.
- E. Disposal must occur at an authorized site in accordance with regulatory requirements of NESHAP and applicable Federal, State, and Local guidelines and regulations.
- F. All dump receipts, trip tickets, transportation manifests and/or other documentation of disposal must be delivered to the A/E Design Team for their records.
  - 1. A recommended record keeping format utilizes a chain of custody form which must include the names and addresses of the A/E Design Team, Contractor, pickup site, and disposal site, the estimated quantity of the asbestos waste and the type and number of containers used.
  - 2. The form must be signed by the Contractor, A/E Design Team and the disposal site operator, as the responsibility of the material changes hands.
  - 3. If a separate hauler is employed, the name, address, telephone number and signature must also appear on the form.
- G. Once bags and wrapped components have been removed from the work areas, they must be loaded into an enclosed lockable waste dumpster. Waste dumpsters must be locked when unattended.
  - 1. When moving containers, utilize hand trucks, carts, and proper lifting techniques to avoid back injuries. Trucks with lift gates are helpful for raising drums during truck loading.

2. The enclosed area of the waste dumpster must be free of debris and lined with six-millimeter polyethylene sheeting to prevent contamination from leaking or spilled containers. Floor sheeting must be installed first and extend up the side walls. Wall sheeting must overlap floor sheeting by six inches and taped into place.
  3. Personnel loading asbestos containing waste must be protected by disposable clothing including head, body, and foot protection and at a minimum, half face piece, air purifying, dual cartridge respirators equipped with HEPA filters.
  4. Any debris or residue observed on containers or surfaces outside of the work area resulting from cleanup or disposal activities must be immediately cleaned up using HEPA filters vacuum equipment and/or wet methods as appropriate.
  5. Dumpsters used for asbestos waste disposal must have metal doors and metal tops that can be closed and locked to prevent vandalism, wind dispersion of asbestos fibers, or other disturbances of bagged asbestos debris. Unbagged material must not be placed in these containers, nor must they be used for non-asbestos waste. Bags must be placed, not thrown, into these containers.
  6. Asbestos containing materials must be transported directly to the landfill from the project site. Temporary storage or waste staging at an alternative site is not permitted.
- H. Upon reaching the landfill, waste shall be off-loaded in accordance with applicable EPA waste disposal requirements.
1. All signed waste shipment records must be submitted to the A/E Design Team within 30 days after waste shipment from the job site.

### 3.7 RE-ESTABLISHMENT OF THE WORK AREA AND SYSTEMS

- A. The Contractor must re-establish the work area only following the completion of cleanup procedures and passing clearance air testing by TEM or PCM in accordance with this specification.
- B. Following satisfactory clearance air monitoring of the work areas, remaining polyethylene barriers and worker and equipment decontamination enclosure systems must be removed and disposed of as asbestos contaminated waste. Following removal, the entire work area, including HVAC filter assembly and ductwork must be wet cleaned or HEPA vacuumed to remove residual asbestos fibers.

- C. The Contractor must reinstall mounted objects removed from their former positions during work area preparation activities, as applicable.
- D. The Contractor must relocate objects that were removed to temporary locations back to their original positions, as applicable.
- E. The Contractor must reestablish HVAC, mechanical and electrical systems in proper working order after receiving written approval from the A/E Design Team, as applicable.
- F. The Contractor must repair all areas of damage that occurred as a result of abatement activities, as applicable.

### 3.8 GLOVEBAG REMOVAL/MINI CONTAINMENT (TENT)

- A. Air monitoring must be performed in accordance with this specification.
  - 1. The Contractor must shut down the electric power to the abatement areas. The Contractor must provide temporary power and lighting. The Contractor must ensure safe installation (including ground faulting) of temporary power sources and equipment by compliance with all applicable electrical code requirements and OSHA requirements for temporary electrical systems.
  - 2. The Contractor must bring all necessary tools and materials into the mini containment (tent) work areas before the glovebag removal procedure begins.
  - 3. The Contractor must clean all visible debris on the floor or other surfaces in the work areas by HEPA vacuuming and wet cleaning methods.
  - 4. The Contractor must contain the work areas in which removal must be performed.
    - a. The Contractor must shut down the work areas HVAC system and seal all openings.
    - b. The Contractor must erect a mini containment (tent) consisting of one layer of six-millimeter polyethylene sheeting. This mini containment (tent) must include a ceiling, walls and a floor.
    - c. The Contractor must provide an airlock with polyethylene sheeting curtained doorway at access doors.
    - d. The Contractor must provide a negative pressure atmosphere within the work areas.

5. The Contractor must provide decontamination facilities consisting of at least a clean room, shower room and equipment room within reasonable proximity to all work areas but within the work area enclosed by each "Type A" barrier. Location must be approved by the A/E Design Team. The equipment room must be under negative air pressure for the entire duration of the work.
  6. The Contractor must provide a waste transfer airlock.
  7. The Contractor must maintain emergency and fire exits from the work areas. Fire extinguishers must be near each tent.
  8. The Contractor's personnel must be provided with two disposable suits to wear during abatement work.
- B. Mini containment (tent) removal procedures must be done by a minimum of two licensed asbestos workers trained in mini containment (tent) procedures and equipped with full personnel protective equipment in accordance with IAC 855.480.
- C. If any insulation is severely damaged, either at or remote from the section of insulation being removed, the Contractor must wrap the entire portion of insulation in polyethylene and secure with duct tape, spiraling the length and must provide a shroud around the damaged area.
1. Insulation adjacent to that being removed must be wrapped in six-millimeter polyethylene sheeting and sealed airtight with duct tape.
  2. The Contractor must wrap one layer of duct tape around the pipe/fitting/duct at each location where the glovebag must be attached.
  3. The pipe/fitting/duct insulation diameter must not exceed one half the glove bag above the attached gloves.
  4. The Contractor must open the bag; must place tools inside; must wrap glovebag around pipe/fitting/duct; and must seal the top with staples and duct tape. The glovebag must be attached securely around the insulation, forming a smooth airtight seal.
  5. The Contractor must tape the ends of the glovebag to the pipe. When removal from vertical piping/fitting/duct, special care must be taken to assure that the lower end of the glovebag is securely sealed against the pipe to ensure the glove bag remains airtight, thus no leakage.
  6. The Contractor must reinforce the bottom of bag; make two folds (approximately one inch each); and must secure with duct tape.

7. The Contractor must tape the wand from the water sprayer to the water sleeve.
  8. The Contractor must tape hose of HEPA vacuum to mini containment (tent) space.
  9. The Contractor must set up a chain of glovebags within the work area prior to requesting the A/E Design Team's inspection. The A/E Design Team will not inspect the glovebags one at a time. The A/E Design Team will issue a warning notice or stop work if abatement starts without A/E Design Team's inspection, testing and approval of glovebag setup.
  10. Each glovebag must be visually and smoke tube tested for air tightness by the A/E Design Team prior to asbestos removal. Any leakage points must be taped airtight and a retest must occur.
- D. Where damaged insulation is laying on ceiling or floor, all surfaces must be HEPA vacuumed prior to starting removal procedures. The Contractor must remove small amount of pipe/fitting/duct insulation in a mini containment (tent).
1. The Contractor must spray all tools with water and place in pouch.
  2. The asbestos containing insulation within the secured glovebag must be wetted with amended water prior to stripping.
  3. The Contractor must cut the ends of the insulation and slit lengthwise. The Contractor must constantly mist the asbestos material with amended water during cutting and removal.
  4. The Contractor must remove insulation.
  5. The Contractor must deposit the waste in the bottom of the glovebag.
  6. The Contractor must spray unprotected pipe with amended water, scrub and wipe down exposed pipe/fitting/duct to remove all visible ACM.
  7. The Contractor must seal the exposed ends of insulation with encapsulant prior to detaching the glovebag.
  8. The pipe/fitting/duct, the interior of the bag, the insulation, and the tools must be sprayed with amended water. The enclosed atmosphere must be misted and time allowed for the mist to settle.
  9. The glovebag must not be shifted down a pipe or duct, nor must it be moved from the initial pipe or duct to another.
  10. The Contractor must isolate tools in the glovebag gloves, thus turning the

gloves inside out, forming a new pouch, twist and seal with duct tape, sever at mid seal forming two separate bags.

11. The Contractor must collapse the glovebag using HEPA filtered vacuum.
12. The Contractor must twist glovebag several times and seal with duct tape.
13. The Contractor must slip a six-millimeter polyethylene disposal bag over the glovebag while it is still attached to pipe/fitting/duct. The Contractor must remove the tape; must open the top of the glovebag; and must fold it down into the disposable bag.
14. The Contractor must twist, seal and label the disposal bag.
15. The Contractor must clean the bag with a damp cloth.
16. The Contractor must dispose of all material, rags, brushes, etc. as asbestos contaminated waste.
17. The Contractor must follow waste container pass out procedures.
18. After removal is finished, the Contractor must wet wipe and HEPA vacuum the work area.
19. Once removal work begins, all workers leaving the work area must be decontaminated by having their outer suit thoroughly HEPA vacuumed.
20. The Contractor must proceed into airlock and remove and place outer suit in drum lined with a six-millimeter polyethylene bag for disposal.
21. All workers must proceed immediately to the shower area, with respirator still on and must perform complete decontamination.
22. The workplace entry and exit procedures must be posted in the clean room and equipment room.

E. Emergency Procedures

1. In the event of the glovebag rupturing or melting, the device and shroud must be immediately cleaned with wet cloths and HEPA vacuuming.
2. The broken glovebag must be encased in a new glovebag and attached as specified in the above paragraphs.
3. Workers contaminated by asbestos material must follow worker decontamination procedures as previously specified.

F. The Contractor must remove and containerize all visible accumulation of

asbestos containing materials and asbestos contaminated debris utilizing rubber dust pans and rubber squeegees to move materials around. The Contractor must NOT use metal shovels to pick up or move accumulated waste.

- G. The Contractor must wet clean all surfaces in the work areas using rags, mops and sponges as appropriate.
- H. The Contractor must encapsulate the work areas from which asbestos has been removed.
- I. The Contractor must remove all containerized waste from the work area.
- J. The Work area must be inspected and approved by the A/E Design Team.
- K. The Contractor must decontaminate all tools and equipment and must remove them at the appropriate time in the cleaning sequence.
- L. The Contractor must inspect the work areas for visible residue. If any accumulation of residue is observed by the A/E Design Team, it must be assumed to be asbestos and the cleaning cycle must be repeated.
- M. Following completion of removal and clean ups, all shrouds (including tent) must remain sealed until clearance air monitoring is complete and the results acceptable.
- N. Aggressive air sampling methods must be utilized for all clearance air monitoring unless directed otherwise by the A/E Design Team.
- O. The Contractor must remove all debris and materials that are left over and leave the area in the "clean" state.
- P. The Contractor must restore all work areas to their original condition.
- Q. Contractor is responsible for all damage caused by or during the abatement process. Contractor must make every effort to rectify the damaged areas to their original condition subject to approval by the A/E Design Team.
- R. Disposal procedures must comply with this specification.
- S. Reestablishment of the work areas and systems must comply with this specification.

END OF SECTION

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## SECTION 02 83 19

### LEAD-BASED PAINT ABATEMENT

#### PART 1 - GENERAL

##### 1.1 SCOPE OF WORK

- A. The work in this specification must include the provision of all labor, operational equipment, disposal, and incidental materials required to abate suspect/assumed lead-based paint (LBP) as required in this specification.

A limited hazardous material inspection was not completed for this project. This general LBP abatement specification section is to be followed if suspect/assumed LBP is encountered and will be disturbed during the project.

1. The work must be performed as part of the scheduled renovation. The work area may be occupied and operational during the renovation project. All work must be coordinated to not interfere with building occupants, operations, or other renovation trades.
2. The work must include, but is not limited to the abatement, removal, and disposal of any suspect/assumed LBP that is encountered and will be disturbed during the project.
3. The Contractor must verify all quantities, field conditions, and obstacles to the work in the field before bidding, and provide estimates based on the field conditions inclusive of suspect/assumed LBP that may be encountered and will be disturbed during the project; including suspect/assumed LBP enclosed in chases, walls, cavities, voids, and ceilings.
4. The Contractor must complete removal and disposal of all suspect/assumed LBP components as defined herein.
5. The Contractor must provide all labor, operational equipment, and incidental materials required for suspect/assumed LBP abatement and/or mitigation, removal, and disposal as described in this specification, including all labor, operational equipment, and incidental materials required for pre-cleaning, moving of furnishings, establishing the regulated work areas, suspect/assumed LBP abatement and disposal shall be included in the base bid.
6. The work will be performed in a fully contained negative pressure work environment unless alternatives are approved by the A/E Design environmental consultant (EC).

7. The work must be performed in accordance with applicable Federal, State and Local regulations. In case of conflict with applicable regulations and/or these specifications, the Contractor shall comply with the most stringent.
  8. All quantities of suspect/assumed LBP shall be field verified by the Contractor prior to bidding.
  9. Suspect/assumed LBP abatement will be conducted inclusive of pipe chases, wall cavities, floor cavities, ceiling cavities and other areas that may require selective demolition to gain access by the Contractor. The Contractor must be responsible for the selective demolition of ceilings, walls, chases, and enclosed areas to provide access for the abatement and/or mitigation of LBP in the defined work area.
- B. The Contractor must coordinate the work with the other trades.
  - C. The City of Evanston will assign a Project Manager (PM) for coordination of work with the A/E Design Team and the Contractor.
  - D. The Contractor must coordinate work with the PM.
  - E. The Contractor must complete preparation of the space to create a contained regulated area for all LBP abatement and/or mitigation activities.
  - F. The Contractor must remove non-salvageable non-contaminated materials as required in this specification.
  - G. The Contractor must clean and salvage the contaminated materials and areas.
  - H. The Contractor must restore the work areas to their pre-construction condition. The Contractor must repair or replace all affected materials, finishes, equipment, etc. which were damaged, affected, or otherwise changed in a manner not in accordance with these specifications during the work.
  - I. The Contractor must be responsible for determining if any material, finishes, equipment, etc., are in good condition prior to commencing the work. These items must be noted and put into record by the Contractor no fewer than 10 calendar days before commencing work, with a copy submitted to the A/E Design Team.
  - J. The A/E Design Team EC will evaluate the work progress of the Contractor and provide onsite oversight during abatement to ensure compliance with this specification and the applicable regulations.
  - K. The A/E Design Team will provide QA/QC functions including but not limited to the following as needed or requested by the A/E Design Team: review of submittals; review of shop drawings; site evaluation during work area

preparation; limited and random site evaluation during work; and site evaluation and review of final clearance and release of work areas.

## 1.2 RELATED DOCUMENTS

- A. Work under this specification is subject to the requirements of the contract documents.

## 1.3 RELATED WORK

- A. Section 01 11 00 – Work Summary
- B. Section 01 12 16 – Construction Work Sequence and Limitations
- C. Section 02 41 19 – Selective Demolition
- D. Section 02 82 13 - Asbestos Abatement
- E. Section 02 83 19 – Lead-Based Paint Abatement
- F. Section 02 84 16 - Hazardous Materials Abatement

## 1.4 SUBMITTALS

- A. Failure to comply with the submittal requirements will delay the issuance of the "Notice to Proceed" by the A/E Design Team. No extensions will be allowed due to a delay in the issuance of a "Notice to Proceed" caused by failure of the Contractor to submit proper paperwork. Within one calendar week after "Notice of Award", the Contractor must submit to the A/E Design Team.

- 1. A complete list of all Subcontractors

- B. At least 14 calendar days before the start of the project, the Contractor must submit the following items to the A/E Design Team:

- 1. A copy of the demolition/renovation notice must be submitted as required by EPA, NESHAPS, 40 CFR 61, Subparts A and M, to the appropriate Federal, State, or Local air pollution control agency responsible for the enforcement of the National Emission Standards for Lead.
  - 2. The Contractor must provide a copy of their written personnel protection program, including applicable respiratory protection, fall protection, and other applicable protection requirements that are necessary for the scope of the work provided in this specification, as required by OSHA.
  - 3. The Contractor must designate a competent person, must notify employees, and must select respirators in accordance with CFR Section 1910.

4. The Contractor must submit for review by the A/E Design Team, shop drawings for layout and construction of decontamination enclosure systems and barriers for isolation of the work areas showing location and venting of HEPA units, proposed routing of waste through building and dumpster location as detailed in this specification and required by applicable regulations.
5. When rental equipment is to be used in abatement areas or to transport LBP contaminated waste, the Contractor must provide a written notification concerning intended use of the rental equipment. The Contractor must provide this to the rental agency with a copy submitted to the A/E Design Team.
6. The Contractor must submit to the A/E Design Team copies of notices to police, fire, and emergency medical personnel.
7. The Contractor must submit to the A/E Design Team a copy of their Respirator Maintenance Plan required in this specification. This must also include a copy of the Respirator Protection Training and Fit Testing Program.
8. The Contractor must provide documentation that arrangements for the transport and disposal of LBP waste or contaminated materials and supplies have been made. The name and location of the disposal site, a copy of handling procedures, and a list of protective equipment utilized for LBP disposal at the landfill, prepared and signed by the landfill operator, must be obtained and submitted to the A/E Design Team.
9. The Contractor must provide documentation from a physician that all employees or agents who may be exposed to lead in excess of background levels have been provided with an opportunity to be medically monitored to determine if physically capable of working while wearing the required respiratory equipment without suffering adverse health effects.
10. The Contractor must provide documentation that personnel have received medical monitoring as required in OSHA 29 CFR 1926.62 must be submitted. The Contractor must provide information to the examining physician about conditions in the workplace environment (for example, high temperature, humidity, chemical contaminants).
11. The Contractor must provide a list of NIOSH approvals for all respiratory protective devices utilized on site. In addition, manufacturer certification of HEPA filtration capabilities for all cartridges and fibers must be submitted.
12. The Contractor must provide documentation that all the Contractor's employees and agents who must enter the work area have passed respirator fit tests and have been assigned respirators which fit. This fit testing must

be in accordance with qualitative procedures as detailed in the OSHA Lead Standard 29 CFR 1910.1025, Appendix D Qualitative Fit Test Protocol (1985).

13. The Contractor must provide manufacturer's certification that HEPA vacuums, negative air pressure equipment, and other local exhaust ventilation equipment conform to ANSI Z 9.2 79.
  14. The Contractor must provide MSDS from supplier or manufacturer for all chemicals proposed for use on the project.
  15. The Contractor must provide shop drawings for layout and construction of decontamination enclosure systems and barriers for isolation of the work areas.
  16. The Contractor must provide a written project schedule and phasing plan as applicable. The schedule must be itemized by containment to provide enough information for the A/E Design Team to review and approve/accept the schedule.
    - a. The A/E Design Team estimates that the total abatement schedule for materials covered by specification 02 82 13, 02 83 19, and 02 84 16 must not exceed the project schedule.
    - b. Any schedule duration beyond those estimated above must be justified by the Contractor in the bid for work, including details as to the cause, cost, services that would exceed the estimated schedule and associated cost difference to meet the estimated schedule from the Contractors bid and associated project schedule.
  17. When rental equipment is to be used in removal areas or to transport waste materials, the Contractor must provide a copy of the written notification to inform the rental company of the nature of use of the rented equipment.
- C. During abatement activities, the Contractor must submit to the A/E Design Team:
1. Weekly (or as otherwise required by the A/E Design Team) job progress reports must include details on the abatement activities. The progress review must include previously established milestones and schedules, problems and action taken, injury reports, equipment breakdown and bulk material and air sampling results conducted by Contractor's air sampling personnel.
  2. Weekly job progress reports must include copies of all transport manifests, trip tickets, and disposal receipts for all LBP waste materials removed from the work area during the abatement process.

3. Daily job progress reports must include copies of work site entry logbooks with information on worker and visitor access.
4. Daily job progress reports must include documenting filter changes on respirators, HEPA vacuums, negative pressure ventilation units, and other engineering controls.
5. Daily job progress reports must include results of bulk material analysis and air sampling data collected during the abatement including OSHA air monitoring results.
6. Weekly job progress reports must include documentation that each asbestos worker present in the abatement area was licensed by the IDPH.

## 1.5 REFERENCES

### A. Code of Federal Regulations

29 CFR 1910.1200	Hazard Communication
29 CFR 1910.151	Medical and First
29 CFR 1910.20	Access to Employee Exposure and Medical Records
29 CFR 1910.132	Personal Protective Equipment
29 CFR 1910.134	OSHA Respiratory Protection
29 CFR 1910.141	OSHA Sanitation
29 CFR 1926	OSHA Regulations for Construction
29 CFR 1926.59	OSHA Hazard Communication
29 CFR 1926.62	OSHA Lead
29 CFR 1926.63	OSHA Cadmium
40 CFR 50	EPA NAAQS
40 CFR 50 Appendix B	EPA Reference Method for the Determination of Lead in Suspended PM in the Atmosphere (High Volume Method)
40 CFR 50 Appendix G	EPA Reference Method for the Determination of Lead in Suspended PM Collected from Ambient Air
40 CFR 50 Appendix J	EPA Reference Method for the Determination of PM as PM-10 in the Atmosphere (High Volume Method)
40 CFR 58	EPA Ambient Air Quality Surveillance
40 CFR 60 Appendix A	EPA Visual Determination of the Opacity of Method 9 Emissions from Stationary Sources
40 CFR 60 Appendix A	EPA Visual Determination of Fugitive Method 22 Emissions from Material Sources and Smoke Emissions from Fires
40 CFR 117	EPA Determination of RQs for Hazardous

Substances

40 CFR 122	EPA Administered Permit Program: The NPDES
40 CFR 141	National Primary Drinking Water Regulations
40 CFR 148	Hazardous Waste Injection Restrictions
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	EPA Identification and Listing of Hazardous Waste
40 CFR 261 Appendix II	EPA Method 1311 TCLP
40 CFR 262	EPA Standards Applicable to Generators of Hazardous Waste
40 CFR 263	EPA Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	EPA Standards for Owners and Operators of Hazardous Waste TSD Facilities
40 CFR 265	EPA Interim Status Standards for Owners and Operators of Hazardous Waste TSD Facilities
40 CFR 265 Subpart C	EPA Preparedness and Prevention
40 CFR 265 Subpart D	EPA Contingency Plan and Emergency Procedures
40 CFR 265.16	EPA Personnel Training
40 CFR 268	EPA Land Disposal Restrictions
40 CFR 302	EPA Designation RQ and Notification
40 CFR 355	EPA Emergency Planning and Notification
40 CFR 745	LBP Poisoning Prevention in Certain Residential Structures
49 CFR Part 172	Hazardous Material Table, Special Provisions, Hazardous Material Communications, Emergency Response Information, and Training Requirements
49 CFR Part 178	Specifications for Packaging
49 CFR 100 – 185	Transportation

B. EPA Methods

3050	Acid Digestion of Sediment, Sludge, and Soils
3051	SW-846 Test Methods for Evaluating Solid Waste - Physical/Chemical Methods

C. NIOSH Methods

NIOSH 7082	Lead
OSHA Booklet 3142	Lead in Construction

D. State and Local Regulations

Illinois Environmental Protection Act  
35 IAC part 721 - Fugitive Particulate Matter

35 IAC part 212.302 - Identification and Listing of Hazardous Waste  
77 IAC part 845 - Illinois Lead Poisoning Prevention Code

## 1.6 DEFINITIONS

- A. Definitions included in documents listed in 1.05 REFERENCES, are incorporated into this specification. Whenever a conflict exists or is discovered, the most protective and stringent definition and rule must apply.

## 1.7 QUALITY ASSURANCE

- B. All work under this specification must be done in accordance with applicable Federal, State, and Local regulations, standards and codes governing LBP abatement and any other trade work done in conjunction with the abatement.
- C. The A/E Design Team will provide an EC to evaluate the work progress of the Contractor and to provide onsite oversight during abatement to assurance compliance with this specification and the applicable regulations.
- D. All laboratory testing services must be in compliance with the IDPH rules and regulations. (77 IAC 845).
- E. The Contractor OSHA compliance air samples must be analyzed by an American Industrial Hygiene Association (AIHA) accredited laboratory.
  - 1. Results of OSHA compliance air sample analysis must be reported verbally within 24-hours and be followed by a written copy.
  - 2. The Contractor must provide original documents to the A/E Design Team covering the results of the air monitoring. The report must include the following:
    - a. Introduction must indicate location of projects, dates, name of Contractor, area size of projects, and identification of monitoring firm.
    - b. Summary must briefly state conclusions and findings of study.
    - c. Methodology must describe sampling equipment, procedures, and analytical methods used.
    - d. Tables must be provided for sample data and calculations.
    - e. The original of all reports of Contractor's air monitoring must be signed by the person who conducted the monitoring.

- F. Air Monitoring
1. The A/E Design Team EC will be on site during the duration of the abatement work.
  2. The number of daily air monitoring samples during removal or mitigation will be decided by the A/E Design Team EC based on the size of the abatement activity.
  3. Removal and/or mitigation activities must be halted when area sample results exceed the background levels.
- G. Clearance settled dust wipe sampling will not begin until the visual inspection is conducted and passed.
1. The A/E Design Team EC will conduct final settled lead dust wipe sampling.
  2. Clearance dust wipe sampling will be conducted in accordance with the IDPH standards.
  3. The area will be considered clean if, according to the analysis using, every sample value is at or below the regulatory limits established by the IDPH regulations.
  4. All cost associated with failure of air clearance sampling are the responsibility of the Contractor, including:
    - a. A/E Design Team EC time and materials for additional site oversight during re-cleaning and additional clearance air sample analysis cost.
    - b. A/E Design Team time and expenses for delay in project schedule.
- H. The most recent edition of any relevant regulation, standard, document or code must be in effect. Where there is conflict between the requirements or with this specification, the most stringent requirements must be utilized.
- I. The Contractor must ensure compliance with regulations incorporated in 1.05 REFERENCES, and other applicable standards as they are adopted or revised.
- J. Contractor must meet transporter regulations and arrange permitting for disposal facilities, respective to hazardous materials to be disposed or transported for salvage.
1. Contractor's disposal plan for all materials must be outlined and submitted for review, including materials to be disposed, packing materials, estimated quantities, transport, and disposal facility certifications.

## 1.8 WARRANTY

- A. The Contractor must provide a warranty as required by the terms and conditions of the project.

## 1.9 PROJECT SITE CONDITIONS

- A. The City of Evanston will assign a PM for coordination of work with the A/E Design Team and the Contractor.
- B. The A/E Design Team and staff are currently expected to be on premises during abatement work.
- C. No construction traffic must occur through occupied portions of the building and isolation barriers must be provided to secure the work areas as required in this specification.
- D. No staff or public must enter the work areas. The Contractor must be responsible to keep the work areas secure and posted with required warning signs.

## 1.10 SEQUENCING/SCHEDULING

- A. Contractor must provide a written work schedule for review by the A/E Design Team at least 10 working days before commencing work.
  - 1. The A/E Design Team estimates that the total abatement schedule for materials covered by Specification 02 82 13, 02 83 19, and 02 84 16 must not exceed the project schedule.
  - 2. Any schedule duration beyond those estimated above must be justified by the Contractor in the bid for work, including details as to the cause, cost, services that would exceed the estimated schedule and associated cost difference to meet the estimated schedule from the Contractors bid and associated project schedule.
- B. The schedule must be itemized by task and area to provide enough information for the A/E Design Team to review the schedule.
- C. The schedule must follow the scheduling as required in specification 01 11 00 – WORK SUMMARY, and in specification 01 12 16 – CONSTRUCTION WORK SEQUENCE AND LIMITATIONS; and as shown on the specification design drawings.

## 1.11 EMERGENCY PROCEDURES

- A. Emergency planning must be developed prior to abatement initiation and agreed to by the Contractor and the A/E Design Team.

- B. Emergency procedures must be in written form and prominently posted in the clean change areas and equipment rooms of the worker decontamination areas. Prior to entering the work areas, everyone must read and sign these procedures to acknowledge receipt and understanding of work site layouts, location of emergency exits, and emergency procedures. The Contractor is responsible for establishing and maintaining emergency fire exits from work areas.
- C. Emergency planning must include written notification of police, fire and emergency medical personnel of planned abatement activities, work schedules and layout of work areas, particularly barriers that may affect response capabilities and approved means of egress.
- D. Emergency planning must include considerations of fire, explosion, toxic atmospheres, electrical hazards, skips, trips and falls, confined spaces and heat related injuries. Written procedures must be developed and employee training in procedures must be provided.
- E. Employees must be trained in evacuation procedures in the event of workplace emergencies.
- F. For all glove-bag removal, a written contingency plan must be provided to the A/E Design Team that details how an accidental breaking of a glove-bag must be cleaned up, decontamination procedures of work area and workers, and any other pertinent information for the project.
- G. The Contractor must prepare and file a written report immediately following any accident or emergency. A copy of each report must be issued to the A/E Design Team.

#### 1.12 PROJECT COORDINATION

- A. The City of Evanston will assign a PM for coordination of work with the A/E Design Team and the Contractor.
- B. The A/E Design Team will enforce the contract documents.
- C. The A/E Design Team EC will tour the work area with the Contractor and agree on pre-abatement conditions and make a written record of those conditions. Written records must be provided to the A/E Design Team.
- D. The A/E Design Team EC will observe activities at all times during the course of abatement.
- E. The A/E Design Team EC will meet with the Contractor daily to review work progress and solve problems or adjust procedures as appropriate.
- F. The A/E Design Team EC will provide air sampling, workplace inspections and

clearance air test and provide written documentation of such to the A/E Design Team.

- G. The A/E Design Team EC will report on abatement activities to the A/E Design Team.
- H. The A/E Design Team EC will request, review, and maintain a copy of the Contractor submittals. The Contractor must have a complete copy of all submittals onsite at all times for review by the A/E Design Team EC, the City of Evanston, and any regulatory agent.
- I. The A/E Design Team EC will have the authority to stop any job activities if they are not performed in accordance with applicable regulations or guidelines, or the requirements of these specifications. These must be reported to the A/E Design Team with a description of activity, reason for stopping it and alternatives for correcting the problems.
- J. The Contractor must be responsible for daily personnel monitoring as required by OSHA regulations.
- K. Project sequence pre-abatement meeting must be conducted before the start of work.
- L. Removal work must not commence until the containments are completely constructed, all decontamination areas and equipment are fully in place and operable, and the areas have been inspected and approved by the A/E Design Team and the A/E Design Team EC.

#### 1.13 TRAINING AND PERSONNEL PROTECTION

- A. Prior to commencement of abatement activities, all personnel who must be required to enter the work areas or handle containerized LBP materials must have valid worker and/or supervisor licenses issued by the IDPH.
- B. Special onsite training on equipment and procedures unique to this job site must be performed as required, such as confined space entry.
- C. Training in emergency response and evacuation procedures must be provided to all workers.
- D. The Contractor must provide respiratory protection to workers in accordance with a submitted written respiratory protection program and must include all items in OSHA 29 CFR 1910.134. This program must be posted onsite. Workers must be provided with personally issued, individually identified (marked with waterproof designations) respirators approved by NIOSH.
- E. The minimum respiratory protection requirements during abatement must be

established by the Contractor in accordance with their written respiratory protection program.

1. The Contractor must provide evidence of exposure monitoring and a written exposure assessment to document the use of the respiratory protection selected.
  2. The Contractor's written documentation will be reviewed by the A/E Design Team EC.
  3. The Contractor must not provide lesser protective alternative respiratory protection for the hazards associated with the work.
  4. If at any time the Contractor's OSHA monitoring shows the need for more protective respiratory protection, the Contractor must provide the more protective respiratory protection immediately and continue use until continued monitoring indicates that less protective respiratory protection use is acceptable based on the assigned protection factor.
- F. The Contractor must provide, and workers must be given a qualitative fit test in accordance with procedures detailed in the OSHA Standard 29 CFR for all respirators that must be used on this abatement project.
- G. The Contractor must provide documentation of adequate respirator fit and must be provided to the A/E Design Team EC.
- H. The Contractor must provide additional respirators (minimum of two of each type), and training on their donning and use must be available at the work site for authorized visitors who may be required to enter the work area.
- I. The Contractor must provide protective clothing in accordance with OSHA 29 CFR and the Contractor's written personnel protection program.
- J. The Contractor must provide disposable clothing including head, foot, and full body protection in sufficient quantities and adequate sizes for all workers, A/E Design Team EC, and all authorized visitors by the A/E Design Team.
- K. The Contractor must provide hard hats, protective eyewear, gloves, rubber boots, and/or other footwear as required for workers and authorized visitors. Safety shoes may be required for some activities.
- L. Non-disposable footwear or clothing must remain in the work area and must be disposed as contaminated material at the end of the work activities.

## 1.14 WORKER PROTECTION COMPLIANCE PROGRAM

### A. General

1. The Contractor must develop a written compliance program to establish and implement practices and procedures for assuring that no employee is exposed to lead at concentrations greater than 50  $\mu\text{g}/\text{m}^3$ , the OSHA permissible exposure limit (PEL). This program is in addition to other OSHA hazard communication and safety and health requirements of the project and must be revised and updated at least every six months.
2. The program must establish methods for complying with this specification and the OSHA construction industry lead standard, 29 CFR 1926.62, which must be thoroughly reviewed. The Federal regulation is referred to as the "lead standard" for the purpose of this specification.
3. The program must apply to all Contractor employees associated with lead on the project, and to Subcontractors working under the direct control of the Contractor who are associated with lead on the project.
4. The program must assign the specific responsibility for implementation and enforcement of the program to the Contractor.
5. The program must contain a description of each activity in which lead is emitted (e.g., equipment used, material involved, controls in place, crew size, employee job responsibilities, operating procedures and maintenance practices). All elements of the lead standard as listed in this specification, must be addressed.
6. The program must contain a report of the technology considered in meeting the PEL and air monitoring data which documents the source of lead emissions.
7. The program must contain a work practice program which includes items required in the lead standard such as protective clothing and equipment, housekeeping, and hygiene facilities and practices. The program must include provisions for blood lead and zinc protoporphyrin (ZPP) testing of all Contractor personnel prior to assignment to a lead project with follow-up testing at the frequencies established in the lead standard.

### B. Elements of Lead Standard to Be Addressed

1. Exposure monitoring, including proper protection during initial monitoring
2. Action level

3. PEL
  4. Respiratory protection
  5. Protective clothing and equipment
  6. Housekeeping
  7. Personal hygiene facilities and practices
  8. Medical surveillance and medical removal protection
  9. Employee information and training
  10. Signs and regulated areas
  11. Recordkeeping
- C. An emergency action plan must be provided if an incident occurs that may require the modification of the Contractor's standard operating procedures during abatement. The Contractor must detail procedures to be followed in the event of an incident assuring that lead abatement work is stopped until the problem is corrected.
- D. Prior to beginning any abatement activity, all Contractor personnel must be trained in accordance with OSHA 29 CFR 1926.62 and any additional State/Local requirements. Training must have been conducted by a third party, EPA/State approved trainer meeting the requirements of EPA 40 CFR 745. Initial training certificates, current refresher training certificates and any applicable state and local licensing must be submitted for each person working at the site.

#### 1.15 AMBIENT AIR AREA SAMPLING

- A. General
1. The A/E Design Team EC will collect area air samples using personal or area sampling pumps to monitor the air around the perimeter of any activities that might generate airborne lead emissions.
  2. Based on the monitoring results, the Contractor must establish a regulated area around the work sites to assure that unprotected personnel are not permitted access to any locations where the levels of airborne lead are at or above the OSHA action level ( $30 \mu\text{g}/\text{m}^3$ ) as an 8-hour time-weighted average, and/or the established background levels.
  3. All air samples will be collected and analyzed according to NIOSH Method 7082, or equivalent. All samples must be analyzed by laboratories accredited by the AIHA for metals analysis.

B. Area Sampling

1. Area samples must be collected throughout an entire work shift (or shifts, if more than one shift is operating) at a minimum of four locations around the perimeter of each work area that may potentially create lead emissions, unless otherwise directed by the A/E Design Team.
2. Ropes, ribbons, tape, or other visible means must be used to define the areas. Entrance into the regulated areas by unprotected personnel must be prohibited.

C. Monitoring During Paint Removal Work

1. Perform personal and area monitoring during the entire abatement operation. Sufficient area monitoring must be conducted at the physical boundary to ensure unprotected personnel are not exposed above  $30 \mu\text{g}/\text{m}^3$  of air at all times. If the outside boundary lead levels are at or exceed  $30 \mu\text{g}/\text{m}^3$  of air or in excess of the background level (whichever is less), work must be stopped, and the Contractor must immediately correct the condition(s) causing the increased levels and notify the A/E Design Team immediately.
2. The A/E Design Team EC must review the sampling data collected on that day to determine if condition(s) requires any further change in work methods. Removal work must resume when approval is given by the A/E Design Team. The Contractor must control the lead level outside of the work boundary to less than  $30 \mu\text{g}/\text{m}^3$  of air or applicable background levels at all times.

D. Stop Lead Removal

1. If the A/E Design Team EC presents a written stop lead removal order, the Contractor must immediately stop all lead removal and maintain the regulated area.
2. The Contractor must not resume any lead removal activity until authorized to do so by the A/E Design Team EC.
3. A stop lead removal order may be issued at any time the A/E Design Team EC determines abatement conditions/activities are not within the specification requirements.
4. Work stoppage must continue until conditions have been corrected to the satisfaction of the A/E Design Team EC.
5. Standby time and costs for corrective actions must be borne by the Contractor, including the A/E Design Team EC time and expenses.

6. The occurrence of any of the following events must be reported immediately by the Contractor in writing to the A/E Design Team and must require the Contractor to immediately stop lead removal/disturbance activities and initiate contamination control activities:
  - a. serious injury/death at the site
  - b. fire/safety emergency at the site
  - c. respiratory protection system failure
  - d. exceedance of protection factor for PPE provided to workers
  - e. power failure or loss of wetting agent
  - f. any visible emissions observed outside the regulated area

#### 1.16 WASTE CLASSIFICATION, HANDLING, AND DISPOSAL

##### A. General

1. All waste disposal certificates and manifest shall be executed and signed by an authorized City of Evanston Representative, prior to any waste leaving the project site. The Contractor shall coordinate all waste removal from the site with the Contractor for execution and signature on any waste manifest, and/or waste disposal certificate.
2. All waste that departs the site shall be delivered DIRECTLY to an approved landfill and shall not be stockpiled off-site or co-mingled with waste streams from other projects.
3. The site-specific Illinois EPA waste generator number and US EPA waste generator numbers must be used on all manifests that accompany the waste from the location of generation to the treatment/disposal facility.
4. The Contractor is responsible for assuring that all testing, handling, storage, transportation, manifesting, and disposal requirements are properly implemented, including satisfactory training of job site personnel and the cleaning of all reusable items and equipment prior to removal from the site.
5. The Contractor must develop a written program to establish and implement practices and procedures for the proper testing, handling, and disposal of waste generated on the project. The name, address, and qualifications of the testing laboratory, transporter, and disposal facility must be provided. Only

IEPA licensed waste haulers and IEPA-approved disposal facilities must be used. The program must include procedures that must be followed to assure that all reusable items such as equipment, containment materials, and scaffolding are cleaned free of lead prior to removal from the site.

6. The program must effectively and clearly communicate the means for complying with the requirements of this specification, Federal EPA and 35 Illinois Administrative Code for solid and hazardous waste. Generic statements must not be used. Specific methods, procedures, and details are required.

## B. Waste Handling and Storage

### 1. Hazardous Waste

- a. The Contractor must comply with EPA 40 CFR 262 and Illinois regulations for the on-site handling and storage of all hazardous waste generated by the project.
- b. Analysis of the waste and debris must be completed immediately upon filling waste containers in accordance with applicable regulations and this specification until the TCLP test results are received, the containers must be labeled as “lead-containing debris”. Hazardous waste labels must be applied after the test results are received, if the debris tests hazardous.
- c. Hazardous waste must not be stored at the project site for more than 90 days for a large quantity generator or 180 days for a small quantity generator.
- d. Special attention must be given to the time of storage, storage conditions, amount of material stored at any one time, use of proper containers, and personnel training.
- e. Different types of hazardous waste must not be co-mixed (e.g., do not mix clothing with paint debris).
- f. Hazardous waste must not be placed on unprotected ground, must be located in a secure area enclosed by a fence with signs around the perimeter, and must be shielded adequately to prevent dispersion of the waste by wind or water. Under no circumstances must the waste be stored within a flood plain area. Any evidence of improper storage must be cause for immediate shutdown of the project until corrective action is taken.
- g. Non-Hazardous Special Waste and Non-Hazardous Waste.

- h. Non-hazardous special waste and non-hazardous waste must be stored in closed containers separate from hazardous waste.
- i. Non-hazardous special waste and non-hazardous waste must not be stored at the Project site for more than 90 days.
- j. Only Department of Transportation (DOT)-approved containers must be used for the storage of non-hazardous special waste and non-hazardous waste, the containers must be properly labeled, and compatible with the waste stream stored.

### C. Waste Classification

#### 1. Testing

- a. All solid waste generated by the abatement activities must be tested in accordance with 35 Illinois Administrative Code Part 721 and 40 CFR 261, Appendix II, Method 1311 TCLP, to determine if it is a hazardous waste as defined by the United States Environmental Protection Agency (USEPA).
- b. In the case of wet methods of preparation, the use of chemical strippers, or containerized hygiene water, all liquids and sludge must also be tested. When chemical strippers are used, the testing must include pH to determine corrosivity.
- c. Representative samples of each waste stream must be collected. A minimum of four samples representative of each waste stream must be analyzed. Note that more than four initial samples of each waste stream must be collected to obtain the four representative samples for analysis.
- d. The collection of the initial representative samples of each waste stream and selection of the minimum of four for testing must be accomplished using a random sampling technique and must comply with the following: a minimum of one representative sample for each 55 gallons of waste, or a minimum of four representative samples for each gondola or roll-off box of waste. Samples must be collected in accordance with SW-846, "Test Methods for Evaluating Solid Waste - Physical/Chemical Methods."
- e. Sampling and testing must be performed by a qualified laboratory acceptable to the A/E Design Team. The name, address, and qualifications of the laboratory must be provided for approval. The A/E Design Team must be provided with copies of the test results as soon as they are received by the Contractor.

2. Classification

- a. Lead containing paint debris is classified as hazardous waste if, after testing by TCLP, the leachate contains any of the eight metals or other hazardous substances in concentrations at or above limits established in 40 CFR 261. The levels provided below include only those elements typically associated with paints. Other substances may be present which may cause debris to be classified as hazardous waste as defined in 40 CFR 261 (such as pH less than 2.0 or greater than 12.5, resulting in corrosivity), and must be considered.

Arsenic	5.0 mg/L
Barium	100.0 mg/L
Cadmium	1.0 mg/L
Chromium	5.0 mg/L
Lead	5.0 mg/L
Mercury	0.2 mg/L
Selenium	1.0 mg/L
Silver	5.0 mg/L

D. Waste Transportation

- 1. Hazardous Waste - all hazardous waste must be transported by an IEPA-licensed transporter in accordance with EPA 40 CFR 263 and Illinois regulations. The name, address, and qualifications of the licensed waste transporter must be provided to the A/E Design Team for acceptance prior to shipment.
- 2. Non-Hazardous Special Waste and Non-Hazardous Waste - All non-hazardous special waste and non-hazardous waste must be transported in accordance with Illinois regulations regarding waste transportation.

E. Waste Disposal

- 1. Hazardous Waste
  - a. The Contractor is responsible for ensuring the proper disposal of all hazardous waste generated during the project.
  - b. All hazardous waste must be disposed of in accordance with 40 CFR 264, 40 CFR 268, and Illinois regulations. Only currently licensed TSD facilities must be used. The name, address, and qualifications of the TSD facility must be provided to the A/E Design Team for acceptance prior to disposal.
  - c. Non-hazardous special waste and non-hazardous waste

- d. The Contractor is responsible for the proper disposal of all non-hazardous special waste and non-hazardous waste generated during the project.
  - e. Non-hazardous waste must be disposed of in accordance with Illinois regulations and at approved landfills. A state identification number must be obtained for non-hazardous special waste.
2. Contingency Plan and Training
- a. The Contractor must comply with EPA 40 CFR 265, Subpart C in the event of a spill or a release of waste, EPA 40 CFR 265 Subpart D, and Illinois regulations.
  - b. All personnel associated with the handling of hazardous waste must complete a formal training program in accordance with 40 CFR 265.16 and Illinois regulations.
  - c. Training records of all employees must be maintained and kept on file.
3. Manifest and Reporting
- a. The Contractor must investigate whether the facility already has usable Federal and State identification numbers for hazardous waste. If the facility does not, the Contractor must obtain Federal and State identification numbers for hazardous waste.
  - b. A state identification number must be obtained for non-hazardous special waste. Illinois regulations and the certification, and reporting requirements of EPA 40 CFR 262, 40 CFR 268, must be followed, including certificates of final disposal for each shipment.
  - c. Copies of all records and reports, test sample chain of custody forms, and TCLP test results must be provided to the A/E Design Team.
4. Hazardous Waste Management
- a. The hazardous waste management plan must comply with applicable requirements of Federal, State, and Local hazardous waste regulations and address:
    - i. Identification of hazardous wastes associated with the work.
    - ii. Estimated quantities of wastes to be generated and disposed of.
    - iii. Names and qualifications of each Contractor transporting,

storing, treating, and disposing of the wastes. Include the facility location and a 24-hour point of contact.

- iv. Names and qualifications (experience and training) of personnel who will be working onsite with hazardous waste.
- v. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.
- vi. Spill prevention, containment, and cleanup contingency measures to be implemented.
- vii. Work plan and schedule for waste containment, removal and disposal. Waste must be cleaned up and containerized daily.
- viii. Cost for hazardous waste disposal according to this plan.

5. Decontamination

- a. The Contractor must thoroughly vacuum, wash, or otherwise decontaminate reusable items prior to removal from the project site.
- b. Items include but are not limited to equipment, containment materials, ground covers, scaffolding, and change and shower facilities.
- c. If adequate cleaning is not possible, the materials must be treated as waste and tested and disposed of in accordance with the requirements of this specification.

6. Clearance Testing

- a. Surfaces surrounding the work site must be examined and tested for the presence of any surface lead dust which may remain. If detected, such dust must be thoroughly removed.
- b. Dust wipe samples must be collected at the end of lead abatement activities to determine if the area is clean.
- c. If the dust wipe sample results reveal that lead is greater than 40 ug/ft<sup>2</sup>, which are IDPH and EPA requirements, the area must be re-cleaned and dust wipe samples collected. The area must be re-cleaned until the samples results reveal that lead is less than 40 ug/ft<sup>2</sup>. Clearance testing will be performed by the A/E Design Team EC.

- d. All costs associated with the repeated failure of clearance testing must be the responsibility of the Contractor, including sampling cost, analysis cost and cost for retesting by the A/E Design Team.

#### 1.17 CONTAINMENT SYSTEM CRITERIA

##### A. General

1. The Contractor must design a containment system for the work area that must preclude release of LBP or contaminated dust and debris outside of the contained work area.
2. The containment must have air impenetrable walls, ceiling, and floors, as applicable, with rigid or flexible framing, fully sealed joints, airlock or re-sealable entryways, negative air pressure, and exhaust air filtration.
3. For wet methods of preparation, the containment must have water impermeable walls, ceiling, and floors as applicable, with rigid or flexible framing, fully sealed joints, re-sealable entryways, negative air pressure, and exhaust air filtration.
4. For chemical stripping, the containment must have chemical resistant walls, ceiling, and floors, as applicable, with rigid or flexible framing, fully sealed joints and overlapping entryways, forced air flow, and exhaust air filtration.
5. The containment must control environmental emissions and must maintain the site that is free of fugitive dust (i.e. dust that becomes airborne or visual) in accordance with the provisions of this specification.
6. The containment must provide protection to the facility structures from contamination during the LBP removal.
7. The containment systems must be constructed to allow paint removal work without damage or contamination of adjacent areas. Where existing work is damaged or contaminated, the Contractor must be responsible to restore such to its original condition.
8. Criteria for worker protection must be in accordance with the provisions of this specification. Mechanical ventilation for the containment enclosure must be employed as required to achieve a safe working environment in accordance with OSHA regulations.

B. Work Plan

1. The work plan and sequencing of the construction activities must be developed by the Contractor and submitted to the A/E Design Team for review.
2. The work plan must incorporate industry standards for paint removal.
3. Debris must be removed from the containment and equipment prior to relocation to subsequent work areas.
4. Reusable containment materials and equipment must be cleaned of lead prior to relocation to subsequent work areas or removal from the site as outlined in this specification.

C. Mechanical Ventilation System

1. Use adequate ventilation to control personnel exposure to lead in accordance with 29 CFR 1926.57.
2. Use fixed local exhaust ventilation connected to HEPA filters or other collection systems. Local exhaust ventilation systems must be designed, constructed, installed, and maintained in accordance with ANSI Z9.2, and must be located in areas approved by the A/E Design Team.
3. Any air exhausted from the containment enclosure or vacuum equipment must be passed through a HEPA filtering system. The Contractor must be responsible for the design, effectiveness and maintenance of this HEPA filtering system. No discharge of debris dust must be allowed.

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. The Contractor must deliver all materials in the original packages, containers or bundles bearing the name of the manufacturer and the brand name (where applicable).
- B. The Contractor must provide all equipment and materials must be completely clean before being brought on the work site.
- C. The Contractor must provide six-millimeter polyethylene sheeting utilized for worker decontamination, enclosure must be opaque white or black in color.
- D. The Contractor must provide warning signs as required by OSHA final rules and standards.

- E. The Contractor must provide MSDS from supplier or manufacturer and are required for all chemicals proposed for use on projects.

## 2.2 TOOLS AND EQUIPMENT

- A. All equipment must at least conform to minimum industry standards.
  - 1. Negative air machines must provide HEPA filtration and conform to ANSI Z9.2 fabrication criteria.
  - 2. Respirators and associated air purifying cartridges must be NIOSH or MSHA approved for use with lead, asbestos, or other contaminants anticipated in the work.
  - 3. Safety equipment, such as hard hats, eye protection, gloves, and footwear must comply with their respective ANSI standards.
- B. Tools
  - 1. Shovels and scoops must be suitable for use in a plasticized containment. Plastic or rubber models are preferred, but metal shovels are acceptable when used with care to prevent damage to poly sheeting and permanent surfaces. Duct tape may be applied to the leading edges to aid in poly damage prevention.
  - 2. Scrapers, wire and bristle brushes, utility knives and other hand tools must be of good quality and suitable for the intended uses. The Contractor must keep an ample supply on hand for the completion of the work.
  - 3. Power tools such as, but not limited to saws, pneumatic chisels, brushes, sanders, and needle guns must be equipped with shrouds and HEPA-filtered local exhaust systems to capture released particles.

## 2.3 MATERIALS

- A. Abatement materials
  - 1. Tape must be 2-inch or 3-inch duct tape or other waterproof tape suitable for joining poly seams and attaching poly sheeting to surfaces.
  - 2. Spray adhesives must be non-flammable and free of methylene chloride solvents.
  - 3. Disposal bags must be minimum six millimeters, where used for single-bagging, and minimum four millimeters, where used for double-bagging.
  - 4. Disposable suits, hoods, and foot coverings must be TYVEK or similar.

5. Solvents must be compatible with any primers, paints, coatings, or other surfacing materials to be installed following their use.
6. Cleaning solutions must cause lead to chelate, precipitate, or otherwise release effectively from surfaces. Cleaning solutions must not leave residue on surfaces to be painted.

END OF SECTION

## SECTION 02 84 16

### HAZARDOUS MATERIAL ABATEMENT

#### PART 1 - GENERAL

##### 1.1 SCOPE OF WORK

- A. The work in this specification must include the provision of all labor, operational equipment, disposal, and incidental materials required to segregate, package, remove, transport, and dispose of suspect/assumed hazardous material/universal waste as required in this specification.

A limited hazardous material inspection was not completed for this project. This general hazardous material abatement specification section is to be followed if suspect/assumed hazardous material/universal waste is encountered and will be disturbed during the project.

1. The work must be performed as part of the scheduled renovation. The work area may be occupied and operational during the renovation project. All work must be coordinated to not interfere with building occupants, operations, or other renovation trades.
- B. The work must include, but is not limited to the segregation, packaging, removal, transportation, and disposal of suspect/assumed hazardous material/universal waste as required by this specification.
- C. The work must include, but is not limited to the abatement, removal, and disposal of the following categories and example suspect hazardous material/universal waste:
1. Fluorescent light bulbs and ballast
  2. Other special use light bulbs and ballast
  3. Mercury containing equipment (thermostats, switches, etc.)
  4. Electric transformers (that do not contain a “No PCBs” sticker)
  5. Other PCBs-containing equipment
  6. Refrigerants (air-conditioning units, drinking fountains, etc.)
  7. Batteries

- D. The Contractor must verify all quantities, field conditions, and obstacles to the work in the field before bidding, and provide estimates based on the field conditions inclusive of suspect/assumed hazardous material/universal waste present in the field before bidding.
- E. The Contractor must complete removal and disposal of all suspect/assumed hazardous material/universal waste components as defined herein, inclusive of actual field conditions.
  - 1. The Contractor must provide all labor, operational equipment, and incidental materials required for suspect/assumed hazardous material/universal waste abatement, removal, and disposal as described in the general specifications; including all labor, operational equipment, and incidental materials required for pre-cleaning, moving of furnishings, establishing the regulated work area, abatement and disposal shall be included in the base bid.
- F. The City of Evanston will assign a Project Manager (PM) for coordination of work with the A/E Design Team and the Contractor.
- G. The Contractor must coordinate work with the Construction Manager (CM).
- H. The A/E Design Team will review all submittals and documents required in these specifications. All submittals and documents must be submitted to the A/E Design Team.
- I. The Contractor must complete preparation of the space to create a regulated area for all abatement activities.
- J. The Contractor must remove non-salvageable non-contaminated materials as required in this specification.
- K. The Contractor must clean and salvage the contaminated materials and areas.
- L. The Contractor must restore the work areas to their pre-construction condition. The Contractor must repair or replace all affected materials, finishes, equipment, etc. which were damaged, affected, or otherwise changed in a manner not in accordance with these specifications during the course of the work.
- M. The Contractor must be responsible for determining if any material, finishes, equipment, etc. are in good condition prior to commencing the work. These items must be noted and put into record by the Contractor no fewer than 10 calendar days before commencing work, with a copy submitted to the A/E Design Team.
- N. The A/E Design Team will provide an environmental consultant (EC) to evaluate the work progress of the Contractor and to provide onsite oversight during

abatement to assurance compliance with this specification and the applicable regulations.

- O. The A/E Design Team will provide QA/QC functions including but not limited to the following as needed or requested by the A/E Design Team: review of submittals; review of shop drawings; site evaluation during work area preparation; limited and random site evaluation during work; and, site evaluation and review of final clearance and release of work areas.

## 1.2 RELATED DOCUMENTS

- A. Work under this specification is subject to the requirements of the contract documents.

## 1.3 RELATED WORK

- A. Section 01 11 00 – Work Summary
- B. Section 01 12 16 – Construction Work Sequence and Limitations
- C. Section 02 41 19 – Selective Demolition
- D. Section 02 82 13 - Asbestos Abatement
- E. Section 02 83.19 – Lead-Based Paint Abatement
- F. Section 02 84 16 - Hazardous Materials Abatement

## 1.4 SUBMITTALS

- A. The Contractor must provide the following submittals to the A/E Design Team prior to starting removal activities work.
  - 1. The Contractor must submit for approval a schedule of activities, including sampling (if necessary), containment of hazardous material, transporter, and disposal facility.
  - 2. The Contractor must submit for approval a schedule of salvage inventory plan, transporter, and storage facility or recipient.
  - 3. The Contractor must submit for approval an inventory of suspect/assumed hazardous material/universal waste and methods of disposal for each material.
  - 4. The Contractor must submit applications and obtain proper permitting for disposal from the appropriate disposal facility for categorized suspect/assumed hazardous waste/universal waste.

5. The Contractor must provide copies of all permits and approvals for record.
  6. The Contractor must submit for review the names and resumes of Contractor and Subcontractor personnel that are to perform the removal work. The Contractor must submit activities of Subcontractors and Subcontractor information. Resumes must identify personnel qualifications to perform the methods, protocols, and procedures for the work. Proof of OSHA training must be in compliance with the Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) for applicable workers.
    - a. The Contractor must submit specific training and experience, including key personnel qualifications in recognizing, assessing, desensitizing, decontaminating, characterizing and packaging for the disposal of energetic materials including perchlorates.
  7. The Contractor must submit for approval a site-specific Health and Safety Plan (HASP) for removal work.
- B. The Contractor must provide the following submittals to the A/E Design Team after completion of the removal work.
1. The Contractor must submit disposal records. All records must be tracked in accordance with regulatory requirements.
    - a. Copies of all daily reports must include transport records, and disposal receipts.
    - b. Bills of sale must be for all materials sold as scrap or salvage.
    - c. Log must include materials retained by Contractor.
    - d. All waste disposal certificates and manifest shall be executed and signed by an authorized City of Evanston Representative, prior to any waste leaving the project. The Contractor shall coordinate all waste removal from the site with the CM for execution and signature on any waste manifest, and/or waste disposal certificate.
    - e. All waste that is transported off the site shall be delivered DIRECTLY to an approved landfill, disposal and/or recycling facility and shall not be stockpiled off-site or co-mingled with waste streams from other projects.
    - f. All manifests must include waste disposal and measured waste tickets, as appropriate, of all materials removed.

2. The Contractor must submit certificates of disposal from the disposal facilities.
3. The Contractor must submit salvage records. All records must be tracked in accordance with regulatory requirements.
  - a. Copies of all daily reports and transport records must be provided.
  - b. Receipts for all salvaged equipment must be provided.

## 1.5 REFERENCES

### C. Illinois, Title 35

1. Part 721.103: Definition of Hazardous Waste
2. Part 808: Special Waste Classifications
3. Part 809: Nonhazardous Special Waste Hauling and the Uniform Program

### D. Occupational Safety and Health Administration (OSHA)

1. 29 CFR 1910.120. Hazardous Waste Operations and Emergency Response (HAZWOPER)

### E. US Department of Transportation

1. 49 CFR Parts 171-177: Hazardous Materials Regulations

### F. U.S. Environmental Protection Agency (USEPA)

1. 40 CFR 261: Identification and Listing of Hazardous Waste
2. 40 CFR 268 Land Disposal Restrictions
3. 40 CFR 761: PCBs Manufacturing, Processing, Distribution in Commerce, and Use Prohibition
4. TSCA regulations

## 1.6 DEFINITIONS

Not Used

## 1.7 QUALITY ASSURANCE

- A. Requirements of regulatory agencies must be adhered to during handling,

transport, and/or disposal of suspect/assumed hazardous materials/universal waste.

- B. Governing regulatory agencies include IDOT (hazardous materials transport rules), IEPA, other Federal, State, and Local regulations governing hazardous materials/universal waste.
- C. Contractor must meet transporter regulations and arrange permitting for disposal facilities, respective to hazardous materials/universal waste to be disposed or transported for salvage.
  - 1. Contractor's disposal plan for all materials must be outlined and submitted for review, including materials to be disposed, packing materials, estimated quantities, transport, and disposal facility certifications. A plan for salvage, removal and storage of medical equipment must also be outlined and submitted for review.
  - 2. Contractor must show applicable certifications and record of previous job performance.

#### 1.8 WARRANTY

- A. The Contractor must provide a warranty as required by the Terms and Conditions of the project.

#### 1.9 PROJECT SITE CONDITIONS

- A. The City of Evanston will assign a PM for coordination of work with the A/E Design Team and the Contractor.
- B. The A/E Design Team and staff are currently expected to be on premises during work.
- C. No construction traffic must occur through occupied portions of the buildings and isolation barriers must be provided to secure the regulated work areas as required.
- D. No staff or public must enter the regulated work areas. The Contractor must be responsible to keep the regulated work areas secure and posted with required warning signs.

#### 1.10 SEQUENCING/SCHEDULING

- A. The Contractor must provide a written project schedule and phasing plan as applicable. The schedule must be itemized by containment so as to provide enough information for the A/E Design Team to review and approve/accept the schedule.

1. The A/E Design Team estimates that the total abatement schedule for materials covered by specification 02 82 13, 02 83 19, and 02 84 16 must not exceed scheduled working days.
2. Any schedule duration beyond those estimated above must be justified by the Contractor in the bid for work, including details as to the cause, cost, services that would exceed the estimated schedule and associated cost difference to meet the estimated schedule from the Contractor's bid and associated project schedule.

#### 1.11 EMERGENCY PROCEDURES

- A. Emergency planning must be developed prior to work initiation and agreed to by Contractor and the A/E Design Team.
- B. Emergency procedures must be in written form and prominently posted in an accessible point to the regulated area. The Contractor is responsible for establishing and maintaining emergency fire exits from regulated work areas.
- C. Emergency planning must include written notification of police, fire and emergency medical personnel of planned abatement activities, work schedules and layout of work areas, particularly barriers that may affect response capabilities and approved means of egress.
- D. Emergency planning must include considerations of fire, explosion, toxic atmospheres, electrical hazards, slips, trips and falls, confined spaces and heat related injuries. Written procedures must be developed and employee training in procedures must be provided.
- E. Employees must be trained in evacuation procedures in the event of workplace emergencies.
- F. The Contractor must prepare and file a written report immediately following any accident or emergency. A copy of each report must be issued to the A/E Design Team.

#### 1.12 PROJECT COORDINATION

- A. The City of Evanston will assign a PM for coordination of work with the A/E Design Team and the Contractor.
- B. The A/E Design Team will enforce the contract documents.
- C. The A/E Design Team EC will tour the work areas with the Contractor and agree on pre-abatement conditions and make a written record of those conditions. Written record must be provided to the A/E Design Team.

- D. The A/E Design Team EC will observe activities at all times during the course of abatement.
- E. The A/E Design Team EC will meet with the Contractor daily to review work progress and solve problems or adjust procedures as appropriate.
- F. The A/E Design Team EC will ensure performance of sampling, workplace inspections and clearance assessment/testing and provide written documentation of such to the A/E Design Team.
- G. The A/E Design Team EC will report on abatement activities to the A/E Design Team.
- H. The A/E Design Team EC will request, review, and maintain Contractor submittals.
- I. The A/E Design Team EC will have the authority to stop any job activities if they are not performed in accordance with applicable regulations or guidelines, or the requirements of the specifications. These must be reported to the A/E Design Team with description of activity, reason for stopping it and alternatives for correcting the problems.
- J. The Contractor must be responsible for personnel monitoring as required by OSHA regulations.
- K. Project sequence pre-abatement meeting must be conducted before start of work.
- L. Removal work must not commence until the regulated areas are completely constructed, all decontamination areas and equipment are fully in place and operable, and the areas have been inspected and approved by the A/E Design Team EC and provided in writing to the A/E Design Team.
- M. Upon completion of work, for each regulated work area, regulated work areas must remain in place until areas have been inspected, approved by the A/E Design Team EC and clearance monitoring is complete and written results have been provided to the A/E Design Team.

#### 1.13 TRAINING AND PERSONNEL PROTECTION

- A. Prior to commencement of work activities, all personnel who must be required to enter the regulated work areas or handle suspect/assumed hazardous material/universal wastes must have training and medical surveillance as required by OSHA regulations and this specification.

1. The Contractor must submit specific training and experience, including key personnel qualifications, in recognizing, assessing, desensitizing, decontaminating, characterizing and packaging for the disposal of energetic materials including perchlorates.
- B. Special onsite training on equipment and procedures unique to this job site must be performed as required, such as confined space entry.
- C. Training in emergency response and evacuation procedures must be provided to all workers.
- D. The Contractor must provide respiratory protection to workers in accordance with a submitted written respiratory protection program, and must include all items in OSHA 29 CFR 1910.134. This program must be posted onsite. Workers must be provided with personally issued, individually identified (marked with waterproof designations) respirators approved by NIOSH.
- E. The Contractor must provide protective clothing in accordance with OSHA 29 CFR and the Contractor's written personnel protection program.
- F. The Contractor must provide disposable clothing including head, foot, and full body protection in sufficient quantities and adequate sizes for all workers, A/E Design Team and all authorized visitors by the Contractor.
- G. The Contractor must provide hard hats, protective eyewear, gloves, rubber boots, and/or other footwear as required for workers and authorized visitors. Safety shoes may be required for some activities.
- H. Non disposable footwear or clothing must remain in the work area and must be disposed as contaminated material at the end of the work activities.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Contractor must provide all materials, equipment, supplies, and other necessary items to complete the safe and contained removal, transport, and disposal of hazardous materials/universal waste. It is the Contractor's responsibility to acquaint and satisfy themselves as to the nature and material of the work and general conditions. Any failure by the Contractor to acquaint themselves with all available information must not relieve the Contractor of responsibility for properly estimating the difficulty or cost of successfully performing the work.
- B. The Contractor must provide and maintain an adequate safety zone to secure the site work area during handling and removal of materials from the project.

- C. Packing materials must be used to safely containerize materials for transport and safe disposal in accordance with all applicable regulations per each type of hazardous material. Suspect/assumed hazardous material/universal waste must be properly removed. Packing materials must meet or exceed the requirements of applicable governing agencies or approving bodies.
- D. Any leaking materials or compromised containers are the Contractors responsibility to address for packing, cleanup, and on site impacts.
- E. The Contractor must provide the necessary safety equipment for protection of personnel to conduct Work under safe conditions and in accordance with applicable OSHA requirements regarding removal, transport, and disposal of hazardous materials/universal waste.
- F. No fire or open flame must be allowed in the work area at any time. Smoking must not be allowed in work areas.
- G. All materials must be contained on site prior to transport and may require over pack materials or other containment.

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. The Contractor must supply all materials, equipment, labor and supervision necessary to complete the removal, transport and disposal.
- B. All work must be in accordance with all applicable Federal, State, and Local requirements and regulations. In case of conflict with applicable regulations and/or these specifications, the Contractor shall comply with the most stringent.
- C. The Contractor must be responsible for and obtain at their own expense: disposal permits and other necessary permits, equipment registrations, operating certificates, and any other documents required by applicable codes, regulations, and laws.
- D. Omissions from this specification that are necessary to carry out the intent of the project, or omissions which are customarily performed, must not relieve the Contractor from performing such omitted details of the work, but they must be performed as if fully and correctly set forth and described in this specification.
- E. The Contractor must conduct the work so that operations of facilities must not be disturbed at any time during the project.

1. The Contractor must perform all work within the permissible noise levels, day of week, and hour of day limitations, and within the guidelines established by applicable federal, state, and municipal codes, regulations, laws, and standards.
  2. The Contractor must use prevention techniques to prevent the generation of fumes, dust, and environmental disruption to prevent any health hazards to nearby occupants.
- F. The Contractor must have a superintendent available to respond to the job site from telephone or in person immediately, upon request.
- G. Before starting any work, the Contractor must meet with the A/E Design Team to discuss all phases of work to be performed.
1. At these meetings, an order of procedure must be established and documented that must be mutually satisfactory to the A/E Design Team and Contractor.
  2. Suspect/assumed hazardous material/universal waste handling protocols must be defined in detail and must become part of the Contractor's standard operating procedures (SOPs) throughout all project operations.
  3. No deviation from this established order of procedures must be permitted unless approved, in writing, by the A/E Design Team.
- H. The Contractor must provide the following protection.
1. The Contractor must exercise care during the work to confine operations to the immediate areas of the suspect/assumed hazardous materials/universal waste to be removed. The physical means and methods used for protection must be at the Contractor's option. However, the Contractor must be completely responsible for replacement and restitution work of whatever nature at no additional cost to the City of Evanston.
  2. Adequate protection of persons and property must be provided at all times. The work must be executed in such a way as to avoid hazards to persons and property.
  3. The Contractor must furnish signs, lights, barricades, and other work equipment and temporary controls as may be necessary for the safe execution of the work. The Contractor must remove when work is complete.
  4. The Contractor must take all possible actions to prevent hazardous materials/universal waste from entering any surface area or drainage system.

5. The Contractor must maintain safe working conditions and meet all applicable laws and regulations. The Contractor must keep the work area clean and secure at all times.
6. Workers must hold current certification in 40-hour OSHA training in accordance with OSHA 29 CFR 1910.120 (HAZWOPER).

### 3.2 EXAMINATION

- A. The Contractor must conduct a site survey of suspect/assumed hazardous material/universal waste to be removed.
- B. The Contractor must verify suspect/assumed hazardous material/universal waste locations, quantities, and classes.
- C. The Contractor must identify ancillary non-hazardous waste to be removed with suspect/assumed hazardous material/universal waste.

### 3.3 PREPARATION

- A. The Contractor must notify the A/E Design Team a minimum of one week prior to commencement of suspect/assumed hazardous material/universal waste work.
- B. The Contractor must prepare separate onsite areas for approved containment of suspect/assumed hazardous material/universal wastes.
- C. The Contractor must provide containers, vehicles, equipment, labor, signs, and labels as required for suspect/assumed hazardous material/universal waste removal and disposal.
- D. Prior to beginning onsite activities, the Contractor must obtain disposal permits for each of the materials to be disposed. The following methods in order of preference must be provided and must be conducted in accordance with Federal, State, and Local regulations.
  1. Recycling
  2. Reclamation
  3. Incineration (including fuel blending and high temperature)
  4. Secure chemical landfill
  5. Aqueous treatment
  6. Chemical treatment

- E. Alternative methods must require written approval from the A/E Design Team. Application for approval must contain a description and give the quantity of the waste, and the method that must be utilized.

#### 3.4 WASTE CHARACTERIZATION

- A. All waste disposal certificates and manifest shall be executed and signed by an authorized City of Evanston Representative prior to any waste leaving the project site. The Contractor shall coordinate all waste removal from the site with the PM for execution and signature on any waste manifest, and/or waste disposal certificate.
- B. All waste that departs the site shall be delivered DIRECTLY to an approved landfill, disposal and/or recycling facility and shall not be stockpiled off-site or co-mingled with waste streams from other projects.

#### 3.5 PERFORMANCE

- A. The means and methods of performing the suspect/assumed hazardous material/universal waste work must be solely the responsibility of the Contractor.
- B. Visual inspections and damage repairs must be made daily by the Contractor and/or as directed by the A/E Design Team to assure that product release and containment control measures are functioning properly. Damage caused by the Contractor must be repaired to the existing condition before the damage occurred at no additional cost to the City of Evanston.
- C. In order to prevent and to provide for abatement of any environmental pollution arising from removal activities in the performance of this contract, the Contractor and all the Subcontractors must comply with all applicable Federal, State, and Local laws, and regulations concerning environmental pollution control and abatement and controlling hazards.

#### 3.6 REMOVAL, TRANSPORT, AND DISPOSAL

- A. All waste disposal certificates and manifest shall be executed and signed by an authorized City of Evanston Representative prior to any waste leaving the project. The Contractor shall coordinate all waste removal from the site with the CM for execution and signature on any waste manifest, and/or waste disposal certificate.
- B. All waste that departs the site shall be delivered DIRECTLY to an approved landfill, disposal and/or recycling facility and shall not be stockpiled off-site or co-mingled with waste streams from other projects.
- C. The Contractor must perform the suspect/assumed hazardous material/universal waste removal procedures in accordance with all applicable Federal, State, and

Local regulations including, but not limited to, the following:

1. 29 CFR 1910 Occupational Safety and Health Standards
  2. 40 CFR 268 Land Disposal Regulations (USEPA)
- D. The Contractor must use field instrumentation and/or laboratory analysis to collect and screen samples for waste stream profile.
- E. The Contractor must segregate all materials into appropriate disposal facility classifications.
- F. The Contractor must inspect and assure adequate and proper containment for all materials. If proper containment is not present, it is the Contractor's responsibility to properly package suspect/assumed hazardous material/universal waste for transport.
- G. The Contractor must arrange for proper vehicles and transport of all suspect/assumed hazardous material/universal waste to the permitted disposal or salvage facilities.
- H. The Contractor must be responsible for transporting and disposing of all suspect/assumed hazardous material/universal waste to the permitted disposal facility, in accordance with the rules and regulations of the UEPA.
1. The Contractor must not transport suspect/assumed hazardous material/universal waste off site until evidence has been submitted to the A/E Design Team that disposal facility is authorized and must accept the suspect/assumed hazardous material/universal waste.
  2. Suspect/assumed hazardous material/universal waste must NOT be transported off site that does not meet acceptance criteria of the intended disposal facility.
- I. Suspect/assumed hazardous waste/universal waste left after work hours must be properly secured with flashing barricades, caution tape, and/or fencing as deemed necessary during Contractor's hours away from the site.
- J. The Contractor must provide proof that contaminated substances transported off site were properly dispositioned and must include the following minimum information.
1. Name and address of disposal or recycling facility
  2. Signature of authorized agent for the disposal or recycling facility
  3. Date shipment accepted

4. Description of shipment
  5. Quantity of shipment
  6. Method of disposal or recycling
- K. Any planned deviations from this procedure must be communicated to the A/E Design Team in writing.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 03 20 00  
CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Bar supports.
3. Mechanical splice couplers.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of Architect and Structural Engineer.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
  - 1. Reinforcement to Be Welded: Welding procedure specification in accordance with AWS D1.4.
- B. Material Certificates: For each of the following, signed by manufacturers:
  - 1. Epoxy-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."
- C. Material Test Reports: For the following, from a qualified testing agency:
  - 1. Steel Reinforcement:
    - a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706.
  - 2. Mechanical splice couplers.
- D. Field quality-control reports.
- E. Minutes of preinstallation conference.

#### 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4.

### PART 2 - PRODUCTS

#### 2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615, Grade 60, deformed.
- B. Low-Alloy Steel Reinforcing Bars: ASTM A706, deformed.
- C. Headed-Steel Reinforcing Bars: ASTM A970.
- D. Epoxy-Coated Reinforcing Bars:
  - 1. Steel Bars: ASTM A615, Grade 60, deformed bars.
  - 2. Epoxy Coating: ASTM A775 with less than 2 percent damaged coating in each 12-inch bar length.

- E. Plain-Steel Welded-Wire Reinforcement: ASTM A1064, plain, fabricated from as-drawn steel wire into flat sheets.
- F. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064, flat sheet.
- G. Galvanized-Steel Welded-Wire Reinforcement: ASTM A1064, plain, fabricated from galvanized-steel wire into flat sheets.
- H. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884, Class A coated, Type 1, plain steel.

## 2.2 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
  - 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
    - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
    - b. For epoxy-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
    - c. For dual-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
    - d. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
    - e. For stainless steel reinforcement, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- B. Mechanical Splice Couplers: ACI 318 Type 1, same material of reinforcing bar being spliced.
- C. Steel Tie Wire: ASTM A1064, annealed steel, not less than 0.0508 inch in diameter.
  - 1. Finish: Plain

## 2.3 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protection of In-Place Conditions:
  - 1. Do not cut or puncture vapor retarder.
  - 2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

### 3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
  - 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
  - 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
  - 1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
  - 2. Stagger splices in accordance with ACI 318.
  - 3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
  - 4. Weld reinforcing bars in accordance with AWS D1.4, where indicated on Drawings.
- G. Install welded-wire reinforcement in longest practicable lengths.
  - 1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."

- a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.
2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

### 3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect and Structural Engineer.
  1. Place joints perpendicular to main reinforcement.
  2. Continue reinforcement across construction joints unless otherwise indicated.
  3. Do not continue reinforcement through sides of strip placements of floors and slabs.

### 3.4 INSTALLATION TOLERANCES

- A. Comply with ACI 117.

### 3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
  1. Steel-reinforcement placement.
  2. Steel-reinforcement mechanical splice couplers.
  3. Steel-reinforcement welding.

END OF SECTION

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## SECTION 03 30 00

### CAST-IN-PLACE CONCRETE

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

###### B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
3. Section 312000 "Earth Moving" for drainage fill under slabs-on-ground.

##### 1.2 DEFINITIONS

- ###### A. Cementitious Materials:
- Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, and other pozzolans materials subject to compliance with requirements.

- ###### B. Water/Cement Ratio (w/cm):
- The ratio by weight of water to cementitious materials.

##### 1.3 PREINSTALLATION MEETINGS

- ###### A. Preinstallation Conference:
- Conduct conference at Project site.

##### 1.4 ACTION SUBMITTALS

- ###### A. Product Data:
- For each of the following.

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Aggregates.

6. Admixtures:
    - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
  7. Vapor retarders.
  8. Liquid floor treatments.
  9. Curing materials.
  10. Joint fillers.
- B. Design Mixtures: For each concrete mixture, include the following:
1. Mixture identification.
  2. Minimum 28-day compressive strength.
  3. Durability exposure class.
  4. Maximum w/cm.
  5. Calculated equilibrium unit weight, for lightweight concrete.
  6. Slump limit.
  7. Air content.
  8. Nominal maximum aggregate size.
  9. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
  10. Intended placement method.
  11. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- C. Shop Drawings:
1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
    - a. Location of construction joints is subject to approval of the Architect and Structural Engineer.

- D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
1. Concrete Class designation.
  2. Location within Project.
  3. Exposure Class designation.
  4. Formed Surface Finish designation and final finish.
  5. Final finish for floors.
  6. Curing process.
  7. Floor treatment if any.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
  2. Admixtures.
  3. Curing compounds.
  4. Vapor retarders.
  5. Joint-filler strips.
- B. Material Test Reports: For the following, from a qualified testing agency:
1. Portland cement.
  2. Fly ash.
  3. Slag cement.
  4. Blended hydraulic cement.
  5. Aggregates.
  6. Admixtures:
- C. Research Reports: For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
- D. Preconstruction Test Reports: For each mix design.

- E. Field quality-control reports.
  - F. Minutes of preinstallation conference.
- 1.6 QUALITY ASSURANCE
- A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment.
    - 1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- 1.7 PRECONSTRUCTION TESTING
- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
    - 1. Include the following information in each test report:
      - a. Admixture dosage rates.
      - b. Slump.
      - c. Air content.
      - d. Seven-day compressive strength.
      - e. 28-day compressive strength.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Comply with ASTM C94 and ACI 301.
- 1.9 FIELD CONDITIONS
- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1.
  - B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1.

## PART 2 - PRODUCTS

### 2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

## 2.2 CONCRETE MATERIALS

### A. Cementitious Materials:

1. Portland Cement: ASTM C150, Type I/II, gray.
2. Fly Ash: ASTM C618, Class F.

### B. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

### C. Lightweight Aggregate: ASTM C330, 3/4-inch nominal maximum aggregate size.

### D. Air-Entraining Admixture: ASTM C260.

### E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494, Type A.
2. Retarding Admixture: ASTM C494, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017, Type II.

### F. Water and Water Used to Make Ice: ASTM C94/C94M, potable.

## 2.3 VAPOR RETARDERS

### A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

## 2.4 CURING MATERIALS

### A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

### B. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

1. Color:
    - a. Ambient Temperature Below 50 deg F: Black.
    - b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
    - c. Ambient Temperature Above 85 deg F: White.
  - C. Water: Potable or complying with ASTM C1602.
  - D. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.
- 2.5 RELATED MATERIALS
- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.
- 2.6 CONCRETE MIXTURES, GENERAL
- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
    1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
  - B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
    1. Fly Ash or Other Pozzolans: 25 percent by mass.
    2. Total of Fly Ash or Other Pozzolans, Slag Cement: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass.
    3. Total of Fly Ash or Other Pozzolans: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass.
  - C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
- 2.7 CONCRETE MIXTURES
- A. Class A: Normal-weight concrete used for pile caps, grade beams, and tie beams.
    1. Exposure Class: ACI 318 F2 S0 W0 C1.
    2. Minimum Compressive Strength: As indicated at 28 days.
    3. Maximum w/cm: 0.45.

4. Air Content:
    - a. Exposure Class F1: 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch (19-mm) nominal maximum aggregate size; 4.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch (25-mm) nominal maximum aggregate size.
    - b. Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch (19-mm) nominal maximum aggregate size; 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch (25-mm) nominal maximum aggregate size.
  5. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- B. Class B: Normal-weight concrete used for foundation walls.
1. Exposure Class: ACI 318 F3 S0 W0 C2.
  2. Minimum Compressive Strength: As indicated at 28 days.
  3. Maximum w/cm: 0.40.
  4. Air Content:
    - a. Exposure Class F1: 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch (19-mm) nominal maximum aggregate size; 4.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch (25-mm) nominal maximum aggregate size.
    - b. Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch (19-mm) nominal maximum aggregate size; 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch (25-mm) nominal maximum aggregate size.
  5. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- C. Class C: Normal-weight concrete used for interior slabs-on-ground.
1. Exposure Class: ACI 318 F0 S0 W0 C2.
  2. Minimum Compressive Strength: As indicated at 28 days.
  3. Maximum w/cm: 0.50.
  4. Minimum Cementitious Materials Content: 540 lb/cu. yd.

5. Air Content:
    - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
  6. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Class D: Structural lightweight concrete used for concrete toppings.
1. Exposure Class: ACI 318 F0 S0 W0 C0.
  2. Minimum Compressive Strength: As indicated at 28 days.
  3. Calculated Equilibrium Unit Weight: 105 lb/cu. ft., plus or minus 3 lb/cu. ft. as determined by ASTM C567.
  4. Air Content:
    - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
  5. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.
- E. Class E: Normal-weight concrete used for building walls.
1. Exposure Class: ACI 318 F1 S0 W0 C1.
  2. Minimum Compressive Strength: As indicated at 28 days.
  3. Maximum w/cm: 0.45.
  4. Air Content:
    - a. Exposure Class F1: 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch (19-mm) nominal maximum aggregate size; 4.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch (25-mm) nominal maximum aggregate size.
    - b. Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch (19-mm) nominal maximum aggregate size; 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch (25-mm) nominal maximum aggregate size.
  5. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

- F. Class F: Normal-weight concrete used for exterior retaining walls.
1. Exposure Class: ACI 318 F3 S0 W0 C2.
  2. Minimum Compressive Strength: As indicated at 28 days.
  3. Maximum w/cm: 0.40.
  4. Air Content:
    - a. Exposure Class F1: 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch (19-mm) nominal maximum aggregate size; 4.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch (25-mm) nominal maximum aggregate size.
    - b. Exposure Classes F2 and F3: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch (19-mm) nominal maximum aggregate size; 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch (25-mm) nominal maximum aggregate size.
  5. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

## 2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and ASTM C1116/C1116M, and furnish batch ticket information.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
  2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
  3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
  - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
  - 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

### 3.2 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
  - 1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
  - 2. Face laps away from exposed direction of concrete pour.
  - 3. Lap vapor retarder over footings and grade beams not less than 6 inches (150 mm), sealing vapor retarder to concrete.
  - 4. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.
  - 5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
  - 6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
  - 7. Protect vapor retarder during placement of reinforcement and concrete.
    - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches (150 mm) on all sides, and sealing to vapor retarder.

### 3.3 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
  2. Place joints perpendicular to main reinforcement.
    - a. Continue reinforcement across construction joints unless otherwise indicated.
    - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
  3. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  5. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
  2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
  3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.
2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

3.4 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.

1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.
3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301 (ACI 301M).
  - a. Do not use vibrators to transport concrete inside forms.
  - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer.

- c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
  - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
  - 1. Do not place concrete floors and slabs in a checkerboard sequence.
  - 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  - 3. Maintain reinforcement in position on chairs during concrete placement.
  - 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
  - 5. Level concrete, cut high areas, and fill low areas.
  - 6. Slope surfaces uniformly to drains where required.
  - 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
  - 8. Do not further disturb slab surfaces before starting finishing operations.

### 3.5 FINISHING FORMED SURFACES

- A. As-Cast Surface Finishes:
  - 1. ACI 301 (ACI 301M) Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
    - a. Patch voids larger than 1-1/2 inches (38 mm) wide or 1/2 inch (13 mm) deep.
    - b. Remove projections larger than 1 inch (25 mm).
    - c. Tie holes do not require patching.
    - d. Surface Tolerance: ACI 117 (ACI 117M) Class D.
    - e. Apply to concrete surfaces not exposed to public view.
  - 2. ACI 301 (ACI 301M) Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.

- a. Patch voids larger than 3/4 inch (19 mm) wide or 1/2 inch (13 mm) deep.
  - b. Remove projections larger than 1/4 inch (6 mm).
  - c. Patch tie holes.
  - d. Surface Tolerance: ACI 117 (ACI 117M) Class B.
  - e. Locations: Apply to concrete surfaces exposed to public view, or to be covered with a coating or covering material applied directly to concrete.
3. ACI 301 (ACI 301M) Surface Finish SF-3.0:
- a. Patch voids larger than 3/4 inch (19 mm) wide or 1/2 inch (13 mm) deep.
  - b. Remove projections larger than 1/8 inch (3 mm).
  - c. Patch tie holes.
  - d. Surface Tolerance: ACI 117 (ACI 117M) Class A.
  - e. Locations: Apply to concrete surfaces exposed to public view, or to be covered with a coating or covering material applied directly to concrete.

B. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.6 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish:

1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch (6 mm) in one direction.
3. Apply scratch finish to surfaces to receive concrete floor toppings.

C. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 (ACI A117M) tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
7. Finish and measure surface, so gap at any point between concrete surface and an unveled, freestanding, 10-ft.- (3.05-m-) long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch (3 mm).

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated on Drawings. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.

1. Coordinate required final finish with Architect before application.
2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
  - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
  - 2. Coordinate required final finish with Architect before application.
- G. Slip-Resistive Finish: Before final floating, apply slip-resistive aluminum granule finish to concrete stair treads, platforms, ramps as indicated on Drawings
  - 1. Apply in accordance with manufacturer's written instructions and as follows:
    - a. Uniformly spread 25 lb/100 sq. ft. (12 kg/10 sq. m) of dampened slip-resistive aluminum granules over surface in one or two applications.
    - b. Tamp aggregate flush with surface, but do not force below surface.
    - c. After broadcasting and tamping, apply float finish.
    - d. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aluminum granules.

### 3.7 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Filling In:
  - 1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
  - 2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
  - 3. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
  - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
  - 2. Construct concrete bases 4 inches (100 mm) high unless otherwise indicated on Drawings, and extend base not less than 4 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
  - 3. Minimum Compressive Strength: As indicated at 28 days.

4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
  5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
  6. Prior to pouring concrete, place and secure anchorage devices.
    - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    - b. Cast anchor-bolt insert into bases.
    - c. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.
1. Cast-in inserts and accessories, as shown on Drawings.
  2. Screed, tamp, and trowel finish concrete surfaces.

### 3.8 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
1. Comply with ACI 301 (ACI 301M) and ACI 306.1 for cold weather protection during curing.
  2. Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M) for hot-weather protection during curing.
  3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h (1 kg/sq. m x h), calculated in accordance with ACI 305.1, before and during finishing operations.
- B. Curing Formed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:
1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
  2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
  3. If forms remain during curing period, moist cure after loosening forms.
  4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:

- a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
  - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
  - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
  - d. Water-Retention Sheetting Materials: Cover exposed concrete surfaces with sheetting material, taping, or lapping seams.
  - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
    - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
    - 2) Maintain continuity of coating and repair damage during curing period.
- C. Curing Unformed Surfaces: Comply with ACI 308.1 (ACI 308.1M) as follows:
- 1. Begin curing immediately after finishing concrete.
  - 2. Interior Concrete Floors:
    - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
      - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
        - a) Lap edges and ends of absorptive cover not less than 12 inches (300 mm).
        - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
      - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive.
        - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
        - b) Cure for not less than seven days.

- 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
  - a) Water.
  - b) Continuous water-fog spray.
- b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
  - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
    - a) Lap edges and ends of absorptive cover not less than 12 inches (300 mm).
    - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
  - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive.
    - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
    - b) Cure for not less than seven days.
  - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
    - a) Water.
    - b) Continuous water-fog spray.
- c. Floors to Receive Polished Finish: Contractor has option of the following:
  - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
    - a) Lap edges and ends of absorptive cover not less than 12 inches (300 mm).
    - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

- 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
  - a) Water.
  - b) Continuous water-fog spray.
- d. Floors to Receive Chemical Stain:
  - 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.
  - 2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
  - 3) Butt sides of curing paper tight; do not overlap sides of curing paper.
  - 4) Leave curing paper in place for duration of curing period, but not less than 28 days.
- e. Floors to Receive Urethane Flooring:
  - 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
  - 2) Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped 6 inches (150 mm) and sealed in place.
  - 3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
  - 4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.
- f. Floors to Receive Curing Compound:
  - 1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
  - 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
  - 3) Maintain continuity of coating, and repair damage during curing period.

- 4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

g. Floors to Receive Curing and Sealing Compound:

- 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

### 3.9 TOLERANCES

- A. Conform to ACI 117 (ACI 117M).

### 3.10 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
  - a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:

- 1) Project name.
- 2) Name of testing agency.

- 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
- 4) Name of concrete manufacturer.
- 5) Date and time of inspection, sampling, and field testing.
- 6) Date and time of concrete placement.
- 7) Location in Work of concrete represented by samples.
- 8) Date and time sample was obtained.
- 9) Truck and batch ticket numbers.
- 10) Design compressive strength at 28 days.
- 11) Concrete mixture designation, proportions, and materials.
- 12) Field test results.
- 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
- 14) Type of fracture and compressive break strengths at seven days and 28 days.

C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

D. Inspections:

1. Headed bolts and studs.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.
5. Verification of concrete strength before removal of shores and forms from beams and slabs.
6. Batch Plant Inspections: On a random basis, as determined by Architect.

- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
    - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  2. Slump: ASTM C143/C143M:
    - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    - b. Perform additional tests when concrete consistency appears to change.
  3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; ASTM C173/C173M volumetric method, for structural lightweight concrete.
    - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  4. Concrete Temperature: ASTM C1064/C1064M:
    - a. One test hourly when air temperature is 40 deg F (4.4 deg C) and below or 80 deg F (27 deg C) and above, and one test for each composite sample.
  5. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.
    - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  6. Compression Test Specimens: ASTM C31/C31M:
    - a. Cast and laboratory cure two sets of three 6-inch (150 mm) by 12-inch (300 mm) or 4-inch (100 mm) by 8-inch (200 mm) cylinder specimens for each composite sample.
    - b. Cast, initial cure, and field cure two sets of three standard cylinder specimens for each composite sample.
  7. Compressive-Strength Tests: ASTM C39/C39M.
    - a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.

- b. Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.
  - c. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa) if specified compressive strength is 5000 psi (34.5 MPa), or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi (34.5 MPa).
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests:
- a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
  - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
    - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301 (ACI 301M), Section 1.6.6.3.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

### 3.11 PROTECTION

- A. Protect concrete surfaces as follows:
  - 1. Protect from petroleum stains.

2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.

END OF SECTION

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## SECTION 04 01 21

### BRICK MASONRY REPAIR

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Repointing mortar joints, repairing brick masonry sills and copings, including replacing units.

##### 1.2 RELATED DOCUMENTS:

- A. Drawings, photos and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

##### 1.3 DEFINITIONS

- A. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.

##### 1.4 REFERENCES

- A. Codes and standards referred to in this Section are:
  1. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
  2. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
  3. STM C91 - Standard Specification for Masonry Cement
  4. ASTM C114 - Standard Test Methods for Chemical Analysis of Hydraulic Cement
  5. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar
  6. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes
  7. ASTM C270 - Standard Specification for Mortar for Unit Masonry

8. ASTM C979 - Standard Specification for Pigments for Integrally Colored Concrete
9. ASTM C1329- Standard Specification for Mortar Cement

## 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  1. Include plans, elevations, sections, and locations of replacement masonry units on the structure.
  2. Show provisions for expansion joints or other sealant joints.
- C. Samples: For each exposed product and for each color and texture specified.
  1. Each type of exposed masonry unit to be used for replacing existing units.
    - a. For each brick type, provide straps or panels containing at least four bricks.
  2. Each type of pointing mortar in the form of sample mortar strips, 6 inches long by 1/2 inch wide, set in aluminum or plastic channels.
    - a. Include with each sample a list of ingredients with proportions of each. Identify sources, both supplier and quarry, of each type of sand and brand names of cementitious materials and pigments if any.
  3. Each type of masonry patching compound in the form of briquettes, at least 3 inches long by 1-1/2 inches wide. Document each sample with manufacturer and stock number or other information necessary to order additional material.
- D. Submit, for verification purposes, samples of the following:
  1. Each new exposed masonry mortar to be used for replacing existing materials. Include in each set of samples the full range of colors and textures to be expected in completed work.
  2. Each type of chemical cleaning material data.
  3. Each type of chemical clear sealer provide manufacturers data.

## 1.6 PROJECT CONDITIONS

- A. Do not repoint mortar joints or repair masonry unless air temperatures are between 40 deg.F and 80 deg..F and will remain so for at least 48 hours after completion of work.

- B. Prevent grout or mortar used in repointing and repair work from staining face of surrounding masonry and other surfaces. Remove immediately grout and mortar in contact with exposed masonry and other surfaces.
- C. Protect sills, ledges and projections from mortar droppings.

## 1.7 SEQUENCING AND SCHEDULING

- A. Order replacement materials at earliest possible date, to avoid delaying completion of the Work.
- B. Perform masonry restoration work in the following sequence:
  - 1. Remove plant growth.
  - 2. Repair existing masonry, including replacing existing masonry with new masonry materials.
  - 3. Rake out joints that are to be repointed.
  - 4. Point mortar and sealant joints.
  - 5. Inspect for open mortar joints and repair before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
  - 6. Clean masonry surfaces.
  - 7. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in masonry units to comply with "Masonry Unit Patching" Article. Patch holes in mortar joints to comply with "Repointing Masonry" Article.

## PART 2 PRODUCTS

### 2.1 MASONRY MATERIALS

- A. Face Brick: As required to complete brick masonry repair work.
  - 1. Brick Matching Existing: Units with colors, color variation within units, surface texture, size, and shape that match existing brickwork, as indicated in
  - 2. Special Shapes: As identified onsite.
  - 3. Provide molded, 100 percent solid shapes for applications where core holes or "frogs" could be exposed to view or weather when in final position and where shapes produced by sawing would result in sawed surfaces being exposed to view.

- a. Mechanical chopping or breaking brick, or bonding pieces of brick together by adhesive, are unacceptable procedures for fabricating special shapes.
- b. Building Brick: ASTM C 62, Grade SW where in contact with earth or Grade SW, MW, or NW for concealed backup; and of same vertical dimension as face brick, for masonry work concealed from view.

## 2.2 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150. Type I or Type 11, except Type III may be used for cold-weather construction; white or gray, or both where required for color matching of mortar.
  1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Masonry Cement: ASTM C 91/C 91M.
- D. Mortar Cement: ASTM C 1329/C 1329M.
- E. Mortar Sand: ASTM C 144.
  1. Exposed Mortar: Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
  2. Colored Mortar: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color to match adjacent existing mortar color.
  3. Match size, texture and gradation of existing mortar as closely as possible.
- F. Mortar Pigments: ASTM C 979, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.
- G. Water: Potable.

## 2.3 MANUFACTURED REPAIR MATERIALS

- A. Brick Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching brick masonry.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Cathedral Stone Products, Inc.

- b. Conproco Corporation.
  - c. Other as approved equal by Engineer.
2. Use formulation that is vapor and water permeable (equal to or more than the masonry unit) exhibits low shrinkage, has-lower modulus of elasticity than masonry. Units being repaired and develops high bond strength to all types of masonry.
  3. Formulate patching compound in colors and textures to match each masonry unit being patched.

#### 2.4 ACCESSORY MATERIALS

- A. Setting Buttons and Shims: Resilient plastic- nonstaining to masonry; sized to suit joint thicknesses and bed depths of masonry units, less the required depth of pointing materials unless removed before pointing.
- B. Other Products: Select materials and methods of use based on the following, subject to approval:
  1. Previous effectiveness in performing the work involved.
  2. Minimal possibility of damaging exposed surfaces.
  3. Consistency of each application.
  4. Uniformity of the resulting overall appearance.
  5. Do not use products or tools that could leave residue on surfaces.

#### 2.5 MORTAR MIXES

- A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.
- B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions. Without Professional's approval.
  1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent.
- C. Do not use admixtures in mortar unless otherwise indicated.
- D. Mixes: Mix mortar materials in the following proportions:

1. Pointing Mortar for Brick Masonry: Comply with ASTM C 270, Proportion Specification, Type N, (Portland cement, lime, and sand).
2. Rebuilding (Setting) Mortar by Volume: ASTM C270, Proportion Specification, 1 part portland cement, 1 part lime, and 6 parts sand.
3. Rebuilding (Setting) Mortar by Type: ASTM C270, Proportion Specification, Type N unless otherwise indicated; with cementitious material limited to portland cement and lime.
4. Rebuilding (Setting) Mortar by Property: ASTM C270, Property Specification, Type N unless otherwise indicated; with cementitious material limited to portland cement and lime.
5. Pigmented, Colored Mortar: Add mortar pigments to produce exposed, setting (rebuilding) mortar of colors required.

## PART 3 EXECUTION

### 3.1 PROTECTION

- A. Protect persons, motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm resulting from masonry restoration work.
  1. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during course of restoration and cleaning work.

### 3.2 BRICK REMOVAL AND REPLACEMENT

- A. At locations indicated, remove bricks that are damaged, spalled, or deteriorated or are to be reused. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.
- B. Support and protect remaining masonry that surrounds removal area.
- C. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.
- D. Notify Engineer of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.
- E. Remove in an undamaged condition as many whole bricks as possible.
  1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.

2. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.
- F. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick replacement.
  - G. Replace removed damaged brick with other removed brick in good condition, where possible, matching existing brick. Do not use broken units unless they can be cut to usable size.
  - H. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.
    1. Maintain joint width for replacement units to match existing joints.
    2. Use setting buttons or shims to set units accurately spaced with uniform joints.
  - I. Lay replacement brick with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter ends with enough mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C 67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per mm. Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.
    1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.
    2. Rake out mortar used for laying brick before mortar sets. Point at same time as repointing of surrounding area.
    3. When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.
  - J. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
    1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

### 3.3 MASONRY UNIT PATCHING

#### A. Patching Bricks

1. Remove loose material from masonry surface. Carefully remove additional material so patch does not have feathered edges but has square or slightly undercut edges on area to be patched and is at least 1/4 inch thick, but not less than recommended in writing by patching compound manufacturer.

2. Mask adjacent mortar joint or rake out for repointing if patch extends to edge of masonry unit.
3. Mix patching compound in individual batches to match each unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.
4. Rinse surface to be patched and leave damp, but without standing Water.
5. Brush-coat surfaces with slurry coat of patching compound according to manufacturer's written instructions.
6. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch or more than 2 inches thick. Roughen surface of each layer to provide a key for next layer.
7. Trowel scrape or carve surface of patch to match texture and surrounding surface plane or contour of masonry unit. Shape and finish surface before or after curing, as determined by testing, to best match existing masonry unit.
8. Keep each layer damp for 72 hours or until patching compound has set.

#### 3.4 REPOINTING MASONRY

- A. Rake out and repoint joints to the following extent:
  1. All joints in areas indicated.
  2. Joints where mortar is missing or where they contain holes.
  3. Cracked joints where cracks can be penetrated at least 1/4 inch by a knife blade 0.027 inch thick.
  4. Cracked joints where cracks are 1/8 inch or more in width and of any depth.
  5. Joints where they sound hollow when tapped by metal object.
  6. Joints where they are worn back 1/4 inch or more from surface.
  7. Joints where they are deteriorated to point that mortar can be easily removed by hand, without tools.
  8. Joints where they have been filled with substances other than mortar.
  9. Joints indicated as sealant-filled joints.
- B. Do not rake out and repoint joints where not required.

- C. Rake out joints as follows, according to procedures demonstrated in approved mockup:
1. Remove mortar from joints to depth of 2-1/2 times joint width, but not less than 1/2 inch or not less than that required to expose sound, unweathered mortar.
  2. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
  3. Do not over-cut joints. Do not spall edges of masonry units or widen joints. Replace or patch damaged masonry units as directed by Engineer.
    - a. Remove existing mortar by hand using mallet and chisels. Based on the repointing mockup, the Engineer may approve the use of power-operated grinders for mortar removal.
    - b. The use of power-operated grinders to remove existing mortar shall be authorized with the Engineer's written consent only, based on submission by Contractor of a satisfactory mockup and continued, demonstrated ability of operators to use tools without damaging masonry.
    - c. Engineer reserves the right to withdraw this consent at any point in the project if Contractor demonstrates an inability to maintain the mortar removal quality established by the mockup.
    - d. Masonry cut or otherwise damaged during mortar removal will be repaired or replaced at no expense to the Owner.
- D. Notify Engineer of unforeseen detrimental conditions including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.
- E. Point joints as follows:
1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
  2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 1/4 inch until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.

3. After low areas have been filled to same depth as remaining joints, point all joints by placing mortar in layers not greater than 1/4 inch. Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing masonry units have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.
  4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
- F. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours including weekends and holidays.
1. Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.
  2. Adjust curing methods to ensure that pointing mortar is damp throughout its depth without eroding surface mortar.
- G. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

### 3.5 CLEANING

- A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or fiber brushes, and clean water, applied by low pressure spray.
1. Do not use metal scrapers or brushes.
  2. Do not use acidic or alkaline cleaners.
- B. Wash adjacent woodwork and other non masonry surfaces. Use detergent and soft brushes or cloths.
- C. Clean mortar and debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.
- D. Sweep and rake adjacent pavement and grounds to remove mortar and debris. Where necessary, pressure wash pavement surfaces to remove mortar, dust, dirt, and stains.

END OF SECTION

## SECTION 04 20 00

### UNIT MASONRY

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Face brick, Concrete Masonry Units, Structural Glazed Tile, masonry mortar and corefill grout, reinforcement, anchorage, flexible flashings, accessories.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 03 20 00 - Concrete Reinforcement
  - 2. Section 03 15 00 - Concrete Accessories
  - 3. Section 03 31 00 - Cast-In-Place Concrete
  - 4. Section 04 01 21 - Brick Masonry Repair
  - 5. Section 05 05 13 - Galvanizing
  - 6. Section 07 27 00 - Fluid Applied Membrane Air Barriers
  - 7. Section 07 90 00 - Joint Sealers

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1 ASTM A 82 - Steel Wire, Plain, for Concrete Reinforcement
  - 2 ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
  - 3 ASTM C 90 - Specification for Load-Bearing Concrete Masonry Units
  - 4 ASTM C 140 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
  - 5 ASTM C 145 - Solid Load-Bearing Concrete Masonry Units
  - 6 ASTM C 216 - Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale)
  - 7 ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials

- |    |                  |   |
|----|------------------|---|
| 8  | ACI-530/ASCE 5   | - Building Code Requirements for Masonry Structures and Specifications for Masonry Structures                       |
| 9  | ACI-530.1/ASCE 6 | - Specifications for Masonry Structures   |
| 10 | ASTM C270        | - Standard Specification for Mortar for Unit Masonry  |
| 11 | ASTM C476        | - Standard Specification for Grout for Masonry  |
| 12 | ASTM C780        | - Standard Test Method for Preconstruction and Construction Evaluation for Mortars for Plain and Reinforced Masonry |
| 13 | ASTM C979        | - Standard Specification for Pigments for Integrally Colored Concrete   |
| 14 | ASTM C1384       | - Standard Specification for Admixtures for Masonry Mortars   |

### 1.3 DEFINITIONS

- A. Reinforced Masonry: Masonry unit containing reinforcing steel in Concrete Masonry Unit (CMU) grouted cells.
- B. Face Brick (FB): Fired clay masonry unit used as a finished exterior veneer.
- C. Structural Glazed Tile (SGT): Extruded and manufactured clay masonry unit with a ceramic glazed face that is a structural unit which can be loadbearing masonry.
- D. Veneer: A single wythe of masonry for facing and weather-resistant purposes, not structurally bonded.

### 1.4 ACTION SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
- B. Product Data: For each different masonry unit, accessory, and other manufactured products specified.
- C. Submit the following for masonry mortar and grout:
  - 1. Furnish notarized certificates of manufacture as evidence that the cement conforms to the specified requirements. Include mill-test reports on the cement.

2. Furnish notarized certificates to verify that the hydrated lime and aggregates meet the specified requirements.
  3. Furnish laboratory tests as evidence that the air content and masonry mortar compressive strength meet the requirements of ASTM C270 Type N and that the efflorescence tendency meets the requirements of the wick test in Brick Institute of America Research Report No. 15.
  4. Furnish laboratory tests as evidence that the masonry grout compressive strength is equal to or greater than 2,500 psi at 28 days.
- D. Samples for Initial Selection: For the following:
1. Brick, unit masonry, and SGT samples in small-scale form showing the full range of colors and textures available for each different exposed masonry unit required.
  2. Colored mortar Samples showing the full range of colors available.
- E. Samples for verification purposes of the following:
1. Full-size units for each different exposed clay brick and masonry unit required showing full range of exposed color, texture, and dimensions to be expected in completed construction.
  2. Strap Samples for SGT: Submit three samples to indicate the approximate range of color and texture to be expected in the completed wall for each color and texture.
  3. Colored mortar Samples for each color required, showing the full range of colors expected in the finished construction. Make samples using the same sand and mortar ingredients to be used on Project. Label Samples to indicate types and amounts of pigments used.
  4. Stone/cast stone trim samples not less than 12 inches in length, showing the full range of colors and textures expected in the finished construction.
  5. Weep holes/vents in color to match mortar color.
  6. Accessories embedded in the masonry.
  7. Flashing.
- F. Shop Drawings: For the following:
1. Brick and Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.

2. Stone/cast stone Trim Units: Show sizes, profiles, and locations of each stone/cast stone trim unit required.
  - a. Provide anchors and attachments of type and size required to support the stone/cast stonework.
3. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Show elevations of reinforcement layout for reinforced walls. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
4. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:
  1. Masonry units and Concrete Masonry Units
    - a. Include material test reports substantiating compliance with requirements.
    - b. For bricks, include size-variation data verifying that actual range of sizes falls within specified tolerances.
    - c. For exposed brick, include material test report for efflorescence according to ASTM C 67.
    - d. For surface-coated brick, include material test report for durability of surface appearance after 50-cycles of freezing and thawing per Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.
  2. Cementitious materials. Include brand, type, and name of manufacturer.
  3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
  4. Reinforcing bars.
  5. Joint reinforcement.
  6. Anchors, ties, and metal accessories.

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  - 1. Provide no less than 3-ft protection on either side.
- B. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
  - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- C. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
- D. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.
- E. Certificates:
  - 1. Material Safety Data Sheet (MSDS)
  - 2. Certification Letter: Submit a certified letter from manufacturer prior to delivery of SGT to the jobsite for compliance with specifications requirements.
- F. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- G. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.
- H. Sample panels: Provide a composite sample panel, including face brick, CMU, SGT, stone/cast stone, bond pattern, mortar color, tooled joints, insulation, air and vapor barrier, reinforcing and backup.
  - 1. Build sample panels for typical exterior wall and interior walls in sizes approximately 60 inches long by 48 inches by full thickness, including face and backup wythes and accessories.

- a. Include a sealant-filled joint at least 16 inches long in each exterior wall mockup.
  - b. Include lower corner of window opening framed with stone/cast stone trim at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
  - c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
  - d. Include veneer anchors, flashing, and weep holes in exterior masonry-veneer wall mockup.
  - e. Include concrete masonry units on one face of interior unit masonry wall mockup.
2. Clean one-half of exposed faces of panels with masonry cleaner indicated.
  3. Protect approved sample panels from the elements with weather-resistant membrane.
  4. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship and for other material and construction qualities specifically approved by Engineer in writing.
    - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Engineer in writing.
  5. Demolish sample panel after Work has been completed.

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. General: Deliver, store, and handle all products and materials as specified in Division 1 and as follows:
  1. Deliver SGT to the jobsite as packaged by manufacturer. Offload SGT packages using equipment that will not damage SGT. No SGT is allowed to be in direct contact with the ground. Do not double stack cubes or SGT.
- B. Masonry units: Handle masonry units in a manner to prevent undue breakage or chipping.
  1. Unload face brick, and concrete masonry units with brick clamps.

2. Keep SGT units in the individual cardboard packaging provided by the manufacturer until the unit is ready to be laid in the wall. Never use brick tongs or “pitch” the SGT to upper levels of scaffolding.
- C. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
1. Cover SGT with non-staining waterproof membrane covering. Keep units dry. Allow air circulation around stacked units. Installation of wet or stained SGT is prohibited.
- D. Deliver preblended, dry mortar mix in their original, unbroken packages or containers with the manufacturer's label thereon. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover. Store accessory materials in weathertight sheds.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.
- F. Reject masonry units that are warped, cracked or of inferior quality and remove them from the Work.
- G. Stone/cast stone: Carefully pack stone/cast stone to prevent damage in transit. Handle stone/cast stone by methods that guard against soiling and mutilation in transit, and from damage at the building site. Store stone/cast stone at the building site on planking set entirely clear of the ground, and protected from damage to and arising from contact with anything which would result in the accumulation of dirt, dust, mud, soot, grease and other staining or disfiguring elements during extended periods of storage at the building site.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
1. Concrete Masonry
    - a. Trenwyth Masonry
    - b. Old Castle / Northfield
  2. Glazed Clay Masonry
    - a. Elgin Butler

- b. Ternwyth Masonry
- 3. Brick Masonry
  - a. Belden Brick
  - b. Glen-Gery Brick
- 4. Pre-blended Mortar and Grout:
  - a. Amermix Preblended Mortar and Corefill Grout
  - b. AMX400 Type N or S Preblended Portland Lime mortar
  - c. AMX405 Type N or S Preblended Portland Lime Color Mortar
  - d. AMX410 Type N or S Preblended Portland Lime Mortar with Water Repellent
  - e. AMX600 Fine or Coarse Preblended Corefill Grout 3000 or 5000psi
- 5. Horizontal Joint Reinforcement, Rebar Positioners Anchors and Ties:
  - a. Hohmann and Barnard, Inc.
- 6. Flexible Flashings:
  - a. York Manufacturing-Copper Fabric Flashing
- 7. Continuous Cavity Drainage Material:
  - a. Cavclear by Archovations inc.
- 8. Water repellent:
  - a. Addiment Incorporated; Block Plus W-10.
  - b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Dry-Block.
  - c. Master Builders, Inc.; Rheopel.

## 2.2 MATERIALS

- A. Concrete Masonry Units (CMUs): concrete masonry units manufactured with lightweight aggregate, integral water repellent where exposed to the exterior and as follows:
  - 1. Hollow Load-Bearing Units: Conform hollow load-bearing units to ASTM C 90, and provide for exterior walls, foundation walls, interior load-bearing

and non-load bearing walls and partitions. Provide units with a compressive strength of 1,900 pounds per square inch over their net area.

2. Solid Load-Bearing Units: Conform solid load-bearing units to ASTM C 90. Provide solid units for masonry bearing under structural framing members and for fireproofing of steel structural members. Provide units with a compressive strength of 3,000 pounds per square inch over their net area.
3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
4. Special Shapes: Provide special shapes, for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions such as closures as necessary to complete the Work.
  - a. Provide bullnose units for outside corners, unless otherwise indicated.
5. Integral Water Repellent: Provide units made with integral water repellent for exposed units.
  - a. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive according to ASTM E 514, with test period extended to 24 hours, show no visible water or leaks on the back of test specimen.

B. Structural Glazed Tile (SGT): Clay masonry units manufactured with horizontal cores.

1. Conform to ASTM C-126 for grade S (Select) quality.
2. Must meet ASTM C-84 (UL723) requirements and rated zero flame spread, zero smoke developed and zero fuel contribution. Also will not release any toxic or noxious fumes when burned at 2000 degrees F.
3. Nominal Face stretcher dimensions matching the existing masonry.
4. Nominal bed depths: 4"
5. Shapes: Furnished as shown on the plans in accordance with manufacturers current standard production. All external corners, sills and jambs shall be bullnose, unless otherwise noted. Lintels and internal corners shall be square unless otherwise noted. The base course is straight as shown on the drawings.
6. Colors: To match existing adjacent SGT.

- C. Face Brick: Provide face brick conforming to ASTM C 216 Grade SW Type FBS.
1. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
  2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
  3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
- E. Mortar And Grout Materials:
1. Portland Cement: ASTM C 15G, Type I or II, except Type III may be used for cold weather construction, Provide natural color or white cement as required to produce mortar color indicated.
  2. Hydrated Lime: ASTM C 207, Type S,
  3. Mortar Cement: ASTM C 1329,
  4. Aggregate for Mortar: ASTM C 144,
  5. Aggregate for Grout: ASTM C 404.
  6. Water: Potable.
- F. Mortar And Grout Mixes:
1. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
    - a. Do not use calcium chloride in mortar or grout.
  2. Preblended, Dry Mortar Mix; Furnish dry mortar ingredients in the form of a preblended mix. Measure quantities by weight to ensure accurate

proportions, and thoroughly blend ingredients before delivering to Project site.

- a. Field mixing of portland cement, lime and sand by hand on the job site is not allowed

3. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification.

- a. Extended-Life Mortar for Unit Masonry: Mortar complying with ASTM C 1142 may be used instead of mortar specified above, at Contractor's option.
- b. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
- c. Use mortar Type N, S, or O per ASTM C270 Table X1.1 Guide for the Selection of Masonry Mortars, or per direction of masonry unit manufacturer.

(1) For reinforced masonry use Type N.

- d. Integral Water Repellant: Where exposed to the exterior, provide compatible preblended mortar with integral water repellant per ASTM C1384.

4. Grout for Unit Masonry: Comply with ASTM C 476.

- a. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Tables of ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.

(1) Use fine grout for masonry voids two inches or less, use coarse grout for masonry voids of two inches or more.

- b. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.

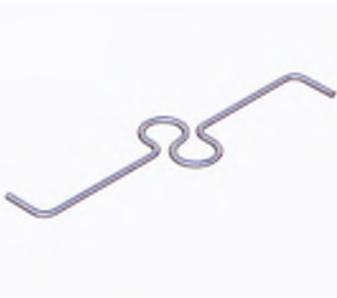
G. Integral Water Repellant: Where exposed to the exterior, provide concrete masonry units and compatible preblended mortar with integral water repellant per ASTM C1384. See Section 09 96 00 High Performance Coatings for requirements of applied sealants to masonry surfaces to be provided in addition to repellant.

H. Preblended Mortar and Corefill Grout: Dry, preblended portland lime mortar and corefill grout mixes conforming to ASTM C270 and ASTM C476. Field mixing of portland cement, lime and sand by hand on the job site is not allowed. Provide integral mortar color as required and as conforms to ASTM C979.

- a. Mortar type N, S, or O per ASTM C270 Table X1.1 Guide for the Selection of Masonry Mortars, or per direction of masonry unit manufacturer.
  - b. Preblended corefill grout: In conformance with ASTM C476. Use fine grout for masonry voids two inches or less, use coarse grout for masonry voids of two inches or more.
  - c. Mixing water must be clean and free from deleterious acids, alkalis and organic matter.
- I. Metal Accessories: Provide hot-dipped galvanized metal anchors, ties, rebar positioners and reinforcements conforming to ASTM A 153, Class B2 that are galvanized after cutting and as required to secure masonry to adjoining construction for interior walls and partitions. Provide Type 304 stainless steel for anchors, anchor slots, ties and horizontal reinforcement for exterior walls.
- J. Reinforcing Bars: Conform deformed reinforcing bars to ASTM A 615 Grade 60.
- K. Rebar Positioners:
- 1. Provide 9 gauge vertical Spyra-Lox rebar positioners spaced at 48-inch centers maximum.



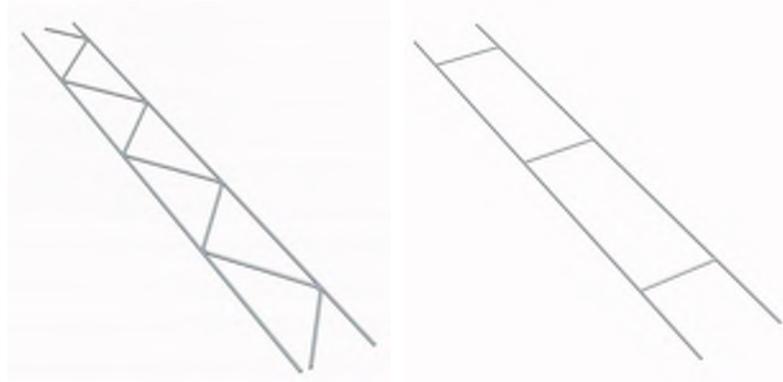
- 2. Provide 9 gauge horizontal rebar positioners spaced at 48-inch centers maximum.



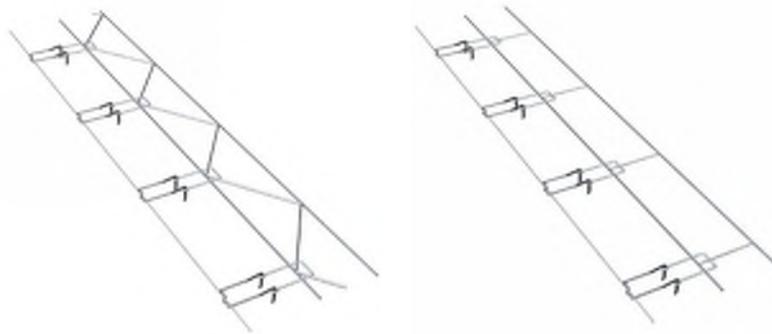
- L. Horizontal Joint Reinforcement: Provide horizontal reinforcing 2 inches less in width than the actual thickness of the wall or partition in which it is to be placed.

Horizontal joint reinforcement product numbers are listed solely for the purpose of indicating the type and quality of materials desired.

1. Corners and tee intersections: Reinforce with prefabricated corner or tee modules with same wall reinforcing type: standard 9-gauge (.148 inch) side rods by 9-gauge (.148-inch) cross rods placed in the same course as the wall reinforcing.
2. Solid interior or exterior masonry walls: Reinforce horizontally with No. 120 Truss Mesh, or 220 Ladder Mesh, standard 9-gauge (.148-inch) side rods by 9-gauge (.148-inch) cross rods.



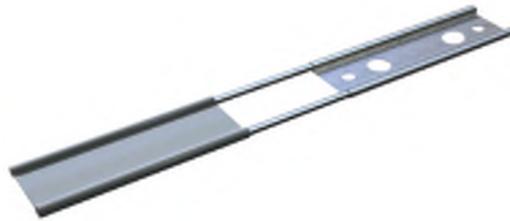
- M. Exterior Cavity Walls: For brick unit veneer anchored to CMU back-up walls: At contractor's option HB 170-2X-SH Adjustable Truss type Eye-wire with 2X seismic hook or HB 270-2X-SH Adjustable Ladder type Eye-wire with 2X seismic hook.



- N. Where required for seismic control, at brick unit veneers anchored to concrete walls, beams, columns and structural members: HB-213-2X S.I.S adjustable stainless steel veneer anchor with "2X-Hook" and seismic clip interlock system.



- O. Slip Joint Masonry Tie: Bonds masonry walls and restrains lateral movement while allowing expansion and control joints to perform as designed. Field bend to connect intersecting walls, or new walls to existing walls. Provide to be Hot Dipped Galvanized.



- P. Rigid Partition Anchors: Provide plain steel anchors 1-inch wide, 3/16-inch thick, and 18 inches long (minimum) between bent ends. Bend each end down minimum 3 inches into mortar filled cells.



- Q. Column Anchors: Provide stainless steel wire column ties 351 and/or 352 spaced 24-inch on centers for anchoring masonry to structural columns.

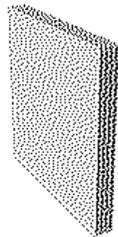


- R. Stone/cast stone and Strap Anchor: Provide stainless steel type 304 stone/cast stone and strap anchors in thickness required to maintain structural stability. If anchor types specified are not adequate provide stainless steel 304 anchors as

needed or recommended by stone/cast stone manufacturer for proper stone/cast stone installation.



- S. Metal Fastenings: Provide bolts, metal wall plugs or other approved metal fastenings for securing furring to masonry and elsewhere as necessary.
- T. Weep Vents: Provide 3/8-inch wide, 3-1/2 inches deep, and brick height rectangular, plastic vents made of clear Polypropylene tested in conformance with ASTM D2240, ASTM D790B, ASTM D638, and ASTM D1238B.



- U. Anchors, Cramps and Dowels for Stone/cast stone: Provide materials of Type 304 stainless steel.
- V. Rigid Partition Anchors: Provide 1-inch wide minimum, 3/16-inch thick and 18 inches long between bent ends steel anchors. Bend each end down 3 inches minimum into the mortar filled cells.
- W. Partition Top Anchor: Provide 3/8-inch diameter round anchor with minimum 12 gauge strip.
- X. Flashing Materials:
  - 1. Laminated Copper Flashing:
    - a. Description: Asphalt free copper fabric flashing, 5 ounce minimum weight.
    - b. Material: CDA 110 Alloy Copper sheet with 060 temper conforming to ASTM B 370 bonded with a rubber based adhesive , between two layers of fiberglass fabric.

- c. Acceptable Products:
  - (1) Copper Sealtite 2000, Advanced Building Products, Inc.
  - (2) Multi-Flash 500 Series Asphalt Free, York Manufacturing, Inc.
  - (3) Cooper-Fabric SA Self-Adhereing Flasing, Hohmann & Barnard, Inc.
- 2. Laminated Stainless Steel:
  - a. Description: Stainless steel core flashing with polymer fabric laminated to the bottom stainless steel face with non-asphalt adhesive: ASTM A240, Type 304, 2D annealed finish, soft temper, 20 gage minimum.
  - b. Acceptable Products:
    - (1) Mighty-Flash Stainless Steel Fabric Flashing. Hohmann & Barnard, Inc.
    - (2) Multi-Flash Series Asphalt Free, York Manufacturing, Inc.
  - 3. Accessories: Provide solder sealants, and mastics as required by flashing manufacturer to maintain flashing joints watertight.
- Y. Continuous Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
  - 1. Provide the following:
    - a. Sheets or strips full depth of cavity and installed to full height of cavity.
    - b. Sheets or strips not less than 3/4 inch thick and installed to full height of cavity with additional strips 4 inches high at weep holes and thick enough to fill entire depth of cavity and prevent weep holes from clogging with mortar.
    - c. Available products:
      - (1) CavClear Masonry Mat. Archovations, Inc.
- Z. Mortar/Grout Screen: Provide monofilament screen of non-corrosive polypropylene polymers 1/4-inch mesh hardware cloth. Install below all block courses that are to be filled with mortar or grout and to insure full embedment of masonry veneer ties to the mortar joint.

- AA. Preformed Control Joint Gasket: provide pre molded gaskets made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- BB. Cleaning Solutions: Use nonacidic clean water and soap powders which are not harmful to masonry work or adjacent materials.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install materials in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.
- B. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
- F. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.
- G. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
  - 1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
  - 2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.

3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
- H. Cutting and Fitting: Cut and fit for chases pipes, conduit, sleeves, grounds, and other items specified elsewhere. Coordinate the Work to provide correct size, shape, and location
- I. Preblended Mortar and Preblended Corefill Grout: Follow manufacturers recommendations for mixing times and processes, including but not limited to:
1. Tool mortar joints when thumbprint hard
  2. Retemper mortar by adding additional mixing water only to replace water lost due to evaporation.
  3. Do not retemper colored mortars.
  4. Discard mortar 2.5 hours after initial mixing.
  5. Installation of mortar and grout shall be in accordance with ACI/ASCE-530.1.
  6. Clean masonry with the least aggressive cleaning solution and technique possible to achieve satisfactory results. Comply with cleaning procedure and recommendations of the manufacturers of both the cleaning solution and the unit masonry. Utilize the same cleaning procedure on the sample panel.
  7. Protect installed work from damage due to subsequent construction activity on the site.
  8. Follow cold-weather and hot-weather standard practices per the BIA, IMI and NCMA.
- J. Preblended Mortar and Preblended Corefill Grout Testing:
1. Test preblended corefill grout per ASTM C1019. Three (3) test specimens shall constitute one sample. A strength test shall be the average of the strengths of the specimens tested at 7 days and 28 days. The compressive strength will be considered satisfactory if the average of the three consecutive tests of the grout is equal to or greater than the specified strength and no individual strength test falls below the specified strength by more than 500 psi.

### 3.2 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type

joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.
- G. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.
  - 1. Install compressible filler in joint between top of partition and underside of structure above.
  - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c., unless otherwise indicated.
  - 3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
  - 4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 07 Section "Fire-Resistive Joint Systems."

### 3.3 MORTAR BEDDING AND JOINTING

- 1. Lay hollow concrete masonry units as follows:
  - a. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.

- b. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
  - c. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
  - d. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
2. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- B. Set cast-stone/cast stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
  2. Wet joint surfaces thoroughly before applying mortar.
  3. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

### 3.4 CAVITY WALLS

- A. Bond wythes of cavity walls together using the following method:
1. Masonry Joint Reinforcement: Installed in horizontal mortar joints
    - a. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.
  2. Masonry Veneer Anchors: Comply with requirements for anchoring masonry veneers.
- B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.
- C. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown. In any case install insulation strictly following manufacturer's recommendations.

1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.
2. Coordinate with air barrier to assure compatibility between the barrier and the adhesive being used to adhere the insulation.

### 3.5 MASONRY JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
  1. Space reinforcement not more than 16 inches o.c.
- B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.

### 3.6 ANCHORING MASONRY TO STRUCTURAL MEMBERS

- A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:
  1. Provide an open space not less than 1/2 in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar and other rigid materials.
  2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure.
  3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

### 3.7 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to concrete and masonry backup with seismic masonry-veneer anchors to comply with the following requirements:
  1. Fasten screw-attached and seismic anchors to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
  2. Embed tie sections, connector sections and continuous wire in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.

3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 24 inches o.c. horizontally with not less than 1 anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

### 3.8 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry as follows [using one of the following methods:
  1. Install preformed control-joint gaskets designed to fit standard sash block.
- C. Form expansion joints in brick made from clay or shale as follows:
  1. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants."

### 3.9 LINTELS

- A. Unless otherwise indicated provide masonry lintels and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.
- B. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

### 3.10 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install flashing as follows, unless otherwise indicated:
  1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, finish flashings with a termination bar and seal bar against wall as shown on drawings.
  3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
- C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- D. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing. Install vents a top of walls immediately below parapet coping bottom edge and sills and as follows:
1. Use specified weep/vent products to form weep holes.
  2. Space weep/vent holes 24 inches o.c. unless otherwise indicated.

### 3.11 REINFORCED UNIT MASONRY INSTALLATION

Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
  2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
  2. Limit height of vertical grout pours to not more than 60 inches unless high-lift grouting is allowed by Structural Engineer.

### 3.12 STONE/CAST STONework

- A. Set stone/cast stonework in carefully prepared nonstaining mortar.

- B. Set stone/cast stone using stone/cast stone setters, true to line and level, with each joint entirely filled with mortar unless otherwise indicated. Use soft lead pads or plastic buttons where necessary to prevent crushing of mortar under heavy blocks. Do not set heavy stone/cast stone or projecting courses until the mortar in courses underneath have hardened, and securely prop all projecting stone/cast stone until the wall above it is built.
- C. Provide all joints of a uniform 3/8-inch thickness. Rake all face joints in stone/cast stone masonry out 3/4-inch, brush clean and caulk with sealant in accordance with Section 07 90 00 unless otherwise indicated.
- D. Provide relief joints in all stone/cast stonework at intervals not to exceed 50 feet on centers.
- E. Set copings and all projecting stone/cast stone with wash surfaces, with the vertical and top joints free of mortar. Caulk the face or profile of these joints over a backup material in accordance with Section 07 90 00. Prior to caulking, prime all joints with a saturating coat of caulking compound primer as recommended by the caulking compound manufacturer, returning at least 1/2-inch on the face of the stone/cast stone.
- F. Patching or concealing of defects in exposed stone/cast stone surfaces is not permitted. Remove and replace any pieces damaged or found to be defective with perfect pieces.
- G. Bond Beams: Unless noted otherwise, provide bond beams at head sill of masonry openings and where wall is anchored to the structure. Reinforce with 2 #5 rebars. At masonry openings provide minimum 8" bearing both sides.

### 3.13 CLEANING

- A. Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Engineer's approval of sample cleaning before proceeding with cleaning of masonry.
  3. Protect adjacent stone/cast stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.

4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
  6. Clean stone/cast stone trim to comply with stone/cast stone supplier's written instructions.
- C. Environmental Conditions: Maintain materials and surrounding air temperature to minimum 50 degrees F prior to, during, and 72 hours after completion of masonry work. Do not erect masonry when the ambient temperature is below 32 degrees F with a rising or falling temperature, or when there is a probability of such a condition existing within 48 hours, unless special provisions are made for heating the materials and protecting the Work from freezing. Work will not be permitted with or on frozen materials. Use of masonry units having a film of frost on their surfaces will not be permitted.

END OF SECTION

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## SECTION 05 05 13

### GALVANIZING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: All galvanizing of metals when such coating is specified, except as otherwise shown, specified or required.

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
1. ASTM A 123 - Specification for Zinc-Coated (Hot-Dip Galvanized) Coatings on Iron and Steel Products
  2. ASTM A 153 - Specification for Zinc Coating (Hot-Dip) On Iron and Steel Hardware
  3. ASTM A 924 - Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
  4. ASTM A 385 - Practice for Providing High-Quality Zinc-Coatings (Hot-Dip)
  5. ASTM A 392 - Specification for Zinc-Coated Steel Chain-Link Fence Fabric
  6. ASTM A 53 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
  7. ASTM A 121 - Specification for Zinc-Coated (Galvanized) Steel Barbed Wire
  8. ASTM A 143 - Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
  9. ASTM A 384 - Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanization of Steel Assemblies
  10. ASTM B 6 - Specification for Zinc (Slab Zinc)
  11. MIL-P-21035B - Paint High Zinc Dust Content, Galvanizing Repair

12. MIL-P-26915C - Primer Coating Zinc Dust Pigmented for Steel Surfaces

PART 2 PRODUCTS

2.1 MATERIALS

- A. Standard: Meet the requirements of ASTM B 6 and "Prime Western" grade, or equal, for zinc for galvanizing, zinc coating or plating.

PART 3 EXECUTION

3.1 PREPARATION

- A. General: Blast clean or grind smooth wrought metals and castings. Tumble and grind flush all high spots when a smooth coat is required for castings. Normalize castings to prevent cracking.
- B. Base Metal Cleaning: Thoroughly clean base metal. Remove all welding slag and burrs. Remove surface contaminants and coatings which would not be removable by the normal chemical cleaning process in the galvanizing operation, by blast cleaning, by immersion in a caustic bath, acid pickle and flux or other approved method.
- C. Product Preparation: Fabricate structural steel products and assemblies to be galvanized in accordance with ASTM A 143, A 384, A385 and Class I guidelines as shown in "Recommended Details of Galvanized Structures" as published by American Galvanizers Association, Inc.

3.2 APPLICATION

- A. Hot Dip: Use the hot-dip process for galvanizing as required by the appropriate ASTM and American Galvanizers Association, Inc. specifications.
  - 1. Do not allow the dipping to come in contact with or rest upon the dross during the operation.
  - 2. Do not use procedures tending to agitate the dross.
- B. Required Facilities: Perform the galvanizing and coating in a plant having the required facilities to produce the quality of coatings specified and with ample capacity for the volume of work required. Handle and ship galvanized material in a manner which will avoid damage to the zinc coating.
- C. Requirements: Perform galvanizing in accordance with the requirements of the following specifications:

	<u>Item</u>	<u>ASTM</u>
1.	Iron and steel products	A 123
2.	Iron and steel hardware	A 153
3.	Chain for chainwheel operators	A 153
4.	Chainwheels and Guides	A 123
5.	Steel sheets	A 924
6.	Assembled products	A 385 & A 123
7.	Steel chain link fence fabric	A 392 Class II
8.	Steel pipe	A 53
9.	Steel barbed wire	A 121

### 3.3 INSTALLATION

- A. Field Coating for Touch-Up: Coat all field welds, abraided areas where damage is more than 3/16-inch wide or uncoated cut edges in material more than 1/10-inch thick with an organic zinc-rich paint complying with MIL-P-21035B or MIL-P-26915C in multiple coats to dry film thickness of 8 mils.

END OF SECTION

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SECTION 05 12 00  
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural steel.
2. Shear stud connectors, shop welded.
3. Shrinkage-resistant grout.

B. Related Requirements:

1. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.

1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.
4. Anchor rods.
5. Threaded rods.
6. Forged-steel hardware.
7. Shop primer.

8. Galvanized-steel primer.
9. Etching cleaner.
10. Galvanized repair paint.
11. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.

C. Delegated Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by the licensed Illinois structural engineer responsible for their preparation.

#### 1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Mill test reports for structural-steel materials, including chemical and physical properties.

C. Source quality-control reports.

D. Field quality-control reports.

E. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

#### 1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.

C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1.

#### 1.7 SUSTAINABILITY

A. Submit an EPD for each structural steel type specified in the Steel section of the structural general notes.

B. Hot-rolled sections shall be made up of at least 75% recycled content on average for the Project.

C. Plate shall be produced via the Electric Arc Furnace (EAF) method.

D. Hollow Structural Sections (HSS) shall be manufactured from material produced via the Electric Arc Furnace (EAF) method.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
  - 1. ANSI/AISC 303.
  - 2. ANSI/AISC 360.
  - 3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
  - 1. Design connections and final configuration of member reinforcement at connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer.
    - a. Use Load and Resistance Factor Design; data are given at factored-load level.
- C. Moment Connections: Type FR, fully restrained.
- D. Construction: Moment frame.

### 2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992.
- B. Channels, Angles, M-Shapes , S-Shapes: ASTM A36.
- C. Plate and Bar: ASTM A36.
- D. Cold-Formed Hollow Structural Sections: ASTM A500, Grade C structural tubing.
- E. Steel Pipe: ASTM A53, Type E or Type S, Grade B.
- F. Welding Electrodes: Comply with AWS requirements, 70XX electrodes with low-hydrogen coverings.

### 2.3 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.
  - 1. Direct-Tension Indicators: ASTM F959, Type 325-1, compressible-washer type with plain finish.
- B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125, Grade A490, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F959, Type 490-1, compressible-washer type with plain finish.
  - C. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- 2.4 RODS
- A. Headed Anchor Rods: ASTM F1554, Grade 36, straight.
    1. Finish: Plain.
  - B. Threaded Rods: ASTM A36.
    1. Finish: Plain.
- 2.5 FORGED-STEEL STRUCTURAL HARDWARE
- A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.
- 2.6 PRIMER
- A. Steel Primer:
    1. Comply with Section 099600 "High-Performance Coatings."
- 2.7 SHRINKAGE-RESISTANT GROUT
- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
- 2.8 FABRICATION
- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
  - B. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1 and manufacturer's written instructions.
- 2.9 SHOP CONNECTIONS
- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
  - B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

## 2.10 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123.
  - 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

## 2.11 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
  - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
  - 2. Surfaces to be field welded.
  - 3. Surfaces of high-strength bolted, slip-critical connections.
  - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
  - 5. Galvanized surfaces unless indicated to be painted.
  - 6. Surfaces enclosed in interior construction.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
  - 1. SSPC-SP 2.
- C. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

## 2.12 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
  - 1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
  - 2. Bolted Connections: Inspect and test shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
  - 3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1 and the following inspection procedures, at testing agency's option:
    - a. Liquid Penetrant Inspection: ASTM E165/E165M.

- b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
  - c. Ultrasonic Inspection: ASTM E164.
  - d. Radiographic Inspection: ASTM E94/E94M.
4. Refer to drawings for specified extents of testing required.
  5. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1.
  6. Prepare test and inspection reports.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, decking and bracing are in place unless otherwise indicated.

#### 3.3 ERECTION

- B. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- C. Baseplates, Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  1. Set plates for structural members on wedges, shims, or setting nuts as required.
  2. Weld plate washers to top of baseplate.
  3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.

4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.

D. Maintain erection tolerances of structural steel within ANSI/AISC 303.

E. Splice members only where indicated.

F. Do not use thermal cutting unless approved by Architect. Finish thermally cut sections with smoothness limits in AWS D1.1.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

### 3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: Snug tightened unless noted otherwise on drawings.

2. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

3. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

### 3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.

2. Verify weld materials and inspect welds.

3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

D. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

E. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1 and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E165/E165M.

2. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3. Ultrasonic Inspection: ASTM E164.
4. Radiographic Inspection: ASTM E94/E94M.
5. Refer to drawings for specified extents of required testing.

END OF SECTION

## SECTION 05 31 00

### STEEL DECKING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Roof deck.
2. Composite floor deck.

##### 1.2 ACTION SUBMITTALS

###### A. Product Data:

1. Roof deck.
2. Composite floor deck.

###### B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

##### 1.3 INFORMATIONAL SUBMITTALS

###### A. Certificates:

1. Welding certificates.
2. Product Certificates: For each type of steel deck.

###### B. Test and Evaluation Reports:

1. Product Test Reports: For tests performed by a qualified testing agency, indicating that power-actuated mechanical fasteners comply with requirements.
2. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.

###### C. Field Quality-Control Submittals:

1. Field quality-control reports.

D. Qualification Statements: For welding personnel and testing agency.

#### 1.4 QUALITY ASSURANCE

A. Qualifications:

1. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding code:

a. AWS D1.3.

B. FM Approvals' RoofNav Listing: Provide steel roof deck evaluated by FM Approvals and listed in its "RoofNav" for Class 1 fire rating and Class 1-90 windstorm ratings. Identify materials with FM Approvals Certification markings.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.

B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.

C. Superimposed Load and Diaphragm Shear Capacities: Shall be computed in accordance with the requirements of SDI.

#### 2.2 ROOF DECK

A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:

1. Galvanized- and Shop-Primed Steel Sheet: ASTM A653, Structural Steel (SS), Grade 50, G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.

a. Color: Manufacturer's standard.

2. Deck Profile: As indicated.
3. Profile Depth: As indicated.
4. Design Uncoated-Steel Thickness: As indicated.
5. Span Condition: As indicated.
6. Side Laps: Overlapped.

### 2.3 COMPOSITE FLOOR DECK

- A. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with SDI C, with the minimum section properties indicated, and with the following:
  1. Galvanized-Steel Sheet: ASTM A653, Structural Steel (SS), Grade 50, G60 zinc coating.
  2. Profile Depth: As indicated.
  3. Design Uncoated-Steel Thickness: As indicated.
  4. Span Condition: As indicated.

### 2.4 ACCESSORIES

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 50,000 psi, not less than 0.0474-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 50,000 psi, of same material and finish as deck, and of thickness and profile indicated.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

- H. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- I. Galvanizing Repair Paint: ASTM A780.
- J. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Install deck panels and accessories in accordance with SDI C and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

#### 3.2 INSTALLATION OF ROOF DECK

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
  - 1. Weld Diameter: 5/8 inch, nominal.
  - 2. Weld Spacing: As indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 12 inches, and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
1. End Joints: Lapped 2 inches minimum.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one fastener at each corner.
1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels in accordance with deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive in accordance with manufacturer's written instructions to ensure complete closure.

### 3.3 INSTALLATION OF FLOOR DECK

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
1. Weld Diameter: 5/8 inch, nominal.
  2. Weld Spacing:
    - a. Space and locate welds as indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 12 inches, and as follows:
1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
  2. Mechanically clinch or button punch.
  3. Fasten with a minimum of 1-1/2-inch-long welds.

- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
  - 1. End Joints: Butted.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure in accordance with SDI recommendations unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, in accordance with SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

### 3.4 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.
- B. Repair Painting:
  - 1. Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
  - 2. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
  - 3. Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
  - 1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.
    - a. Field welds will be subject to inspection.
  - 2. Steel decking will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 05 50 00

### METAL FABRICATIONS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Steel, aluminum and stainless-steel items, including nosings, ladders, safety posts, thresholds, anchors, bolts and accessories required for the attachment of items specified herein, and other items shown, to complete the Work in accordance with the Contract Documents.
- B. Related Work Specified In Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 03310 - Cast-In-Place Concrete
  - 2. Section 05085 - Galvanizing
  - 3. Section 05120 - Structural Steel
  - 4. Section 05520 - Handrails and Railings
  - 5. Section 07724 - Roof Hatches
  - 6. Section 08120 - Aluminum Doors and Frames
  - 7. Section 09900 - Painting

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ASTM A 36/A36 - Structural Steel
  - 2. ASTM A 193/A193M  
Grade MT316 - Stainless Steel Bolts
  - 3. ASTM A 283/A283M - Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
  - 4. ASTM A 554 - Welded Stainless Steel Mechanical Tubing
  - 5. ASTM B 137 - Method for Measurement of Mass of Coating on Anodically Coated Aluminum

- 6. ASTM B 244 - Method for Measurement of Thickness of Anodic Coatings on Aluminum and Other Nonconductive Coatings on Nonmagnetic Basic Metals with Eddy-Current Instruments
- 7. FS FF-S-325 - Expansion Shields for Masonry Anchorage
- 8. FS FF-B-588 - Toggle Bolts
- 9. ANSI A14.3 - Safety Requirements for Fixed Ladders

### 1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

### 1.4 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.

### 1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Nonslip aggregates and nonslip-aggregate surface finishes.
  - 2. Fasteners.
  - 3. Shop primers.
  - 4. Shrinkage-resisting grout.
  - 5. Slotted channel framing.
  - 6. Manufactured metal ladders.
  - 7. Metal ships' ladders.
  - 8. Abrasive metal nosings
- B. Sustainable Design Submittals
  - 1. Environmental Product Declaration: For each product.
  - 2. Health Product Declaration: For each product.
  - 3. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

- C. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
1. Steel framing and supports for overhead doors.
  2. Steel framing and supports for countertops.
  3. Steel framing and supports for mechanical and electrical equipment.
  4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
  5. Elevator machine beams, hoist beams, and divider beams.
  6. Steel shapes for supporting elevator door sills.
  7. Shelf angles.
  8. Metal ladders.
  9. Elevator pit sump covers.
  10. Metal ships' ladders.
  11. Miscellaneous steel trim including steel angle corner guards.
  12. Abrasive metal nosings.
  13. Loose steel lintels.
- D. Samples for Verification: For each type and finish of extruded nosing.
- E. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.
- C. Welding certificates.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- E. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

## 1.7 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

## 1.8 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01450 "Quality Requirements," to design ladders.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

### 2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Wide Flange Shapes and Tees: ASTM A 992/A 992M.
- C. Steel Pipe Structural Shapes: ASTM A 53/A 53M, Grade B, FY= 35 ksi ASTM A501, FY=36 ksi.
- D. Round Hollow Structural Sections (HSS): ASTM A 500/A 500M, Grade B, FY=42 ksi or ASTM A1085.
- E. Square or Rectangular Hollow Structural Sections (HSS): ASTM A 500/A 500M, Grade B, FY=46 ksi or ASTM A1085.
- F. Base Plates and Rigid Frame Continuity Plates: ASTM A572, Grade 50.

- G. Channels, Angles, M , S-Shapes: ASTM A 36/A 36M.
- H. Plate and Bar: ASTM A 36/A 36M.
- I. Structural steel, shapes and plates, except plates to be bent or cold-formed: ASTM A 36/A36M.
- J. Steel plates, bent or cold-formed: ASTM A 283/A283M, Grade C
- K. Steel bars and bar size shapes: ASTM A 36/A36M
- L. Welding Electrodes: Comply with AWS A5.1 or A5.5, E70XX with min. CVN Toughness of 20FT-LBF at 20 degrees F.
- M. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 316.
- N. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- O. Stainless-Steel Pipe: ASTM A 554 Grade MT304
- P. Stainless-steel Bolts: ASTM A 193/A193M, Grade MT316 85 percent copper, 5 percent lead, tin and zinc, unless otherwise specified.
- Q. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- R. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
- S. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
  - 1. Size of Channels: 1-5/8 by 1-5/8 inches.
  - 2. Material: Galvanized steel, ASTM A 653/A 653M, commercial steel, Type B, with G90 coating; 0.079-inch nominal thickness.
  - 3. Material: Cold-rolled steel, ASTM A 1008/A 1008M, commercial steel, Type B; 0.0677-inch minimum thickness; unfinished hot-dip galvanized after fabrication.
- T. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.
  - 1. Aluminum castings thresholds and the like. Ornamental. Alloy 356-T6, Alloy 214-F
  - 2. Aluminum screw machine parts Alloy 2024-T4
  - 3. Aluminum nosing extrusions Alloy 6063-T5

- 4. Structural aluminum Alloy 6061-T6
- 5. Aluminum bar Alloy 6061-T6511

### 2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

- 1. F'c: 5,000 psi.

### 2.4 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts: ASTM A 325-N or ASTM F-1852.

- B. Anchor Rods: ASTM F 1554, Grade 36 (weldable), straight.

- 1. Nuts: ASTM A 563 heavy-hex carbon steel.
- 2. Plate Washers: ASTM A 36/A 36M carbon steel.
- 3. Washers: ASTM F 436, Type 1, hardened carbon steel.
- 4. Finish: Plain.

- C. Smooth and Threaded Rods: ASTM A 36/A 36M.

- 1. Nuts: ASTM A 563 heavy-hex carbon steel.
- 2. Washers: ASTM F 436, Type 1, hardened carbon steel.
- 3. Finish: Plain.

### 2.5 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

- 1. Provide stainless-steel fasteners for fastening aluminum.
- 2. Provide stainless-steel fasteners for fastening stainless steel.

- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.
- D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
  - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
- F. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- G. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.
- H. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

## 2.6 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 09900 "Painting."
- B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

## 2.7 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.
  - 5. Continuously weld exposed joints their entire length unless otherwise shown or specified.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Provide for anchorage of type indicated, coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- I. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c. unless otherwise indicated.
- J. Form all Work true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture, and free from defects impairing

strength or durability. Precision fitting and jointings are required for all Work. Perform all welding in a way to prevent pitting or discoloration.

- K. Miscellaneous: Perform all drilling, tapping, cutouts, and reinforcement required to attach, insert or fit thereto, fixtures and fittings in accordance with the drawings templates or instruction for the fixtures and fittings. Do not begin fabrication of metalwork until all drawings, templates or instructions are available.

## 2.8 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
  - 1. Fabricate units from slotted channel framing where indicated.
  - 2. Furnish inserts for units installed after concrete is placed.
- C. Galvanize miscellaneous framing and supports where indicated.

## 2.9 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.
  - 1. Provide mitered and welded units at corners.
  - 2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Provide Grade 316 stainless-steel shelf angles located in exterior walls.
- D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

## 2.10 MATERIALS

- A. Provide lead expansion anchors for concrete meeting the requirements of FS FF-S-325, wedge type, Group II, Type 4, Class 1 or 2; self-drilling type, Group III, Type I or nondrilling type, Group VIII, Type 1 or 2.

- B. Provide bolt anchor expansion shields for masonry meeting the requirements of FS FF-S-325, lag shield type, Group II, Type I, or split shield type, Group II, Type 3, Class 3.
- C. Provide expansion bolts of Grade 316MT stainless steel.
- D. Provide gauges specified to refer to U.S. Standard gauge for sheet steel, plate iron and steel, and to Brown & Sharp Gauge for wire and sheet aluminum.
- E. Provide stainless steel screws, bolts, nuts and similar items used in connection with galvanized exterior Work.
- F. Anodically treat aluminum to meet the test requirements of ASTM B 137 for weight and ASTM B 244 for thickness.

## 2.11 ABRASIVE METAL NOSINGS

- A. Cast-Metal Units: Cast iron, with an integral-abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
  - 1. Source Limitations: Obtain units from single source from single manufacturer.
  - 2. Nosings: Ribbed bar abrasive nonslip inset nosings for casting into concrete.
    - a. Width: 3-inches
    - b. Base: 6063 T-5 Extruded aluminum alloy
    - c. Base finish: Mill
    - d. Nose type: Short Tipped Nose
    - e. Length: Terminate no more than 3-inches from end of step.
    - f. Thread abrasive filler: Bar type ribbed virgin grain Aluminum Oxide and/or Silicon Carbide. Filler shall be continuous throughout entire tread. Color shall extend uniformly throughout filler.
    - g. Color:
      - (1) Safety yellow for exterior stairs
      - (2) Photo luminescent for interior stairs
    - h. Install nonslip nosings at the edge of each stair landing and platform
    - i. Finish flush with top of the traffic surface.
  - 3. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

4. Apply bituminous paint to concealed surfaces of cast-metal units.
- B. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.
- a. Wooster Products, Inc., Wooster, OH
  - b. Nystorm, Inc., Mineapolis, MN

## 2.12 METAL LADDERS

- A. General:
1. Comply with ANSI A14.3, and OSHA requirements
  2. Delegated Design: Provide ladders designed by an engineer with experience in the design of ladders similar to the ones in this work, and licensed to practice in the state where the project is located.
- B. Aluminum Ladders:
1. Space siderails 16 inches apart unless otherwise indicated.
  2. Siderails: Continuous, 1/2-by-2-1/2-inch aluminum flat bars, with eased edges.
  3. Rungs: 3/4-inch- diameter aluminum bars.
    - a. Space rungs uniformly and at not more than on 12-inch centers.
    - b. Fit rungs in centerline of siderails; weld and grind smooth on outer rail faces.
    - c. Punch rails, pass rungs through rails, and weld on outside.
    - d. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
  4. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch in least dimension.
  5. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted aluminum brackets.
    - a. Fasten to concrete or masonry with stainless steel expansion bolts, unless otherwise indicated. Weld connections between brackets and rails of ladders.

## 2.13 LADDER SAFETY POST

- A. Install a ladder safety post at the top of all fixed ladders and cast-in ladder rungs below floor and sidewalk doors and roof hatches
- B. Provide the device manufactured of high-strength galvanized steel and include a telescoping section that locks automatically when fully extended. Control upward and downward movement by a spring balancing mechanism with the spring of a special corrosion-resistant alloy. Assemble the unit completely and install it in strict accordance with the manufacturer's instruction. Coat contact surfaces between dissimilar metals as specified in Section 09900.
- C. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.
  - 1. The Bilco Company, New Haven, CT, Model 2 Ladder Up

## 2.14 THRESHOLDS

- A. Provide thresholds for door openings of cast abrasive aluminum, and extruded aluminum, at locations shown on the drawings. Provide 6-inch wide thresholds of the types indicated. Make thresholds the full width of door openings, ends notched to fit the door jambs, and secured to the concrete base with lead expansion shields and stainless-steel bolts.
  - 1. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.
    - a. Wooster Products, Inc., Wooster, OH,
      - (1) Type 115S - Exterior
      - (2) Type 115 – Interior

## 2.15 LOOSE LINTELS

- A. Fabricate loose lintels from steel angles and shapes of size adequate for openings and recesses in masonry walls and partitions. Fabricate in single lengths for each opening. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to unless otherwise indicated. provide bearing length at each side of opening equal to 1/12 of clear span, but no less than 8-inches.

## 2.16 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates.

2.17 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.18 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.19 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153 for steel and iron hardware and with ASTM A 123 for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
  - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 4. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

## 2.20 STAINLESS STEEL FINISHES

- A. Provide stainless steel with a No. 4 satin finish unless otherwise indicated.

## 2.21 ALUMINUM FINISHES

- A. Aluminum Finishes: Provide Clear Anodic Aluminum Finishes specified below in strict compliance with the National Association of Architectural Metal Manufacturers (NAAMM) aluminum finish designations, unless otherwise indicated or specified.
  1. Provide miscellaneous aluminum angles and cover moldings which are indicated to be painted with a mill finish.
  2. Provide aluminum finishes as follows:
    - a. Exterior aluminum items, unless otherwise specified: AAMA 611, NAAMM Architectural Class 1, AA-A41 clear coating
    - b. Interior aluminum items, unless otherwise specified: AAMA 611, NAAMM Architectural Class 2, AA-A31 clear coating

## 2.22 ELECTROLYTIC PROTECTION

- A. Stainless Steel:
  1. During handling and installation, take necessary precautions to prevent carbon impregnation of stainless-steel members.
  2. After installation, visually inspect stainless steel surfaces for evidence of iron rust, oil, paint, and other forms of contamination.
  3. Provide passivation of stainless-steel members in accordance with the requirements set forth in ASTM A380 and ASTM A967.
  4. Brushes used to remove foreign substances will utilize only stainless steel or nonmetallic bristles.
  5. After treatment, visually inspect surfaces for compliance.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install metal fabrications in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.

- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- D. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- E. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- F. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- G. Corrosion Protection: Coat concealed surfaces of aluminum that come in contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
  - 1. Extruded Aluminum: Two coats of clear lacquer.

### 3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for overhead doors securely to, and rigidly brace from, building structure.
- C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

### 3.3 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

### 3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION

SECTION 05 51 13  
METAL PAN STAIRS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Preassembled steel stairs with concrete-filled and precast concrete treads.
  2. Steel tube railings attached to metal stairs.
  3. Steel tube handrails attached to walls adjacent to metal stairs.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
1. Section 05 50 00 - Metals Fabrications
  2. Section 09 96 00 - High Performance Coatings

1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
1. ASTM A 36 - Structural Steel
  2. ASTM A 193 - Alloy Steel and Stainless-Steel Bolting Materials for High Temperature Service
  3. AWS D1.1 - Structural Welding Code - Steel
  4. FF-5325 - Expansion Shields

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 45 00 "Quality Control" to design stairs and railings.
- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Uniform Load: 100 pounds per square foot with a deflection of the stringers or landing framing not to exceed  $L/360$  of the span or 1/4 inch, whichever is less.
  2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.

3. Uniform and concentrated loads need not be assumed to act concurrently.
  4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
- C. Structural Performance of Railings: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  2. Infill of Guards:
    - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
    - b. Infill load and other loads need not be assumed to act concurrently.
  3. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
    - a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces

#### 1.4 ACTION SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
- B. Shop Drawings: Submit shop drawings for approval, indicating all the sizes and shapes of the stringers, headers, tees, carrier angles, clip angles, cast treads, landing platforms, bracing, stiffeners, hangers, supports, fascias and anchors as required.
- C. Submit shop drawings signed and sealed by a professional engineer registered to practice in the state of Illinois who is responsible for the stair calculations.
- D. Delegated-Design Submittal: For stairs and railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed the State of Illinois.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

## PART 2 PRODUCTS

### 2.1 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Recycled Content of Steel Products: Post-consumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- C. Steel Plates, Shapes, and Bars: ASTM A 36.
- D. Steel Tubing: ASTM A 500 or ASTM A 513.
- E. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.
- F. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011 structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.
- G. Welding Materials: Provide AWS D1.1 welding for type required for materials being welded.
- H. Expansion Bolts: Provide ASTM A 193 expansion bolts with washers and nuts, stainless steel type.

## 2.2 ABRASIVE NOSINGS

- A. Cast-Metal Units: Cast iron, with an integral-abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions as specified in Section 05500 "Metal fabrications".
- B. Apply bituminous paint to concealed surfaces of cast-metal units set into concrete.
- C. Apply clear lacquer to concealed surfaces of extruded units set into concrete.

## 2.3 FASTENERS

- A. Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
- B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
- D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
  - 1. Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941/F 1941M, Class Fe/Zn 5, unless otherwise indicated

## 2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services) "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- E. Concrete Materials and Properties: Comply with requirements in Section 03 31 00 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
- F. Welded Wire Reinforcement: ASTM A 185, 6 by 6 inches, W1.4 by W1.4, unless otherwise indicated.

## 2.5 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
  - 1. Join components by welding unless otherwise indicated.
  - 2. Use connections that maintain structural value of joined pieces.
- B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Form exposed work with accurate angles and surfaces and straight edges.
- F. Weld connections to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Weld exposed corners and seams continuously unless otherwise indicated.
  - 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

## 2.6 STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," Commercial Class, unless more stringent requirements are indicated.
- B. Stair Framing:
  - 1. Fabricate stringers of rectangular steel tubes.
    - a. Provide closures for exposed ends of channel and rectangular tube stringers.
    - b. Finish: Shop primed.
  - 2. Construct platforms of steel angle or channel headers and miscellaneous framing members as needed to comply with performance requirements
    - a. Provide closures for exposed ends of channel and rectangular tube stringers.
    - b. Finish: Shop primed.
  - 3. Weld stringers to headers; weld framing members to stringers and headers.
  - 4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.
  - 5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.
- C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch.
  - 1. Steel Sheet: Uncoated, cold-rolled steel sheet for interior applications.
  - 2. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
  - 3. Shape metal pans to include nosing integral with riser.
  - 4. Attach abrasive nosings to risers of stairs in stairwell.
  - 5. At Contractor's option, provide stair assemblies with metal pan subtreads filled with reinforced concrete during fabrication.
  - 6. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

7. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.
- D. Abrasive-Coating-Finished, Formed-Metal Stairs: Form risers, treads, and platforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.097 inch.

## 2.7 FABRICATION OF STAIR RAILINGS

- A. Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.
1. Rails and Posts: 1-5/8-inch diameter top and bottom rails and posts.
  2. Picket Infill: 1/2-inch to 3/4-inch round or square pickets spaced less than 4 inches clear.
- B. Welded Connections: Fabricate railings with welded connections.
1. Cope components at connections to provide close fit, or use fittings designed for this purpose.
  2. Weld all around at connections, including at fittings.
  3. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  4. Obtain fusion without undercut or overlap.
  5. Remove flux immediately.
  6. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for:
    - a. At Building Stairs: Finish #1 - No evidence of welded joint as shown in NAAMM AMP 521.
- C. Form changes in direction of railings as follows:
1. By bending or by inserting prefabricated elbow fittings.
  2. By flush bends or by inserting prefabricated flush-elbow fittings.
  3. By radius bends.
  4. By inserting prefabricated elbow fittings.
- D. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member

throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

- E. Close exposed ends of railing members with prefabricated end fittings.
- F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
  - 1. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- G. Connect posts to stair framing by direct welding unless otherwise indicated.
- H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.
  - 1. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
  - 2. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
  - 3. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

## 2.8 FINISHES

- A. Finish metal stairs after assembly.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install metal stairs in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.
- B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.

- C. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

### 3.2 INSTALLING METAL PAN STAIRS

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- B. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
- C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- E. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.
- F. Place and finish concrete fill for treads and platforms to comply with Section 03 31 00 "Cast-in-Place Concrete."
  - 1. Install abrasive nosings with anchors fully embedded in concrete.

### 3.3 INSTALLING RAILINGS

- A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.
  - 1. Space posts at spacing indicated or, if not indicated, as required by design loads.
  - 2. Plumb posts in each direction, within a tolerance of 1/16 inch in 3 feet.
  - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet.
  - 4. Secure posts and rail ends to building construction as follows:
    - a. Anchor posts to steel by welding or bolting to steel supporting members.
    - b. Anchor handrail ends to masonry with steel round flanges welded to rail ends and anchored with post-installed anchors and bolts.

- B. Attach handrails to wall with wall brackets.
  - 1. Locate brackets at spacing required to support structural loads.
  - 2. Secure wall brackets to building construction as required to comply with performance requirements, or as follows:
    - a. For hollow masonry anchorage, use toggle bolts.

#### 3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

END OF SECTION

## SECTION 05 52 12

### ALUMUMINUM HANDRAILS AND RAILINGS

#### PART 1 GENERAL

##### 1.1 SUMMARY

Section Includes: Welded aluminum railings and handrails, anchors, bolts, sleeves and components.

##### 1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ASTM B 241/B241M - Specification for Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube

##### 1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Top Rails of Guards and Handrails:

- a. Uniform load of 50 lbf/ ft. applied in any direction.
- b. Concentrated load of 200 lbf applied in any direction.
- c. Uniform and concentrated loads need not be assumed to act concurrently.

B. Thermal Movements: Provide exterior railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

#### 1.4 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
- B. Samples: Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
  - 1. Show method of finishing and connecting members at intersections.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- D. Engineer Certification: Submit fabricator's shop drawings reviewed and certified by a registered structural engineer licensed in the state in which the project is located and who is experienced in the design of this work.

#### 1.5 QUALITY ASSURANCE

- 1. Source Limitations: Obtain each type of railing through one source from a single manufacturer.
- 2. Welding: Qualify procedures and personnel according to the following:
  - a. AWS D1.2, "Structural Welding Code-Aluminum."

#### 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating railings without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
  - 2. Provide allowance for trimming and fitting at site.

#### 1.7 COORDINATION AND SCHEDULING

- A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the job site in good condition and properly protected against damage to finished surfaces.
- B. Protection: Deliver railings to the job site protected in polyethylene tubing with a minimum wall thickness of 0.05 inches. Remove tubing after construction has been completed and when directed.
- C. Storage on site:
  - 1. Store material in a location and in a manner to avoid damage. Stack in a way to prevent bending.
  - 2. Store material in a clean, dry location away from uncured concrete and masonry. Cover with waterproof paper, tarpaulin, or polyethylene sheeting in a manner that will permit circulation of air inside the covering.
- D. Keep handling on site to a minimum. Exercise particular care to avoid damage to finishes of material.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Aluminum handrails and railings:
    - a. Tuttle Railing Systems, Fishers, IN
    - b. Superior Aluminum Products, Russia, OH
  - 2. Quick setting grout compound
    - a. Quik-Rod, by Preld Industries, Ltd., Plainview, NY
    - b. Pol-Rok, by the Hallemite Mfg. Co., Cleveland, OH

## 2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

## 2.3 ALUMINUM

- A. Extruded Pipe: 1-1/2-inch diameter Schedule 40, Alloy 6063-T4, or 6063-T6 meeting ASTM B 221
- B. Reinforcing Bars: Alloy 6061-T6 meeting ASTM B 221
- C. Extruded Posts: 1-1/2-inch diameter Schedule 40, Alloy 6063-T6 meeting ASTM B 221
- D. Extruded Toe Board: Alloy 6063-T52 meeting ASTM B 221 and the safety requirements of ANSI A21.1
- E. Fittings and Flanges: Type 6063 or 6061 aluminum alloy. Cast # 214 aluminum alloy.

## 2.4 FASTENERS

- A. General: Provide the following:
  - 1. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads and minimize galvanic corrosion.
    - a. Provide chemical or torque-controlled expansion anchors, fabricated from stainless steel type 304 capable to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

## 2.5 MISCELLANEOUS MATERIALS

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

- C. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

## 2.6 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Form work true to line and level with accurate angles and surfaces.
- D. Design components to allow for expansion and contraction without causing buckling, excessive opening of joints, or overstressing of welds and fasteners.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove flux immediately.
  - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
  - 5. Provide Type 2 finish for welded connections according to ANSI/NAAMM AMP 521-01

- H. Form changes in direction as follows:
  - 1. By bending.
- I. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
  - 1. Bend Radius: as shown on drawings but no less than 3-inches.
- J. Close exposed ends of railing members with prefabricated end fittings.
- K. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/8 inch or less.
- L. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.
- M. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- N. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with steel plate forming bottom closure.
- O. For removable railing posts, fabricate slip-fit sockets from aluminum tube or pipe whose Interior Diameter is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.
  - 1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.
- P. Gates: provide self-closing gates with snap hook latch at railing openings and where indicated on drawings.
- Q. Railing gaps: provide a 2-inch max gap between independent railing sections and where railing continuity is interrupted.
- R. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

- S. Handrail: Provide single rail handrails turned 90 degrees to terminate 1/8-inch from walls. Provide manufactured brackets secured to the wall with stainless steel expansion bolts. Grout hollow walls solid at attachment locations. Mount terminal brackets not more than 12 inches from the end of the handrails.

## 2.7 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Paint exposed aluminum components that come in contact with cement or lime mortar, with heavy-bodied bituminous paint.

## 2.8 ALUMINUM FINISHES

- A. Remove tool and die marks and stretch lines or blend into finish.
- B. Finish (refer to NAAMM Metal Finishes Manual):
  - 1. AA-M10-C22-A41 Clear anodized finish.

# PART 3 EXECUTION

## 3.1 INSTALLATION

- A. General: Install handrails and railings in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.
- B. Fit exposed connections together to form tight, hairline joints.
- C. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
  - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

### 3.2 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in Part 2 "Fabrication" Article whether welding is performed in the shop or in the field.
- B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to 1 side, and locate joint within 6 inches of post.

### 3.3 ANCHORING POSTS

- A. Top mount posts to floor surface and anchor with stainless steel expansion bolts capable of resisting the loads indicated in performance requirements section.
- B. At locations where posts are indicated to be installed in predrilled core holes use stainless steel pipe sleeves. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete or as shown on drawings.

### 3.4 ADJUSTING AND CLEANING

- A. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.

### 3.5 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

END OF SECTION

SECTION 06 10 00  
ROUGH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Wood centers, furring, grounds, blocking, nailers, temporary protection of all kinds, and all accessories and appurtenances required for the Work.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 04 20 00 - Masonry
  - 2. Section 07 55 00 – SBS-Modified Bituminous Membrane Roofing

1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ASTM E 84 - Test Method for Surface Burning Characteristics of Building Materials
  - 2. FS TT-W-571 - Wood Preservation Treating Practices
  - 3. AWWPA - American Wood Preservers Association - Type A, Interior Fire Retardant Treated Lumber and Plywood
  - 4. NFPA - National Forest Products Association, National Design Specification for Wood Construction

1.3 SUBMITTALS

- A. General: Provide all submittals, including the following as specified in Division 1.
- B. Certification: Submit certificates of compliance for preservative treated lumber, fire retardant treated lumber and lumber grades.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and handle all products and materials as specified in Division 1 and as follows:
- B. Storage and Protection: Store lumber indoors at the site on raised platforms. If outdoor storage is temporarily incorporated, set the material on raised platforms

and cover with suitable weatherproof protective coverings, such as tarpaulins or heavy polyethylene film. Battened down covers with sufficient weights, ties or anchors to prevent blowoffs.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. General: Provide lumber for rough carpentry such as nailers, grounds, blocking and framing of Construction Grade, thoroughly seasoned dry No. 1 white fir, ponderosa pine, spruce, or hem-fir.
- B. Preservative Treatment: Pressure treat all lumber for rough carpentry which is incorporated into the finished structures. Provide pressure-treated lumber complying with the requirements established in the latest AWPA P5 and TT-W-571. Use water-borne preservative with 0.25 (0.40) percent retainage. Brand all lumber accordingly.
- C. Fire Retardant Treatment: Pressure-impregnate all wood designated to be fire-retardant treated with a flameproofing complying with the requirements of AWPA Type A and with U.L., Inc. requirements for flame spread of 25 or less with no evidence of significant progressive combustion when tested in accordance with ASTM E 84. Provide each piece of wood bearing the U.L., Inc. FRS Label or the U.L., Inc. label indicating complete compliance with the fire hazard classification.
- D. Code Conformance: Unless otherwise indicated, provide materials conforming to the requirements of the National Design Specification for Stress Grade Lumber as recommended by the National Forest Products Association.
- E. Product Standards: Provide plywood conforming to the requirements of the American Plywood Association.
- F. Grading: Provide each panel of plywood identified with the appropriate DFPA grade mark of the American Plywood Association.
- G. Exterior Plywood Uses: Provide exterior type plywood where plywood used for roof sheathing or decking or in areas where it may be exposed to moisture.
- H. Temporary Protection: Provide an exterior type southern yellow pine plywood for temporary protection, APA Grade C, plugged fir.

### 2.2 ACCESSORIES

- A. Provide anchors, connectors, and fastenings, not indicated, or specified otherwise, of the type, size and spacing necessary to suit the conditions encountered and as recommended by National Forest Products Association. Provide sizes, types, and spacing of nails, screws, or bolts for installation of manufactured building materials, as recommended by the product manufacturer, unless indicated or specified otherwise.

1. Zinc-electroplated steel rough hardware exposed to the weather unless indicated otherwise. Provide zinc-electroplated steel bolts, nuts, washers, hangers, and straps, and for all other rough hardware embedded in, or in contact with exterior walls or slabs, and located in humid areas, except as indicated otherwise.
2. Form and punch rough hardware before coating. Use common steel wire nails, bright finish, unless specified otherwise.
3. Provide bolt heads and nuts bearing on wood with standard steel washers.
4. Provide galvanized fasteners for treated wood in accordance with the requirements contained in Section 05085.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. General: Install rough carpentry in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.
- B. Erection: Correctly lay out all carpentry throughout. Coordinate the Work of all built-in anchors and other devices. Carefully fit and erect, accurately locate, plumb, level, properly align, and rigidly secure in place all items of woodwork, hardware, and other work in connection with carpentry.
- C. Protection of the Work: Protect the jambs of finished door frames and finished masonry openings to a height of 6 feet above the floor. Erect protection in a manner to facilitate cleaning, painting, and similar work without damage to finished work.
- D. Centers: Provide centers, where required, for brick and other masonry at the exterior and interior openings.
- E. Blocking: Furnish blocking required for the attachment of copings, roof ventilators, ducts and other sheet metal work and wood grounds for other work and as shown and required.
- F. Securing Finished Work: Provide all wood blocks, strips, plugs, and similar items required to secure finished work to concrete and masonry.
- G. Preservative Coating: Liberally coat all field-cut edges and surfaces of treated lumber with a concentrated solution of preservative.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 07 13 00

### UNDER SLAB VAPOR RETARDER

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section includes:

1. Reinforced-polyethylene vapor retarders, for under slab-on-grade concrete slabs.

##### 1.2 REFERENCES

- A. ASTM D1709 - Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method.
- B. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
- C. ASTM E154 - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs.
- D. ASTM E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
- E. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
- F. ASTM F1249 - Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: 6-inch by 6-inch units for each type of vapor retarder.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's installation instructions for placement, seaming and penetration repair instructions.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency

##### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of vapor retarder through one source from a single manufacturer regularly engaged in manufacturing the product.

- B. Use an experienced installer and adequate number of skilled personnel who are thoroughly trained and experienced in the application of the vapor retarder.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Store materials in a clean, dry area in accordance with manufacturer's instructions.
- C. Protect materials during handling and application to prevent damage or contamination.
- D. Ensure membrane is stamped with manufacturer's name, product name, and membrane thickness at regular intervals.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Provide Vapor Retarder Membrane as follows:
  - 1. Strength: ASTM E1745 Class A.
    - a. Tensile strength: No less than 70.0 lb/in
    - b. Puncture resistance: ASTM D 1709 method B (no less than 2200 grams).
  - 2. Maintain permeance of less than 0.01 Perms (grains/ (ft<sup>2</sup> \* hr \* inHg) as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1-7.1.5)
  - 3. Thickness: 15 mils minimum.
- B. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.
  - 1. Basis of Design: Stego Wrap Vapor Barrier (15-mil) by Stego Industries LLC.
  - 2. Vaporguard by Reef Industries.
  - 3. Other approved equal.

#### 2.2 ACCESSORIES

- A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- B. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.

- C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.
- D. Perimeter/edge seal:
  - 1. Stego Crete Claw by Stego Industries.
  - 2. Stego Tack Tape by Stego Industries.
- E. Vapor Barrier – Safe Screed System: Beast Screed by Stego Industries
- F. Pipe Collars: Construct pipe collars from vapor retarder material and pressure sensitive tape per manufacturer’s instructions.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Prepare surfaces in accordance with manufacturer’s instructions.
- B. Clean substrates of substances that are harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.
- C. Ensure that base material is approved Geotechnical Engineer.
  - 1. Level and compact base material.

#### 3.2 EXAMINATION

- A. Examine surfaces to receive membrane. Notify engineer if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected

#### 3.3 INSTALLATION

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643-11 and manufacturer's written instructions. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement.
  - 1. Ensure subbase for concrete is compacted; sharp objects and scraps are removed.
  - 2. Lap joints 6 inches and seal with manufacturer's recommended double-sided butyl tape.
  - 3. Positioning: Maintain in place. Stretch and weight edges and laps to maintain their position until concrete is placed.
- B. Protection and Patching: Protect vapor retarder from rips. Hold patches in readiness during the concrete pouring operation and lay over all rips (beneath wire fabric and reinforcing steel.)

- C. Penetration: (Pipe, anchors, and other items): Seal penetrations per manufacturer's instructions with manufacturer's pipe boot. Seal boot material to the pipe and other penetrations with an elastomeric sealant that is approved by the vapor retarder manufacturer.
- D. Lap vapor barrier over footings and seal to foundation walls, grade beam, or slab. If practicable, terminate it at the top of the slab, otherwise:
  - 1. At a point acceptable to the structural engineer or,
  - 2. Were obstructed by impediments, such as dowels, water stops or any other site condition requiring early termination of the vapor barrier.
- E. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.
- F. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all sides with tape.
- G. Prior to placement of concrete, receive letter from vapor barrier manufacturer verifying installation per ASTM E1643-11.

END OF SECTION

## SECTION 07 14 16

### COLD FLUID APPLIED WATERPROOFING

#### PART 1 GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Fluid-applied waterproofing membrane system specifically designed for co-spray-application, all applicable sealants, drainage and elastomeric flashings surface preparation of concrete surfaces, sealing of form ties, cracks, joints needed to prevent water penetration at locations applied.

###### B. Related work specified in other sections includes, but is not limited to, the following:

1. Section 03 31 00 - Cast-In-Place Concrete

##### 1.2 REFERENCES

###### A. Codes and standards referred to in this Section are but not limited to:

1. ASTM C 794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
2. ASTM C 836 - Standard Specification for High-Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.
3. ASTM C 1250 - Standard Test Method for Nonvolatile Content of Cold Liquid-Applied Elastomeric Waterproofing Membranes.
4. ASTM C1305 - Standard Test Method for Crack Bridging Ability of Liquid-Applied Waterproofing Membrane.
5. ASTM C 1522 - Standard Test Method for Extensibility After Heat Aging of Cold Liquid-Applied Elastomeric Waterproofing Membranes.
6. ASTM D 412 - Standard Test Method for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.

7. ASTM D 903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.
8. ASTM D2240 - Standard Test Method for Rubber Property-Durometer Hardness.
9. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials

### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Conference: Conduct conference at Project Site.
  1. Review requirements for waterproofing products and installation, including surface preparation, substrate conditions, project and manufacturer's details, installation procedures, mockups, testing and inspection requirements, protection and repairs, and coordination and sequencing of waterproofing work with work of other Sections.

### 1.4 SUBMITTALS

- A. Provide all submittals, including the following, and as specified in Division 1.
  1. ACTION SUBMITTALS:
    - a. Product Data: For each type of waterproofing product specified, including:
      - (1) Technical data indicating compliance with requirements.
      - (2) Substrate preparation instructions and recommendations.
    - b. Shop Drawings: Show locations for waterproofing system components. Show details for each type of substrate, joints, corners, and edge conditions, including flashings, counterflashings, penetrations, transitions, and terminations.
  2. INFORMATIONAL SUBMITTALS
    - a. Qualification Data: For Installer, manufacturer, and waterproofing Inspector.
      - (1) Certification of manufacturer's approval of Installer.
    - b. Product Test Reports: Test data for waterproofing products and waterproofing system, by qualified testing agency, indicating proposed waterproofing meets performance requirements, when requested by Engineer.

- c. Warranty: Sample of unexecuted manufacturer and installer standard warranties.
- d. Field quality control reports.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Provide waterproofing system materials and accessory products from single source from single manufacturer.
- B. Installer Qualifications: A manufacturer-approved firm with minimum three years experience in installation of specified products in successful use on similar projects, employing workers trained by manufacturer, including a full-time on-site supervisor with a minimum of three years experience installing similar work, and able to communicate verbally with Contractor, Engineer, and employees.
- C. Manufacturer Qualifications: A qualified manufacturer with minimum five years experience in manufacture of waterproofing as one of its principal products.
- D. Manufacturer's product submitted has been in satisfactory operation on five similar installations for at least five years.
- E. Testing Agency Qualifications: Qualified independent agency experienced in the installation of the specified waterproofing system, and qualified to perform observation and inspection specified in Field Quality Control Article to determine Installer's compliance with the requirements of this Project, acceptable to Engineer, retained by the Contractor.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by waterproofing manufacturer.
- B. Deliver materials to job site in manufacturer's unopened containers with all labels intact and legible at time of use.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Apply waterproofing barrier within the range of ambient and substrate temperatures recommended by waterproofing manufacturer.
  - 1. Protect substrates from environmental conditions that affect performance of waterproofing.
  - 2. Do not apply waterproofing during snow, rain, fog, or mist.

#### 1.1 SCHEDULING

- A. Coordinate installation of waterproofing with completion of other work requiring interface with waterproofing.

- B. Schedule work so waterproofing applications may be inspected prior to concealment.
- C. Ensure waterproofing materials are cured before covering with other materials.

## 1.2 WARRANTY

- A. **Manufacturer's Standard Warranty:** Manufacturer's standard form in which waterproofing manufacturer agrees to furnish waterproofing material to repair or replace those materials installed according to manufacturer's written instructions that exhibit material defects or otherwise fail to perform as specified under normal use within warranty period specified.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. **Basis-of-Design Products:** Provide waterproofing products manufactured by Tremco, Inc., Commercial Sealants and Waterproofing Division, Beachwood OH; or comparable products of other manufacturer approved by Engineer.

## PERFORMANCE REQUIREMENTS

- B. **General:** Waterproofing system shall be capable of performing as a continuous watertight installation and as a moisture drainage plane transitioned to adjacent flashings and discharging water to the building exterior. Waterproofing shall accommodate normal substrate movement and seal expansion and control joints, construction material transitions, opening transitions, penetrations, and perimeter conditions without resultant moisture deterioration.
- C. **Compatibility:** Provide waterproofing system materials that are compatible with one another and with adjacent materials under conditions of service and application required, as demonstrated by waterproofing manufacturer based on testing and field experience.

### 2.2 WATERPROOFING MEMBRANE

- A. **Cold Fluid-Applied Waterproofing:** Single component, asphalt emulsion formulated for application to damp and green concrete.
  - 1. **Basis of Design Product:** Tremco, Inc., TREMproof 260.
  - 2. **VOC Content:** Less than 72 g/L.
  - 3. **Elongation, ASTM D412:** 800%
  - 4. **Low Temperature Flexibility and Crack Bridging, ASTM C 836:** Pass.
  - 5. **Peel Adhesion, ASTM D903:** Pass.

## 2.3 ACCESSORY MATERIALS

- A. Joint backing: Closed-cell, polyethylene rod as recommended by membrane manufacturer.
- B. Joint Sealants: Termination Seals:
  - 1. Single component, high performance, medium-modulus, low-VOC, UV-stable, non-sag polyurethane sealant.
    - a. Basis of Design Product: Tremco Inc., Dymonic 100.

## 2.4 WATERPROOFING PROTECTION AND DRAINAGE

- A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a nonwoven, needle-punched polypropylene facing laminated to one side of a studded, non-biodegradable, polystyrene drainage core.
  - 1. Basis of Design: Tremco, TREMDrain Total Drain.
  - 2. Flow Capacity, per unit width, ASTM D 4716: 18 gpm/ft.
  - 3. Flow Rate, ASTM D 4491: 150 gpm/ft<sup>2</sup>.
  - 4. Apparent Opening Size: No. 70 sieve.
  - 5. Puncture Strength, ASTM D 4833: 70 lb.
  - 6. Core Compressive Strength, ASTM D 1621: 9,000 lb/ft<sup>2</sup>.
  - 7. Thickness: 0.437 inch.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Surface Condition: Before applying waterproofing materials, examine substrate and conditions to ensure substrates are fully cured, smooth, clean, dry, and free from high spots, depressions, loose and foreign particles and other deterrents to adhesion, and conditions comply with manufacturer's written recommendations.
  - 1. Verify concrete and masonry surfaces are free from release agents, curing agents, laitance, and other contaminants. Test for waterproofing adhesion per manufacturer's recommended method. Notify Engineer of unsatisfactory conditions.
  - 2. Verify masonry joints are filled with mortar and struck flush.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INTERFACE WITH OTHER WORK

- A. Sequencing of Work: Coordinate sequencing of waterproofing work with work of other sections that form portions of building envelope moisture control to ensure that flashings and transition materials can be properly installed and inspected.
- B. Subsequent Work: Coordinate waterproofing work with work of other sections installed subsequent to waterproofing to ensure complete inspection of installed waterproofing and sealing of waterproofing penetrations necessitated by subsequent work.

### 3.3 PREPARATION

- A. Clean, prepare, and treat substrates in accordance with waterproofing manufacturer's written instructions.
  - 1. Mask adjacent finished surfaces.
  - 2. Remove contaminants and film-forming coatings from substrates.
  - 3. Remove projections and excess materials and fill voids with substrate patching material.
- B. Prepare and treat joints and cracks in substrate per ASTM D 4258 and waterproofing manufacturer's written instructions.
- C. Detail Preparation: Prepare non-moving shrinkage cracks, large cracks, construction joints, expansion joints, projections and protrusions, penetrations, drains, and changes in plane in accordance with waterproofing manufacturer's written instructions and details, using accessory materials specified.
- D. Transitions to Adjacent Materials: Apply manufacturer's Approved Primer to transition cold fluid-applied waterproofing membrane to adjacent components of the building envelope.

### 3.4 WATERPROOFING INSTALLATION

- A. General: Apply waterproofing material to form a seal with strips and transition strips and to achieve a continuous waterproofing according to waterproofing manufacturer's written instructions. Apply waterproofing material within manufacturer's recommended application temperature ranges.
- B. Coordination of Testing:
  - 1. Do not cover waterproofing until it has been tested and inspected by Owner's testing agency.

- C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates and reapply waterproofing components.

### 3.5 PROTECTION INSTALLATION

- A. Protect waterproofing as needed for this project using one of the following methods as recommended by manufacturer:
  - 1. Protection Course: Cover waterproofing with protection course following curing of waterproofing and prior to backfilling or subjecting installation to traffic. Overlap protection course joints.
  - 2. Drainage Panel: Place and secure drainage panels using methods that do not penetrate waterproofing. Face geotextile away from deck substrate. Lap edges or abut ends of geotextile.
- B. Insulation: Install one or more layers of board insulation as required, staggering joints, and to achieve insulation R values indicated. Fit within ½-inch of projections and penetrations.
  - 1. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

### 3.6 FIELD QUALITY CONTROL

- A. Contractor's Inspector: Contractor shall engage manufacturer's qualified Inspector full-time during the Work to perform tests and inspections, including documenting of waterproofing prior to concealment.
  - 1. Contractor's Inspector shall measure membrane thickness with a wet film gauge during the application process at least once for every 100 sq. ft.
  - 2. Provide written report of tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, waterproofing application, protection, and drainage components, and to furnish reports to Engineer.
  - 1. Testing includes EFVM inspection prior to concealing deck waterproof membrane
- C. Coordination of Inspection: Cooperate with testing agency. Allow access to work areas and staging. Notify testing agency in writing of schedule for Work of this Section to allow sufficient time for testing and inspection.
- D. Do not cover Work until testing and inspection is completed and accepted.

- E. Reporting: Forward written inspection reports to the Engineer within 10 working days of the inspection and test being performed.
- F. Correction of Work: Correct deficient applications not passing tests and inspections, make necessary repairs, and retest as required to demonstrate compliance with requirements.

### 3.7 CLEANING AND PROTECTING

- A. Clean spills, stains, and overspray resulting from application utilizing cleaning agents recommended by manufacturers of affected construction. Remove masking materials.
- B. Protect waterproofing from damage from subsequent work. Protect waterproofing materials from exposure to UV light for period in excess of that acceptable to waterproofing manufacturer; replace overexposed materials and retest.

END OF SECTION

SECTION 07 21 13  
BUILDING INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes the following:
  - 1. Cavity wall insulation.
  - 2. Perimeter slab-on-grade insulation.
  - 3. Fiberglass Batt Insulation.
  - 4. Below Grade Walls.
  - 5. Elsewhere as shown.
  
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the following:
  - 1. Section 04 20 00 - Masonry

1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ASTM C 272 - Water Absorption of Core Materials for Structural Sandwich Construction
  - 2. ASTM C 578 - Preformed, Cellular Polystyrene Thermal Insulation.

1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
- B. Product Data: For each type of product specified and / or submitted for approval.
- C. Include product characteristics and performance criteria: aged thermal resistance values, fire performance characteristics, moisture vapor permeance, water absorption ratings, and compressive strengths.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
  - 1. Surface-Burning Characteristics: ASTM E 84.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

#### 1.6 ENVIRONMENTAL REQUIREMENTS

- A. Weather Conditions: Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.
  - 1. Insulation materials.
    - a. Dow Chemical Co. Product Styrofoam Board
    - b. AMOCO Foam Products Co. Product AMOFOAM - CM

#### 2.2 MATERIALS

- A. Cavity Wall Insulation:
  - 1. Rigid Foam Board Insulation: closed cell polyisocyanurate foam board with glass fiber reinforced core, to ASTM C1289, Type I, Class 2 meeting the following criteria:
    - a. Thermal Resistance ASTM C1363 at 75 deg. °F: R-6.5 per 1 inch of thickness.

- b. Density ASTM D1622: nominal 2.0 pcf.
- c. Compressive Strength ASTM D162: minimum 25 psi.
- d. Board Sizes: 48 inches wide, 96 inches long.
- e. Board Edges: Square.
- f. Faces: 1.0 mil thick aluminum foil facer, both sides.
- g. Foam Surface Burning Characteristics ASTM E84: flame spread less than 25, smoke developed less than 450.
- h. Water Vapor Transmission ASTM E96: less than 0.03 perms.
- i. Water Absorption by Volume ASTM C209: maximum 0.1 percent.
- j. Available Manufacturers not limited to:
  - (1) Atlas Roofing Corporation.
  - (2) Dow Chemical Company.
- k. Provide the following R values:
  - (1) Exterior masonry cavity wall insulation value = R-11.4 c.i.

B. Perimeter Insulation and Below Grade Walls:

- 1. Extruded Polystyrene Foam: Drainage and insulation moisture resistant, lightweight foam board designed specifically for use on exterior foundation walls. ASTM C 578, Type IV meeting the following criteria:
  - a. Thermal Resistance ASTM C 548 at 75 deg. F: R-5.0 per 1 inch of thickness.
  - b. Water Absorption ASTM C 272 % by volume: max. 0.3
  - c. Compressive Strength ASTM D 1621: minimum 30 psi.
  - d. Drainage Capacity, ASTM D 4716: minimum 3.0 gpm/ft
  - e. Water Vapor Transmission ASTM E 96: max 1.5 perms.
  - f. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
    - (1) Dow Chemical Company.

- (2) Owens Corning.
- g. Provide the following R values:
  - (1) Slab perimeter insulation down to 24 inches value = R-15 c.i.  
Protect exposed perimeter insulation down to a minimum 6 inches below grade with a Cementitious Board minimum 1/2-inch thick.
- C. Fiberglass Batt Insulation.
  - 1. Unfaced Batt Insulation: ASTM C 665, Type I, preformed formaldehyde free glass fiber batt type, unfaced.
  - 2. Noncombustible per ASTM E 136.
  - 3. Flame spread less than 25, smoke developed less than 50 per ASTM E84.
  - 4. Water vapor absorption, Maximum by weight: not more than 5 percent.
  - 5. Provide the following R values: Exterior wall insulation value = R-11.4

## 2.3 AUXILIARY INSULATING MATERIALS

- A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates:
  - 1. Adhesive: single-component, polyurethane adhesives tested to: Underwriters Laboratory Inc. - UL 1897 Standard for Safety for Uplift Tests for Roof Covering Systems.
  - 2. Or as recommended in written by insulation manufacturer.
- B. Joint Tape: 2.0 mil thick aluminum tape, 3 inches wide, or as recommended in written by insulation manufacturer.
- C. Sealant: One-part, flexible polyurethane-based elastomeric sealant; moisture curing and non-sagging; to ASTM C920, Type S, Grade NS, Class 25 or as recommended in written by insulation manufacturer.
- D. Accessories for fiberglass batt insulation: Provide accessories per insulating system manufacturer's recommendations, including the following:
  - 1. Insulation Fasteners: Impale clip of galvanized steel; type recommended by insulation manufacturer for particular use intended.

2. Mechanical Insulation Fasteners: FM approved, corrosion resistant, size required to suit application.
3. Wire Mesh: Galvanized steel, hexagonal wire mesh.
4. Spindle Fasteners: Corrosion-resistant wire spindles.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
  1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Install board insulation in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- E. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

END OF SECTION

(NO TEXT ON THIS PAGE)

## SECTION 07 27 20

### FLUID APPLIED MEMBRANE WEATHER BARRIERS

#### PART 1 GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Fluid-applied membrane weather barriers to be applied to all exterior wall substrates.

###### B. Related work specified in other sections includes, but is not limited to, the following:

1. Section 04 20 00 - Masonry

##### 1.2 REFERENCES

###### A. Codes and standards referred to in this Section are but not limited to:

1. ASTM C 297 - Test Method for Tensile Strength of Flat Sandwich Constructions in Flatwise Plane
2. ASTM D 3273 - Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
3. ASTM D 4541 - Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
4. ASTM E 96 - Test Method for Water Vapor Transmission of Materials Practice
5. ASTM E 119 - Test Methods for Fire Tests of Building Construction and Materials
6. ASTM E 1186 - Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
7. ASTM E 2178 - Method for Air Permeance of Building Materials.
8. ASTM E 2357 - Test Method for Determining Air Leakage of Air Barrier Assemblies

### 1.3 DEFINITIONS

- A. Weather Barrier Material: A building material that is designed and constructed to provide the primary resistance to airflow through an air barrier assembly.
- B. Weather Barrier Accessory: A transitional component of the weather barrier that provides continuity.
- C. Weather Barrier Assembly: The collection of weather barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.
- D. Water-Resistive Barrier Assembly: The collection of water-resistive materials and accessories that direct incidental water that may pass the primary rain screen out of the wall cladding while providing protection for underlying sheathing materials.

### 1.4 SUBMITTALS

- A. Provide all submittals, including the following, in accordance with Division 1.

### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.
- B. Shop Drawings: For weather-barrier assemblies
  - 1. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
  - 2. Include details of interfaces with other materials that form part of weather barrier.

### 1.6 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For weather barriers, certifying compatibility of weather barrier and accessory materials with Project materials that connect to or that come in contact with the barrier; signed by product manufacturer.
- B. Qualification Data: For Applicator.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for weather barriers.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
  - 1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

## 1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on field mockups.
- B. Mockup Testing: Weather-barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.
  - 1. Weather-Leakage-Location Testing: Mockups will be tested for evidence of weather leakage according to ASTM E 1186, chamber pressurization or depressurization with smoke tracers.
  - 2. Weather-Leakage-Volume Testing: Mockups will be tested for weather-leakage rate according to ASTM E 2357.
  - 3. Adhesion Testing: Mockups will be tested for required weather-barrier adhesion to substrate according to ASTM D 4541.
  - 4. Notify Engineer seven days in advance of the dates and times when mockups will be tested.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store liquid materials in their original undamaged packages in a clean, dry, protected from direct sunlight location and within temperature range required by weather barrier manufacturer.
- B. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- C. Protect and store accessory and auxiliary products in accordance with manufacturer's written instructions.

## 1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Apply weather barrier within the range of ambient and substrate temperatures recommended by weather barrier manufacturer.

1. Protect substrates from environmental conditions that affect performance of weather barrier.
  2. Do not apply weather barrier to a damp or wet substrate or during snow, rain, fog, or mist.
- B. Provide protection of surrounding areas and adjacent surfaces from application of materials

## PART 2 PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Source Limitations: Obtain primary weather-barrier materials and weather-barrier accessories from single source from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. General: Class I or Class II weather barrier capable of performing as a continuous vapor- permeable weather barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Weather barrier assemblies capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

1. Weather Barrier Assembly Air Leakage: Not to exceed 0.04 cfm x sq. ft. of surface area at 1.57 lbf/sq. ft. ASTM E 2357

### 2.3 FLUID-APPLIED MEMBRANE WEATHER BARRIER

- A. Fluid-Applied, Vapor-Permeable Membrane Weather Barrier: Synthetic polymer membrane.

1. Available Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Carlisle Coatings & Waterproofing Inc.; Barritech VP.
  - b. Grace, W. R., & Co. - Conn.; Perm-A-Barrier VPL.
  - c. Henry Company; Air-Bloc 31 MR.
  - d. Tremco Incorporated, an RPM company; ExoAir 230.

2. Physical and Performance Properties:
  - a. Air Permeance on CMU: Not to exceed 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
  - b. Vapor Permeance: Minimum 0.1 Maximum 1.0 perms: ASTM E 96 A (Desiccant Method)
  - c. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.
  - d. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

#### 2.4 AUXILIARY MATERIALS

- A. General: Auxiliary materials recommended in writing by weather barrier manufacturer for intended use and compatible with weather barrier membrane. Liquid-type auxiliary materials to comply with VOC limits of authorities having jurisdiction.
  1. Primer: Liquid waterborne primer recommended for substrate by manufacturer of weather barrier material.
- B. Counterflashing Strip: Modified bituminous, 40-mil- thick, self-adhering sheet consisting of 32 mils of rubberized asphalt laminated to an 8-mil thick, cross laminated polyethylene film with release liner backing.
- C. Butyl Strip: Vapor retarding, 30 to 40 mils thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive with release liner backing.
- D. Joint Reinforcing Strip: Weather-barrier manufacturer's glass-fiber-mesh tape. F. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.
- E. Adhesive and Tape: Weather-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.
- F. Sprayed Polyurethane Foam Sealant: One- or two-component, foamed-in-place, polyurethane foam sealant, 1.5- to 2.0-lb/cu. ft density; flame-spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.
- G. Termination Mastic: Weather-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.
- H. Seal weather barrier terminations with windows, doors, curtain walls using manufacturer's recommended sealant.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
  - 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
  - 2. Verify that concrete has cured and aged for minimum time period recommended by weather barrier manufacturer.
  - 3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
  - 4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected

### 3.2 SURFACE PREPARATION

- A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for weather barrier application.
- B. Mask off adjoining surfaces not covered by weather barrier to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate patching membrane.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for weather barrier.

### 3.3 JOINT TREATMENT

- A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and weather barrier manufacturer's written instructions.

Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.

1. Prime substrate and apply a single thickness of preparation coat strip extending a minimum of 3 inches along each side of joints and cracks. Apply a double thickness of weather barrier membrane and embed a joint reinforcing strip in preparation coat.

### 3.4 TRANSITION STRIP INSTALLATION

- A. Install strips, transition strips, and auxiliary materials according to weather barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous weather barrier.
  1. Coordinate the installation of weather barrier with installation of roofing membrane and base flashing to ensure continuity of weather barrier with roofing membrane.
  2. Install strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over both substrates.
- B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by weather barrier sheet in same day. Reprime areas exposed for more than 24 hours.
  1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.
- C. Connect and seal exterior wall weather barrier membrane continuously to roofing membrane weather barrier, concrete below-grade structures, floor-to floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- E. Apply joint sealants forming part of weather barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- F. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply manufacturer's recommended transition strip so that a minimum of 3 inches of coverage is achieved over both substrates. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.
  1. Modified Bituminous Transition Strip: Roll firmly to enhance adhesion.

2. Adhesive-Coated Transition Strip: Roll firmly to enhance adhesion.
  3. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at 6 inches o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.
  4. Preformed Silicone-Sealant Extrusion: Set in full bed of silicone sealant applied to walls, frame, and weather-barrier material
- G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of weather barrier membrane with foam sealant.
- H. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic if strips and transition strips will follow installation of projecting interior wythe masonry ties or joint reinforcement.
- I. Seal top of through-wall flashings to weather barrier with an additional 6-inch- wide, modified bituminous strip.
- J. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counter flashings or ending in reglets with termination mastic.
- K. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

### 3.5 FLUID WEATHER BARRIER MEMBRANE INSTALLATION

- A. Apply weather barrier membrane to exterior wall substrates to form a seal with strips and transition strips and to achieve a continuous weather barrier according to weather barrier manufacturer's written instructions. Apply weather barrier membrane within manufacturer's recommended application temperature ranges.
1. Apply primer to substrates at required rate and allow it to dry.
  2. Limit priming to areas that will be covered by fluid weather-barrier material on same day. Re-prime areas exposed for more than 24 hours.
- B. Apply a continuous unbroken weather barrier to substrates according to the following minimum thickness. Apply membrane in full contact around protrusions such as masonry ties.
1. Vapor-Permeable Membrane Weather Barrier: Total dry film thickness as recommended in writing by manufacturer to meet performance requirements, but not less than 40-mil dry film thickness, applied in one or more equal coats.

- C. Apply strip and transition strip over cured weather membrane overlapping onto each surface according to weather barrier manufacturer's written instructions.
- D. Do not cover weather barrier until it has been tested and inspected by Owner's testing agency.
- E. Correct deficiencies in or remove weather barrier that does not comply with requirements; repair substrates and reapply weather barrier components.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Inspections: Weather barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:
  - 1. Continuity of weather barrier system has been achieved throughout the building envelope with no gaps or holes.
  - 2. Continuous structural support of weather barrier system has been provided.
  - 3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
  - 4. Site conditions for application temperature and dryness of substrates have been maintained.
  - 5. Maximum exposure time of materials to UV deterioration has not been exceeded.
  - 6. Surfaces have been primed, if applicable.
  - 7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
  - 8. Termination mastic has been applied on cut edges.
  - 9. Strips and transition strips have been firmly adhered to substrate.
  - 10. Compatible materials have been used.
  - 11. Transitions at changes in direction and structural support at gaps have been provided.

12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
  13. All penetrations have been sealed.
- C. Tests: Testing to be performed will be determined by owner's testing agency from among the following tests:
1. Qualitative Air-Leakage Testing: Weather-barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186, smoke pencil with pressurization or depressurization.
  2. Quantitative Air-Leakage Testing: Weather-barrier assemblies will be tested for air leakage according to ASTM E 783.
  3. Adhesion Testing: Weather-barrier assemblies will be tested for minimum weather-barrier adhesion of 30 lbf/sq. in. according to ASTM D 4541 for each 600 sq. ft. of installed weather barrier or part thereof.
- D. Weather barriers will be considered defective if they do not pass tests and inspections.
1. Apply additional weather-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
  2. Remove and replace deficient weather barrier components and retest as specified above.
- E. Repair damage to weather barriers caused by testing; follow manufacturer's written instructions.

### 3.7 CLEANING AND PROTECTION

- A. Protect weather barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
1. Protect weather barrier from exposure to UV light and harmful weather exposure as recommended by manufacturer. If exposed to these conditions longer than recommended, remove, and replace weather barrier or install additional, full-thickness, weather-barrier application after repairing and preparing the overexposed membrane according to weather-barrier manufacturer's written instructions.
  2. Protect weather barrier from contact with incompatible materials and sealants not approved by weather-barrier manufacturer.

- B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.
- C. Remove masking materials after installation.

END OF SECTION

(NO TEXT ON THIS PAGE)

## SECTION 07 50 00

### PREPARATION FOR RE-ROOFING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Roof tear-off.
  - 2. Removal of flashings.
- B. Related Sections include the following:
  - 1. Section 06 10 00 - Rough Carpentry
  - 2. Section 07 53 00 - SBS-Modified Bituminous Membrane Roofing
  - 3. Section 07 62 00 - Sheet Metal Flashing and Trim

##### 1.2 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

##### 1.3 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.
- B. Existing Membrane Roofing System: SBS Modified Bituminous Membrane, surfacing, and components and accessories between deck and roofing membrane.
- C. Substrate Board: Rigid board or panel products placed over the roof deck that serve as thermal barriers, provide a smooth substrate, or serve as a component of a fire-resistance-rated roofing system.
- D. Roof Tear-Off: Removal of existing membrane roofing system from deck.
- E. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and reinstalled.

- F. Existing to Remain: Existing items of construction that are not indicated to be removed.

#### 1.4 SUBMITTALS

- A. Temporary Roofing: Include Product Data and description of temporary roofing system. If temporary roof will remain in place, submit surface preparation requirements needed to receive permanent roof, and submit a letter from roofing membrane manufacturer stating acceptance of the temporary membrane, and that its inclusion will not adversely affect the roofing system's resistance to fire and wind or its FMG rating.
- B. Fastener pull-out test report if applicable.
- C. Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including exterior and interior finish surfaces that might be misconstrued as having been damaged by reroofing operations. Submit before Work begins.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Installer of new membrane roofing system.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning membrane roofing removal. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Preliminary Reroofing Conference: Conduct conference at Project. Review methods and procedures related to roofing system including, but not limited to, the following:
  - 1. Meet with Owner; Engineer; Owner's insurer if applicable; testing and inspecting agency representative; roofing system manufacturer's representative; deck Installer; roofing Installer including project manager, superintendent, and foreman; and installers whose work interfaces with or affects reroofing including installers of roof accessories and roof-mounted equipment.
  - 2. Review methods and procedures related to reroofing preparation, including membrane roofing system manufacturer's written instructions.
  - 3. Review roof drainage during each stage of reroofing and review roof drain plugging and plug removal procedures.
  - 4. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

5. Review procedures to determine condition and acceptance of existing deck and base flashing substrate for reuse.
6. Review structural loading limitations of deck during reroofing.
7. Review base flashings, special roofing details, drainage, penetrations, equipment curbs, and condition of other construction that will affect reroofing.
8. Review procedures for asbestos removal or unexpected discovery of asbestos-containing materials.
9. Review governing regulations and requirements for insurance and certificates if applicable.
10. Review existing conditions that may require notification of Engineer before proceeding.

#### 1.6 PROJECT CONDITIONS

- A. Owner will occupy portions of building immediately below reroofing area. Conduct reroofing so Owner's operations will not be disrupted. Provide Owner with not less than 72 hours' notice of activities that may affect Owner's operations.
  1. Coordinate work activities daily with Owner so Owner can place protective dust or water leakage covers over sensitive equipment or furnishings, shut down HVAC and fire-alarm or -detection equipment if needed, and evacuate occupants from below the work area if deemed necessary.
  2. Before working over structurally impaired areas of deck, notify Owner to evacuate occupants from below the affected area. Verify that occupants below the work area have been evacuated prior to proceeding with work over the impaired deck area.
- B. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.
- C. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
- D. Owner assumes no responsibility for condition of areas to be reroofed.
  1. Conditions existing at time of inspection for bidding will be maintained by Owner as far as practical.
- E. Limit construction loads on roof to not overstress the existing roof structure and all associated components and connections.

- F. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering into existing roofing system or building.
- G. Hazardous Materials: It is not expected that hazardous materials such as asbestos-containing materials will be encountered in the Work.
  - 1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Engineer and Owner.

## PART 2 PRODUCTS

### 2.1 INFILL MATERIALS

- A. Use infill materials matching existing membrane roofing system materials, unless otherwise indicated.
  - 1. Infill materials are specified in Division 07 SBS-Modified Bituminous Membrane Roofing.

### 2.2 TEMPORARY ROOFING MATERIALS

- A. Selection of materials and design of temporary roofing is responsibility of Contractor.

### 2.3 AUXILIARY REROOFING MATERIALS

- A. General: Auxiliary reroofing preparation materials recommended by roofing system manufacturer for intended use and compatible with components of new membrane roofing system.
- B. Base Sheet Fasteners: Capped head, factory-coated steel fasteners, listed in FMG's "Approval Guide."
- C. Metal Flashing Sheet: Metal flashing sheet is specified in Division 07 Section "Sheet Metal Flashing and Trim."

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Coordinate with Owner to shut down air intake equipment in the vicinity of the Work. Cover air intake louvers before proceeding with reroofing work that could affect indoor air quality or activate smoke detectors in the ductwork.

- B. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.
- C. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday. Prevent debris from entering or blocking roof drains and conductors. Use roof-drain plugs specifically designed for this purpose. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.
  - 1. If roof drains will be temporarily blocked or unserviceable due to roofing system removal or partial installation of new membrane roofing system, provide alternative drainage method to remove water and eliminate ponding.
- D. Verify that rooftop utilities and service piping have been shut off before commencing Work.

### 3.2 ROOF TEAR-OFF

- A. General: Notify Owner each day of extent of roof tear-off proposed and obtain authorization to proceed.
- B. Roof Tear-Off: Remove existing roofing membrane and other membrane roofing system components down to the deck.
  - 1. Remove flashing, cover boards, roof insulation and substrate boards.
  - 2. Bitumen and felts that are firmly bonded to concrete decks are permitted to remain if felts are dry. Remove unadhered bitumen and felts and wet felts.
  - 3. Carefully remove skylights and skylight curbing. Protect the inside of the building from the elements while skylights are removed during installation of new curbing and flashing. Install new skylights after installation of new roof.
  - 4. Carefully remove HVAC units, fans, and curbing. Disconnect from power as required. Store HVAC units and fans for reuse. Protect the inside of the building from the elements while HVAC units and fans are removed during installation of new increased height curbing and flashing. Replace HVAC units and fans and reconnect power after installation of new roof.
  - 5. Remove roof drains and replace with dual roof drains.

### 3.3 DECK PREPARATION

- A. Inspect deck after tear-off of existing roofing system.

### 3.4 TEMPORARY ROOFING MEMBRANE

- A. Install approved temporary roofing membrane over area to be reroofed.
- B. Remove temporary roofing membrane before installing new roofing membrane.

### 1.1 EXISTING BASE FLASHINGS

- A. Remove existing base flashings around parapets, curbs, walls, and penetrations.
  - 1. Clean substrates of contaminants such as asphalt, sheet materials, dirt, and debris.
- B. Do not damage metal counter flashings that are to remain. Replace metal counter flashings damaged during removal with counter flashings specified in Division 07 Section "Sheet Metal Flashing and Trim." FASTENER PULL-OUT TESTING
  - A. Perform fastener pull-out tests according to SPRI FX-1 and submit test report to Engineer before installing new membrane roofing system.
  - B. Verify that substrate is visibly dry and free of moisture.
  - C. If broken or loose fasteners that secure deck panels to one another or to structure are observed, or if deck appears or feels inadequately attached, immediately notify Engineer. Do not proceed with installation until directed by Engineer.
  - D. If deck surface is not suitable for receiving new roofing, or if structural integrity of deck is suspect, immediately notify Engineer. Do not proceed with installation until directed by Engineer.

### 3.6 DISPOSAL

- A. Collect and place demolished materials in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
  - 1. Storage or sale of demolished items or materials on-site will not be permitted.
- B. Transport demolished materials off Owner's property and legally dispose of them.

END OF SECTION

## SECTION 07 53 00

### SBS-MODIFIED BITUMINOUS MEMBRANE ROOFING

#### PART 1 GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. SBS-Adhered modified bituminous membrane roofing.
2. Roof Insulation.

###### B. Related Sections include the following:

1. Section 06 10 00 – Rough Carpentry
2. Section 07 62 00 – Stainless Steel Sheet Metal Flashing and Trim

##### 1.2 DEFINITIONS

###### A. Roofing Terminology: Refer to the following publications for definitions of roofing work related terms in this Section:

1. ASTM D 1079: “Standard Terminology Relating to Roofing and Waterproofing.”
2. Glossary of NRCA's "The NRCA Roofing and Waterproofing Manual"
3. Roof Consultants Institute “Glossary of Building Envelope Terms.”

##### 1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide an installed roofing membrane system that remains watertight, resist specified wind uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- C. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings from the applicable testing and inspecting agency.
  1. Exterior Fire-Test Exposure: Class A; UL 790, for application and roof slopes indicated on drawings.

D. FMG Listing: Provide roofing membrane, base flashings, and component materials that comply with requirements in FMG 4450 and FMG 4470 as part of a roofing system and that are listed in FMG's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.

1. Fire/Windstorm Classification: Class 1A-90

2. Hail Resistance: SH

#### 1.4 SUBMITTALS

A. Submit the following in accordance with Division 1.

1. Product Data: For each type of product provided.

2. Shop Drawings: Provide roofing system details and details of attachment to other Work, including:

a. Base flashings, cants, and membrane terminations.

b. Tapered insulation, including slopes.

c. Crickets, saddles, and tapered edge strips, including slopes.

d. Insulation fastening and adhesive patterns.

3. Samples for Verification: For each product specified.

4. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and is eligible to receive manufacturer's standard warranty.

5. Submit a statement, signed by the Contractor and Installer, stating that the Contract Drawings and Specifications, as well as the shop drawings and product data have been reviewed with qualified representatives of the roofing materials manufacturers, and that they are in agreement that the selected materials and system are proper and adequate for the application required. In addition, the review statement must cover the following:

a. That the manufacturer has examined the site, specification, and drawings.

b. That the products specified herein are acceptable for and compatible with the roofing and flashing system's design.

- c. That the roofing and flashing system is compatible with the structure.
  - d. Certify that all their products delivered to the site will meet or exceed specified requirements.
  - e. That the manufacturer will issue a warranty covering workmanship and material for the system installed, in accordance with the specifications.
6. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
- a. Submit evidence of meeting performance requirements.
  - b. Qualification Data: For Installer and manufacturer.
  - c. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of roofing system.
  - d. Maintenance Data: For roofing system to include in maintenance manuals.
  - e. Warranties: Standard warranties specified in this Section.
  - f. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's warranty.
  - 1. Installer must have at least three (3) years of successful installation experience with projects utilizing roofing products similar to that required for this project.
- B. Manufacturer Qualifications: A qualified manufacturer that has UL listing and FMG approval for a roofing system identical to that used for this Project.
- C. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 329.

- D. Source Limitations: Obtain all components from the single source roofing manufacturer guaranteeing the roofing system. All products used in the system shall be labeled by the single source roofing manufacturer issuing the guarantee.
- E. Provide evidence of CERTA training for any installer of torch-applied modified bitumen membrane. Copies of certifications are required prior to award and shall be maintained on the jobsite for inspection at any time.
- F. Fire-Test Response Characteristics: Provide roofing materials with the fire-test response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
  - 1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and roof slopes indicated.
- G. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site. Review methods and procedures related to roof deck construction and roofing system including, but not limited to, the following:
  - 1. Owner and Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof mounted equipment.
  - 2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
  - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
  - 5. Review structural loading limitations of roof deck during and after roofing.
  - 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.

7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.
10. Review methods and procedures related to roofing installation, including manufacturer's written instructions.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storage.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

#### 1.7 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

#### 1.8 WARRANTIES

- A. Provide Manufacturer's Standard Roofing System Warranty:
  1. Warranty includes roofing membrane, base flashings, liquid applied flashing, roofing membrane accessories, roof insulation, fasteners, cover board, substrate board, vapor retarder, walkway products, manufacturer's expansion joints, manufacturer's edge metal products, and other single-source components of roofing system marketed by the manufacturer.
  2. State that the roofing and metal materials are free from any defect in material or workmanship for the period specified.

- B. Installer's Standard Warranty: Submit roofing Installer's guarantee, signed by Installer, covering Work of this Section, including all components of roofing system, for the following guarantee period:
  - 1. Warranty Period: Two years from date of Substantial Completion.
- C. Existing Warranties: Warranties on existing building elements should not be affected by scope of work.
  - 1. The installer is responsible for coordinating with the building owner's representative to verify compliance.
- D. Warranties are exclusive of repairs due to improper maintenance or operation, normal wear and tear, usage, structural movement, and acts of God.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. SBS-Modified Bituminous Membrane Roofing with granular surface:
    - a. Johns Manville International, Inc.( Basis of Design)
    - b. The Garland Company, Inc.
    - c. Firestone Building Products Company.
    - d. GAF
- B. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.

### 2.2 BASE PLY AND CAP-SHEET MATERIALS

- A. Roofing Membrane Sheet: ASTM D 6163, Grade S, Type I, glass-fiber-reinforced, SBS-modified asphalt sheet; smooth surfaced; suitable for application method specified.

1. Basis of design product:
  - a. Johns Manville International: DynaBase
- B. Roofing Membrane Cap Sheet: ASTM D 6163, Grade G, Type I, glass-fiber-reinforced, SBS-modified asphalt sheet; granular surfaced; suitable for application method specified.

1. Basis of design product:
  - a. Johns Manville International: DynaGlas FR
2. Granule Color: White

## 2.3 FLASHING SHEET MATERIALS

- A. Backer Sheet: ASTM D 4601, Type II, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.

1. Basis of design product:
  - a. Johns Manville International: PermaPly 28

- B. Backer Sheet: ASTM D 6163, Grade S, Type I, glass-fiber-reinforced, SBS-modified asphalt sheet; smooth surfaced; suitable for application method specified.

1. Basis of design product:
  - a. Johns Manville International: DynaBase

- C. Flashing Sheet: ASTM D 6163, Grade G, Type I, glass-fiber-reinforced, SBS-modified asphalt sheet; granular surfaced; suitable for application method specified.

1. Basis of design product:
  - a. Johns Manville International: DynaLastic 250 FR

- D. Liquid Applied Flashing: A liquid and fabric reinforced flashing system created with a stitchbonded polyester scrim and a two-component, moisture cured, elastomeric, liquid applied flashing material, consisting of an asphalt extended urethane base material and an activator.

1. Basis of design product:
  - a. Johns Manville International: PermaFlash System

- E. High Wall Sheet Flashing Membrane: Basis of Design:
  - 1. EPDM: 60 mils, internally or scrim reinforced.
  - 2. Adhesive Basis of Design: All Season Sprayable Bonding Adhesive.

## 2.4 AUXILIARY ROOFING MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with built-up roofing.
  - 1. Roofing Asphalt: ASTM D 312-15, Type IV.
  - 2. Asphalt Primer: ASTM D 41.
    - a. Basis of design product:
      - (1) Johns Manville International: Concrete Deck Primer
  - 3. Cold-Applied Adhesive: ASTM D3019, Type III, Grade 2. asphalt-based, asbestos-free, cold-applied adhesive specially formulated for compatibility and use with membrane applications.
    - a. Basis of design product:
      - (1) Johns Manville International: MBR Cold Application Adhesive.
  - 4. Cold-Applied Flashing Adhesive: Roofing system manufacturer's asphalt-based, one-part, asphalt-based, trowel-grade mastic, cold-applied adhesive specially formulated for compatibility and use with flashing applications.
    - a. Basis of design product:
      - (1) Johns Manville International: MBR Utility Cement.
  - 5. Mastic Sealant: As required by manufacturer.
  - 6. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roofing membrane components to substrate, tested by manufacturer for required pullout strength, and provided by the roofing system manufacturer.

a. Basis of design product:

(1) Johns Manville International: All Purpose Fasteners and Plates

7. Metal Flashing Sheet: Metal flashing sheet is specified in Division 07 Section "Stainless Steel Sheet Metal Flashing and Trim."
8. Miscellaneous Accessories: Provide all miscellaneous accessories recommended by roofing system manufacturer.
9. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, with anchors. Basis of design: JM Termination Systems
10. Roofing Granules: Ceramic-coated roofing granules matching specified cap sheet, provided by roofing system manufacturer. R Roofing Granules.
11. Self-Adhered Primer: One-part penetrating primer solution to enhance the adhesion of self-adhering membranes.

a. Basis of design: SA Primer.

## 2.5 REFLECTIVE COATING

- A. Elastomeric Coating: ASTM D 6083. A multipurpose, acrylic elastomeric coating for use over a variety of substrates.

## 2.6 WALKWAYS

- A. Walkway Pads: Mineral-granule-surfaced, reinforced modified asphalt composition, slip-resisting pads, manufactured as a traffic pad for foot traffic provided by roofing system manufacturer, with a pad size of 32-inch x 32-inch.
  1. Basis of design: DynaTred Walkway.

## 2.7 ROOF BOARD

- A. Provide gypsum core with embedded glass mat facers on top and bottom of the board and compatible with roofing membrane adhesives, manufactured to conform to ASTM C1177.
  1. Cement Panel: Basis of design: 1/2-inch DensDeck Prime Roof Board. Other manufacturers of equivalent products may be submitted.
    - a. Size: Nominal 4-feet x 8-feet
    - b. Flexural Strength, parallel, lbf. per ASTM C473 Method B:  $\geq 80$

- c. Flute spanability per ASTM E661: 5-inch
- d. Permeance, perms per ASTM E96: >23
- e. R Value, ft<sup>2</sup>x°Fx hr/BTU per ASTM C518: 0.56
- f. Coefficient of thermal expansion, inches/inch/°F, per ASTM C473: 8.5 x 10
- g. Linear variation with change in moisture, %, per ASTM C473: 6.25x10
- h. Water absorption, % max, per ASTM C1177: 5
- i. Compressive strength per ASTM C473: 900
- j. Bending radius: 6-inch.

## 2.8 ROOF INSULATION

- A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2 (20 psi), Basis of design: ENRGY 3.25 PSI CGF
  - 1. Provide insulation package with minimum R Value: 30
  - 2. Provide insulation package with minimum thickness: 1-inch.
  - 3. Provide insulation package in multiple layers.
  - 4. Minimum Long-Term Thermal Resistance (LTTR): 5.7 per inch.
  - 5. Determined in accordance with CAN/ULC S770 at 75°F.
- C. Tapered Insulation: ASTM C 1289, Type II, Class 1, Grade 2 Provide Polyisocyanurate factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches, unless otherwise indicated.
  - 1. Basis of design product:
    - a. Johns Manville International: Flat and Tapered ENRGY 3.25

## 2.9 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.

- B. Provide factory preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drains as indicated. Fabricate to slopes indicated.
  - C. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and furnished by roofing system manufacturer.
    - 1. Basis of design: All Purpose Fasteners and UltraFast Plates
  - D. Cold Fluid-Applied Adhesive: Manufacturer's No VOC, two-component cold fluid-applied adhesive formulated to adhere roof insulation to substrate.
  - E. Insulation Cant Strips: ASTM C 728, perlite insulation board.
- 2.10 VAPOR RETARDER
- A. Self-Adhered SBS Vapor Retarder: ASTM D 4601, [glass-fiber-reinforced], SBS-modified asphalt sheet; sand surfaced; suitable for application method specified.
    - 1. Basis of design: DynaGrip Base SD/SA.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the requirements and other conditions affecting performance of roofing system:
  - 1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
  - 2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
  - 3. Verify that decking is visibly dry and free of moisture.
  - 4. Verify that the decking is smooth and free of large cracks, holes, or sharp changes in elevation of the surface.
  - 5. When applicable perform a pull test with the specific fastener being used on the project to confirm the fastener resistance meets the requirements for that particular system.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean and remove from substrate sharp projections, dust, debris, moisture, and other substances detrimental to roofing installation in accordance with roofing system manufacturer's written instructions.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecasted.

### 3.3 RE-ROOF PREPARATION

- A. Remove all roofing membrane, surfacing, coverboards, insulation, fasteners, asphalt, pitch, adhesives, etc.
  - 1. Remove an area no larger than can be re-roofed in one day.
- B. Tear out all base flashings, counter flashings, pitch pans, pipe flashings, vents, sumps, and like components necessary for application of new membrane.
- C. Remove abandoned equipment curbs, skylights, smoke hatches, and penetrations.
  - 1. Install decking to match existing as directed by Owner's Representative.
- D. Raise (disconnect by licensed craftsmen, if necessary) all HVAC units and other equipment supported by curbs to conform with the following:
  - 1. Modify curbs as required to provide a minimum 8-inch base flashing height measured from the surface of the new membrane to the top of the flashing membrane.
  - 2. Secure flashing and install new metal counterflashing prior to re-installation of unit.
  - 3. Perimeter nailers shall be elevated to match the elevation of new roof insulation.
- E. Immediately remove all debris from roof surface. Do not store demolished roof materials on the roof surface.

### 3.4 INSULATION INSTALLATION

- A. Comply with roofing system manufacturer's written instructions for installing roof insulation.

- B. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing membrane system with vertical surfaces or angle changes greater than 45 degrees per manufacturer's instruction.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install boards with long joints in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with like material.
  - 1. Cut and fit boards within 1/4 inch of nailers, projections, and penetrations
- E. Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2 inches or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
- F. Trim surface of boards where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- G. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
- H. Adhered Insulation and Cover Board: Install each layer of insulation and cover board and adhere to substrate as follows:
  - 1. Set each layer in a two-part cold fluid-applied adhesive.

### 3.5 ROOFING MEMBRANE INSTALLATION, GENERAL

- A. Install roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendations of ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."
- B. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.
- C. Cooperate with testing and inspecting agencies engaged or required to perform services for installing roofing system.
- D. Coordinate installing roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
  - 1. Provide tie-offs at end of each day's work to cover exposed roofing membrane sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt with joints and edges sealed.

2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
3. Remove and discard temporary seals before beginning work on adjoining roofing.

### 3.6 SBS-MODIFIED BITUMINOUS MEMBRANE INSTALLATION

- A. Install modified bituminous roofing membrane sheets and cap sheet according to roofing manufacturer's written instructions, starting at low point of roofing system. Extend roofing membrane sheets over and terminate beyond cants, installing as follows:
  1. Unroll roofing membrane sheets and allow them to relax.
  2. Install one lapped base sheet course and mechanically fasten to substrate according to roofing system manufacturer's written instructions.
  3. Enhance fastening rate in perimeter and corner zones according to code or manufacturer, whichever is more stringent.
  4. Side and end laps shall be installed using heat welding techniques.
  5. Fasteners in field of sheets shall be stripped in per manufacturer's requirements prior to installing cap sheet.
- B. Laps: Accurately align roofing membrane sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Completely bond and seal laps, leaving no voids.
  1. Repair tears and voids in laps and lapped seams not completely sealed.
  2. As required, apply roofing granules to cover exuded bead at laps while bead is hot.
- C. Install roofing membrane sheets so side and end laps shed water.

### 3.7 FLASHING AND STRIPPING INSTALLATION

- A. Install sheet metal roof flashing and trim to comply with roofing manufacturer's recommendations and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.
- B. Install base flashing over cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions and as follows:
  1. Prime substrates with asphalt primer if required by roofing system manufacturer.

2. Backer Sheet Application: Mechanically fasten backer sheet to walls or parapets. Adhere backer sheet over roofing membrane at cants in cold-applied adhesive.
  3. Flashing Sheet Application: Adhere flashing sheet to substrate in cold-applied adhesive at rate required by roofing system manufacturer.
- C. Extend base flashing up walls or parapets a minimum of 8 inches above roofing membrane and 4 inches onto field of roofing membrane. Install stainless steel termination bars and counterflashing at all walls as detailed.
  - D. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.
  - E. Pipe or Post Counterflashing: Install counterflashing umbrella with close fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless steel draw band and tighten.
  - F. Install lead flashing at all vent pipe penetrations as shown and as recommended by roofing manufacturer.
  - G. Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

### 3.8 REFLECTIVE COATING INSTALLATION ON FLASHING

- A. Base flashing material: Minimum solar reflectance, both initial and weathered, of 0.25. Application of a reflective surface coating material is acceptable.
- B. Apply coating by brush, roller or spray at a rate of one gallon per 100 square feet per coat. Apply a two-coat application in a crosshatch manner for a dry film thickness of 10 mils per coat.

### 3.9 FIELD QUALITY CONTROL

- A. The Roofing System Manufacturer must provide daily job site inspections with photographs, submitted weekly, of work in progress. Full time manufacturer's representative must provide all inspections.
- B. Confirm, whenever called upon by the Owner's Construction Representative that no application procedures were in conflict with the published specifications other than those that may have been previously reported and corrected.
- C. Inspections must be performed only by full-time employees of the Roofing System Manufacturer. The Representative must be an employee of the Manufacturer for a minimum of five (5) years and live within a 100 mile radius of the job site.

- D. During the course of work on this Contract, the owner's Construction Representative may secure samples of materials being used from containers at the job site and submit them to an independent laboratory for comparison to specified materials. Should test results prove that a material is not functionally equal to the specified material, roofing installed and found not to comply with the specifications must be removed and replaced at no additional cost to the Owner.

3.10 PROTECTING AND CLEANING

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Requirements for furnishing and installing metal flashing, counterflashing, metal reglets and roof expansion joints covers, together with all accessories necessary for a complete installation.
- B. Related Work Specified In Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 06 10 00 - Rough Carpentry
  - 2. Section 07 90 00 - Joint Sealants
  - 3. Section 09 96 00 – High Performance Coatings

1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
  - 2. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
  - 3. SMACNA - Architectural Sheet Metal Manual
  - 4. NRCA - Roofing and Waterproofing Manual

1.3 COORDINATION

- A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: For sheet metal flashing and trim.
1. Include plans, elevations, sections, and attachment details.
  2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop-and field-assembled work.
  3. Include identification of material, thickness, weight, and finish for each item and location in Project.
  4. Include details for forming, including profiles, shapes, seams, and dimensions.
  5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
  6. Include details of termination points and assemblies.
  7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
  8. Include details of special conditions.
  9. Include details of connections to adjoining work.
  10. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.
- C. Samples for Verification: For each type of exposed finish.
1. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
  2. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

## 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

## 1.7 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, and handle all products and materials as specified in Division 1 and as follows:
- B. Stack preformed and prefinished material to prevent twisting, bending, or abrasion, and to provide ventilation.
- C. Separation: Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- D. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

## 1.8 WARRANTY

- A. Manufacturer's Standard Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- C. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- D. Recycled Content of Steel: Provide steel with minimum 25 percent post-consumer recycled content.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of

components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## 2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: Smooth, flat surface ASTM B 209, standard alloy for finish and temper needed to suit forming operations and performance required.
  1. Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
    - a. Exposed Coil-Coated Finish:
      - (1) Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
        - (a) Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  2. Color: As selected by architect from full color range palette.
  3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

## 2.1 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.
- B. Self-Adhering, High-Temperature Sheet: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.
  1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
  2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.

- C. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum

## 2.2 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
  - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
    - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
  - 2. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- C. Solder:
  - 1. For Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

## 2.3 FABRICATION

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

- B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
  - 1. Obtain field measurements for accurate fit before shop fabrication.
  - 2. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
  - 3. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- D. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
  - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
  - 2. Use lapped expansion joints only where indicated on Drawings.
- E. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- G. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.
- H. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- I. Do not use graphite pencils to mark metal surfaces.

## 2.4 WALL SHEET METAL FABRICATIONS

- A. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch- high, end dams. Fabricate from the following materials:
  - 1. Stainless Steel: 0.019 inch thick.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
  - 1. Verify compliance with requirements for installation tolerances of substrates.
  - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
  - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare surfaces to which sheet metal will be applied which are even, smooth, sound, thoroughly clean and dry, and free from all defects that might affect the application. Cover all concrete surfaces which are shown to receive metal covering with two plies of asphalt-saturated felt.

### 3.3 UNDERLAYMENT INSTALLATION

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.
- B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.
- C. Apply slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.

### 3.4 INSTALLATION

- A. General: Install flashing and trim in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.
- B. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners,

solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
  2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
  3. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
  4. Torch cutting of sheet metal flashing and trim is not permitted.
  5. Do not use graphite pencils to mark metal surfaces.
- C. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
  2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
1. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- E. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant.
  2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.

3. Prepare joints and apply sealants to comply with requirements in Section 07 90 00 "Joint Sealants."
- F. Projections and Openings: Install flashing at all projections through roofs and at all openings through the roof surface for which flashing is not otherwise specified.
  - G. Counterflashing: At locations where sheet metal is turned into reglets as counterflashing over base flashings, and other locations, insert the sheet metal to the full depth and turn back the edge to form a hook. After the flashing is in place, completely fill the reglet with lead wool and compress tight. Joint counterflashing ends of adjacent sheets joined at 8-foot intervals by 3/4-inch locked and soldered seams. Provide a 1-1/2-inch-wide loose lock expansion seam at intervals of 32 feet and fill with caulking compound. Where counter flashings join at external corners of the parapet walls, fabricate the flashing corner piece from one piece of sheet metal and to adjacent right-angle sheets approximately 12 inches from the corner with 3/4-inch locked soldered seams.
  - H. Accessories: Hem exposed edges of all flashings edges, folded back on themselves at outer edges not less than 1/2-inch to provide stiffening. Provide as required all accessories or other items essential to the completeness of the sheet metal installation, though not specifically shown or specified, to assure a watertight installation.
  - I. Seams: Lock all seams, except loose locked seams, and mallet flat and solder for their entire length. Flatten before soldering is done and finish 1-inch wide, unless otherwise specified. Fold and flatten longitudinal seams in the direction of water flow. Provide loose lock seams that are loose, flat locked seams, malleted flat, and finished not less than 1-inch wide, and completely fill with an approved plastic cement.
  - J. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work.
    1. Do not use torches for soldering.
    2. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
    3. Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering.
    4. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

3.5 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.

END OF SECTION

SECTION 07 63 00

GUTTERS AND DOWNSPOUTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum gutters
2. Conductor heads
3. Downspouts
4. Precast concrete splash blocks.

B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:

1. Section 06 10 00 - Rough Carpentry
2. Section 07 53 00 - SBS-Modified Bituminous Membrane Roofing
3. Section 07 62 00 - Sheet Metal Flashing and Trim
4. Section 07 90 00 - Joint Sealants

1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. SMACNA - Architectural Sheet Metal Manual
2. ASTM B 209 - Aluminum and Aluminum-Alloy Sheet and Plate
3. ASTM B 221 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes

1.3 COORDINATION

- A. Coordinate work of this section with interfacing and adjacent work for proper sequencing. Ensure weather resistance and durability of work and protection of materials and finishes.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Installation Requirements: Fabricator is responsible for installing system, including anchorage to substrate and necessary modifications to meet specified and drawn requirements and maintain visual design concepts in accordance with Contract Documents.
  - 1. Drawings are diagrammatic and are intended to establish basic dimension of units, sight lines, and profiles of units.
  - 2. Make modifications only to meet field conditions and to ensure fitting of system components.
  - 3. Obtain Architect's approval of modifications.
  - 4. Provide concealed fastening wherever possible.
  - 5. Attachment considerations: Account for site peculiarities and expansion and contraction movements so there is no possibility of loosening, weakening and fracturing connection between units and building structure or between components themselves.
  - 6. Obtain Architect's approval for connections to building elements at locations other than indicated in Drawings.
  - 7. Accommodate building structure deflections in system connections to structure.

#### 1.5 PERFORMANCE REQUIREMENTS:

- A. Provide system to accommodate movement of components without buckling, failure of joint seals, undue stress on fasteners, or other detrimental effects when subjected to seasonal temperature changes and live loads.
- B. Design system capable of withstanding building code requirements for negative wind pressure.

#### 1.6 SUBMITTALS

- A. Provide all submittals, including the following, and as specified in Division 1.
- B. Product Data: Manufacturer's catalog data, detail sheets, and specifications.
- C. Shop Drawings: Prepared specifically for this project; showing layout, profiles, expansion provisions, gutter slopes, methods of joining, and anchorage details, including downspout strainers, gutter covers, scuppers, and conductor head, attachments to built-in plumbing drain lines, scuppers, and conductor head systems, and interface with other products. Provide layouts at 1/4-inch scale and details at 3-inch scale.

- D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches square, representing actual product, color, and patterns.

#### 1.7 QUALITY ASSURANCE

- A. Fabricator's Qualifications: Company specializing in copper gutter and downspout work with three years experience in similar size and type of installations.
- B. Installer: A firm with 3 years of successful experience with installation of gutter and downspout work of type and scope equivalent to Work of this Section.
- C. Conform to dimensions and profiles shown.
- D. Mock-Up: Before proceeding with final purchase of materials and fabrication of gutter and downspout work components, prepare a mock-up of work. Incorporate materials and methods of fabrication and installation identical with project requirements. Install mock-up at location directed by Architect. Retain accepted mock-up as quality standard for acceptance of completed work. If accepted, mock-up may be incorporated as part of work.
  - 1. Provide mock-up of sufficient size and scope to show typical pattern of seams, fastening details, edge construction, and finish texture and color.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Packing, Shipping, Handling, and Unloading: Protect finish metal faces.
- B. Acceptance at Site: Examine each component and accessory as delivered and confirm that material and finish is undamaged. Do not accept or install damaged materials.
- C. Storage and Protection:
  - 1. Stack pre-formed material to prevent twisting, bending, and abrasions.
  - 2. Provide ventilation.
  - 3. Prevent contact with materials which may cause discoloration or staining.

#### 1.9 WARRANTY

- A. Provide manufacturer's standard warranty to warrant installed gutters, downspouts, and trim components to be free from defects in material and workmanship for period of 2 years.
- B. Include coverage against leakage and damages to finishes.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable manufacturer is listed below. Other manufacturers of equivalent products may be submitted.
  - 1. Roof Drainage Materials: W.P. Hickman Company, Asheville, NC
  - 2. Splash blocks: Nitterhouse Masonry Products, Chambersburg, PA

### 2.2 MATERIALS

- A. Aluminum Sheet: Provide 0.051-inch-thick ASTM B 209, Alloy 3003-H14 aluminum sheet with a mill finish.
- B. Rivets: Provide 0.187-inch minimum shank dimension ASTM B 221, Alloy 1100-H14 rivets.

### 2.3 FABRICATION

- A. General: Fabricate from .051-inch-thick aluminum. Provide end caps to match gutter profile, accessories, straps, and all materials required for a complete roof drainage system.
- B. Gutters: Custom size rectangular Gutter, as shown on the drawings. Gutter Sections: Length of 10 feet.
  - 1. 1.5-inch wide 0.125-inch straps at 18-inch o.c. across top of gutter front edge.
  - 2. Include expansion joints not exceeding 40 feet maximum for long runs, locations as recommended by manufacturer.
  - 3. Include fascia as required for mounting.
- C. Downspouts:
  - 1. Factory fabricated rectangular downspouts, sizes as shown on drawings.
  - 2. Provide three (3) downspout anchor straps per 10 feet section.
  - 3. Provide factory fabricated elbows to match downspout hydraulic section and material.
- D. Fasteners: As recommended by the manufacturer per substrate application.
- E. Splash blocks: Provide 12-inch x 24-inch x 2-7/8-inch precast concrete splash blocks capable of withstanding 100 lbs. per square foot live load

## 2.4 FINISHES

### A. Provide gutters, downspouts and accessories in:

1. Kynar-500 color to be selected by Engineer from manufacturer's standard colors.

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### A. General: Install gutters and downspouts in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.

#### B. Erection: Install gutters and downspouts in accordance with the SMACNA Architectural Sheet Metal Manual and as follows:

1. Gutters: Pitch gutters 1/16-inch per foot to drain and lap ends 3 inches in the direction of flow. Rivet seams at 2-inch centers and caulk in accordance with Section 07 90 00. Fasten gutters to the fascia with spikes and ferrules (strap hangers) at a maximum of 36-inch centers. Rivet or weld outlet to gutters and extend 2 inches into leaders or downspouts. Provide for expansion and contraction.
2. Downspouts: Support downspouts with 1/8- by 3-inch aluminum straps at top and bottom and a maximum of 6 feet on center. Extend straps on wall surface or around posts 2 inches each side of downspout. Secure to masonry with expansion shields and stainless-steel machine bolts and to wood with stainless steel lag screws. Provide removable screen at the top of the downspouts and an elbow at the bottom.
3. Through-wall Scupper: Verify adequate clearance for scupper before commencing with work, coordinate with contractor. Install scupper in accordance with roofing manufacturer's recommendations. Installation of the scupper will not void the roofing system warranty.
4. Conductor Head: Fasten conductor head to exterior wall in accordance with conductor head manufacturer's recommendation and approved by the exterior wall finish manufacturer.
5. Splash blocks: Place splash blocks as indicated on the drawings and to adequately drain water away from building. For splash blocks set on roof assemblies, provide adequate membrane protection as recommended by the roofing manufacturer.

6. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

## SECTION 07 71 00

### PREFABRICATED ROOF SPECIALTIES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Roof curbs.
  - 2. Equipment supports.
  - 3. Preformed flashing sleeves.
  - 4. Metal Coping

##### 1.2 COORDINATION

- A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
- B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of roof accessory.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For roof accessories.
  - 1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.
- C. Delegated-Design Submittal: For roof curbs and equipment supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Detail mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordinating requirements with roof membrane system.

2. Wind-Restraint Details: Detail fabrication and attachment of wind restraints. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
  1. Size and location of roof accessories specified in this Section.
  2. Method of attaching roof accessories to roof or building structure.
  3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
  4. Required clearances.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

### PART 2 PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 45 00 "Quality Control" to design roof curbs and equipment supports to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Wind-Restraint Performance: As indicated on Drawings.

#### 2.2 ROOF CURBS

- A. Roof Curbs: Internally reinforced and insulated roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, straight sides, and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Air Balance, Inc.; a division of Mestek, Inc.
  - b. Custom Solution Roof and Metal Products.
  - c. Greenheck Fan Corporation.
  - d. LM Curbs.
  - e. Milcor; Commercial Products Group of Hart & Cooley, Inc.
  - f. Thybar Corporation.
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Material: Aluminum-zinc alloy-coated steel sheet, 14 Gauge (0.064 inch) thick.
- D. Construction:
  1. Curb Profile: Manufacturer's standard compatible with roofing system.
  2. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
  3. Top Surface: Level top of curb, with roof slope accommodated by use of leveler frame.
  4. Insulation: Factory insulated with 1-1/2-inch- thick glass-fiber board insulation.
  5. Liner: Same material as curb, of manufacturer's standard thickness and finish.
  6. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
  7. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.

## 2.3 EQUIPMENT SUPPORTS

- A. Equipment Supports: Rail-type metal equipment supports capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural

supports; capable of meeting performance requirements; with welded corner joints, and integrally formed structure-mounting flange at bottom.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Air Balance, Inc.; a division of Mestek, Inc.
  - b. Custom Solution Roof and Metal Products.
  - c. Greenheck Fan Corporation.
  - d. LM Curbs.
  - e. Milcor; Commercial Products Group of Hart & Cooley, Inc.
  - f. Thybar Corporation.
- B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
- C. Material: Aluminum-zinc alloy-coated steel sheet, 14 Gauge (0.064 inch) thick.
- D. Construction:
  1. Curb Profile: Manufacturer's standard compatible with roofing system.
  2. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb of size and spacing required to meet wind uplift requirements.
  3. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
  4. Fabricate equipment supports to minimum height of 12 inches above roofing surface unless otherwise indicated.

## 2.4 PREFORMED FLASHING SLEEVES

- A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches high, with removable metal hood and slotted or perforated metal collar.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Custom Solution Roof and Metal Products.
  - b. Thaler Metal Industries Ltd.
  2. Metal: Aluminum sheet, 14 Gauge (0.064 inch) thick.
  3. Diameter: As indicated on Drawings.
  4. Finish: Manufacturer's standard.
- B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Custom Solution Roof and Metal Products.
    - b. Milcor; Commercial Products Group of Hart & Cooley, Inc.
    - c. Thaler Metal Industries Ltd.
  2. Metal: Aluminum sheet, 0.063 inch thick.
  3. Height: 13 inches.
  4. Diameter: As indicated on Drawings.
  5. Finish: Manufacturer's standard.

## 2.5 METAL COPING

- A. Manufactured Metal Coping including but not limited to miters 90 degrees and non-90 degrees, welded or quick locked, transitions, endcaps and endwall flashing.
1. Material: Aluminum
  2. Standards: ANSI / SPRI / FM ES-1
  3. Finish: Kynar 500. Color selected by engineer from manufacturer's full color palette.
  4. Provide Stainless steel springs factory attached to pre-punched anchor clips.
  5. Attachment system: Snap-on.
  6. Standard Length: 12 feet.
  7. Gauge: 16ga max (0.059)

## 2.6 METAL MATERIALS

- A. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, AZ50 coated.
  - 1. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A 755. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- B. Aluminum Sheet: ASTM B 209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
  - 1. Mill Finish: As manufactured.
  - 2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.
- C. Aluminum Extrusions and Tubes: ASTM B 221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.
- D. Stainless-Steel Sheet and Shapes: ASTM A 240 or ASTM A 666, Type 304.

## 2.7 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, thickness and thermal resistivity as indicated.
- C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, and complying with AWWA C2; not less than 1-1/2 inches thick.
- D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- E. Underlayment:
  - 1. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
  - 2. Slip Sheet: Building paper, 3 lb/100 sq. ft. minimum, rosin sized.
  - 3. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of

butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

4. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.
  5. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153 or ASTM F 2329.
  6. Fasteners for Aluminum Sheet: Aluminum or Series 304 stainless steel.
  7. Fasteners for Stainless-Steel Sheet: Series 304 stainless steel.
  8. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- F. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

## 2.8 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. General: Install board insulation in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.

### 3.2 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

- B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- C. Verify dimensions of roof openings for roof accessories.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. General: Install roof accessories according to manufacturer's written instructions.
  - 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
  - 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
  - 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
  - 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
  - 1. Coat concealed side of stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  - 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
  - 3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.
- C. Roof Curb Installation: Install each roof curb so top surface is level.
- D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.
- E. Preformed Flashing-Sleeve Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.

- F. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

#### 3.4 REPAIR AND CLEANING

- A. Clean exposed surfaces according to manufacturer's written instructions.
- B. Clean off excess sealants.
- C. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 07 81 00

### SPRAY APPLIED FIRE RESISTIVE MATERIALS

#### PART 1 GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Section includes Sprayed-Applied Fire-Resistive Materials (SFRMs).

###### B. Related sections:

1. 05 12 00 Structural Steel Framing.

##### 1.2 COORDINATION

###### A. Preinstallation Conference: Conduct conference at Project site.

###### B. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

##### 1.3 ACTION SUBMITTALS

###### A. Product Data: For each type of product.

###### B. Shop Drawings: Framing plans, schedules, or both, indicating the following:

1. Extent of fireproofing for each construction and fire-resistance rating.
2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
4. Treatment of fireproofing after application.

##### 1.4 INFORMATIONAL SUBMITTALS

###### A. Qualification Data: For Installer and testing agency.

###### B. Product Certificates: For each type of fireproofing.

###### C. Evaluation Reports: For fireproofing, from third party.

D. Preconstruction Test Reports: For fireproofing.

E. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

B. Mockups: Build mockups to include a connection of columns, beams, and metal deck.

1. Build mockup of representative size to convey product application and appearance.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Follow industry guidelines as noted in The National Fireproofing Contractors Association (NFCA) 100 – Standard Practice for the Application of Spray-Applied Fire Resistive Materials (SFRMs) be maintained on the project site.

#### 1.6 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on fireproofing.

B. Provide test specimens and assemblies representative of proposed materials and construction.

C. Preconstruction Adhesion and Compatibility Testing: Test for compliance with requirements for specified performance and test methods.

D. Bond Strength: Test for cohesive and adhesive strength according to ASTM E 736. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.

E. Density: Test for density according to ASTM E 605. Provide density indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.

F. Verify that manufacturer, through its own laboratory testing or field experience, attests that primers or coatings are compatible with fireproofing.

- G. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
- H. For materials failing tests, obtain applied-fireproofing manufacturer's written instructions for corrective measures including the use of specially formulated bonding agents or primers.

## 1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 40 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours prior to, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing a minimum 4 complete air exchanges per hour and according to manufacturer's written instructions until Spray-Applied Fire Resistive Materials are dried and cured. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
- B. Source Limitations: Obtain fireproofing for each fire-resistance design from a single source.
- C. Fire-Resistance Design: UL-D985 or as indicated on Drawings, tested according to ASTM E 119/UL 263 by a qualified testing agency. Identify products with appropriate markings from an applicable testing agency.
  - 1. Steel members are to be considered unrestrained unless specifically noted otherwise.
  - 2. UL design listings must state that the loading was determined by Allowable Stress Design Method or Load and Resistance Factor Design Method. UL design listings requiring a load restriction factor are not allowed.
  - 3. Asbestos: Provide products containing no detectable asbestos.

### 2.2 MATERIALS, GENERAL

- A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.

- B. Source Limitations: Obtain fireproofing from single source.
- C. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction.
- D. Low-Emitting Materials: Fireproofing used within the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Asbestos: Provide products containing no detectable asbestos.
- F. Environmental: International Living Future Institute DECLARE Label.
  - 1. Declaration Status "LBC Red List Free"

### 2.3 SPRAY-APPLIED FIRE RESISTIVE MATERIALS

- A. Standard Durability SFRM: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application.
- B. Products: Subject to compliance with requirements, provide one of the following:
  - 1. High Density Exposed SFRMs:
    - a. GCP Applied Technologies: Monokote Z-106
    - b. Other approved equivalent by Engineer.
- C. Physical Properties:
  - 1. Bond Strength: Minimum 2000-lbf/sq. ft. cohesive and adhesive strength based on field testing according to ASTM E 736.
  - 2. Density: Not less than 22 lb/cu. ft. as specified in the approved fire-resistance design, according to ASTM E 605.
  - 3. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E 605, whichever is thicker but no less than 0.375 inch.
  - 4. Combustion Characteristics: Noncombustible, according to ASTM E 136.
  - 5. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings from an applicable testing agency.
    - a. Flame Spread Index 10 or less.

- b. Smoke Developed 10 or less.
- 6. Compressive Strength: No more than 10 percent deformation when subjected to a crushing force of 43,200 psf. according to ASTM E761. Min 100 psi.
- 7. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
- 8. Deflection: No cracking, spalling, or delamination according to ASTM E 759.
- 9. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
- 10. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours according to ASTM E 859.
- 11. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth after 28 days on specimens per ASTM G 21.
- 12. Sound Absorption: NRC 0.65 to 0.75 according to ASTM C 423 for Type A mounting according to ASTM E 795.
- 13. Finish: Rolled, spray-textured finish.

#### 2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with one or both of the following requirements:
  - 1. Contact Fireproofing manufacturer for procedures on handling primed/painted steel.
  - 2. Primer's bond strength in required fire-resistance design complies with specified bond strength for fireproofing and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests according to ASTM E 736.
- C. Bonding Agent: Provide product approved by fireproofing manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.

- D. Metal Lath: Provide expanded metal lath fabricated from material of weight, configuration, and finish required, according to fire-resistance designs indicated and fireproofing manufacturer's written recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive fireproofing.
- E. Reinforcing Fabric: Glass or carbon fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by fireproofing manufacturer.
- F. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by fireproofing manufacturer. Include pins and attachment.
- G. Sealer: If required, a transparent-drying, water-dispersible, tinted protective coating as recommended by fireproofing manufacturer.
- H. Topcoat: If required, a topcoat suitable for application over applied fireproofing; of type recommended by fireproofing manufacturer.

### PART 3 EXECUTION

#### 3.1 GENERAL

- A. General: Install Spray Applied Fire Resistive Materials in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.

#### 3.2 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design. Verify compliance with the following before commencing fireproofing application:
  - 1. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
  - 2. Objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
  - 3. The installation of ducts, piping, conduit, or other suspended equipment will take place only after the application of the fireproofing is complete in an area.
- B. Verify that concrete work on steel deck is complete before beginning fireproofing work.

- C. Do not commence the application of fireproofing to the underside of roof until the roof is completely installed and tight, all penthouses are complete, all mechanical units have been placed, and construction roof traffic has ceased. When roof traffic is anticipated, as in the case of periodic maintenance, install roofing pavers as a walkway to distribute loads.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 PREPARATION

- A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.
- B. Clean substrates of substances that could impair bond of fireproofing.
- C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.
- D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

### 3.4 APPLICATION

- A. General: Install roof accessories according to manufacturer's written instructions.
- B. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.
- C. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- D. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
  - 1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.

2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.
- E. Metal Decks:
1. Do not apply fireproofing to underside of metal deck substrates until concrete topping, if any, has been completed.
  2. Do not apply fireproofing to underside of metal roof deck until roofing has been completed; prohibit roof traffic during application and drying of fireproofing.
  3. When roof traffic is anticipated, as in the case of periodic maintenance, install roof pavers as a walkway to distribute loads.
- F. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written recommendations for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.
- G. Spray apply fireproofing to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.
- H. Extend fireproofing in full thickness over entire area of each substrate to be protected.
- I. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.
- J. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply fireproofing that differs in color from that of encapsulant over which it is applied.
- K. Where sealers are used, apply products that are tinted to differentiate them from fireproofing over which they are applied.
- L. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.
- M. Cure fireproofing according to fireproofing manufacturer's written recommendations.
- N. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.

- O. Finishes: Apply fireproofing to produce the following finishes:
  - 1. Rolled, Spray-Textured Finish: Even finish produced by rolling spray-applied finish with a damp paint roller to remove drippings and excessive roughness.

### 3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
  - 1. Test and inspect as required by Chapter 17 of the applicable building code.
- B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.

### 3.6 CLEANING, PROTECTING, AND REPAIRING

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing is without damage or deterioration at time of Substantial Completion.
- C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.
- D. Repair fireproofing damaged by other work before concealing it with other construction.
- E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION

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## SECTION 07 84 13

### PENETRATION FIRESTOPPING

#### PART 1 GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.

###### B. Related Requirements:

1. Section 07 84 43 - Joint Firestopping

##### 1.2 SUBMITTALS

- ###### A. General: Provide all submittals, including the following, as specified in Division 1.

##### 1.3 ACTION SUBMITTALS

- ###### A. Product Data: For each type of product.

- ###### B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

##### 1.4 INFORMATIONAL SUBMITTALS

- ###### A. Qualification Data: For Installer.

- ###### B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

##### 1.5 CLOSEOUT SUBMITTALS

- ###### A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."
- B. Source Limitations: Obtain each type of penetration firestopping through one source from a single manufacturer.

## 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

## 1.8 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
  - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
  - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article.
  - 3. Provide rated systems complying with the following requirements:
    - a. Penetration firestopping systems shall bear the classification marking of a qualified testing agency.
      - (1) UL in its "Fire Resistance Directory."

- (2) Intertek Group in its "Directory of Listed Building Products."
- (3) FM Global in its "Building Materials Approval Guide."

## 2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
- B. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
  1. Acceptable manufacturers are listed below. Subject to compliance with requirements other manufacturers of equivalent products may be submitted:
    - a. 3M Fire Protection Products.
    - b. Hilti, Inc.
    - c. Specified technologies Inc.
- C. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
  1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- D. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
  1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
  2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
  3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
- F. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content:

1. Sealants: 250 g/L.
  2. Sealant Primers for Nonporous Substrates: 250 g/L.
  3. Sealant Primers for Porous Substrates: 775 g/L.
- G. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
1. Permanent forming/damming/backing materials.
  2. Substrate primers.
  3. Collars.
  4. Steel sleeves.

### 2.3 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a non-shrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

- I. Firestop Block: Ready-to-use, intumescent flexible block designed to seal medium to large size openings and for sealing penetrations with cables.
- J. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.
- K. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric Sealants.

## 2.4 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
  - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
  - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

### 3.3 INSTALLATION

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
  - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
  - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
  - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### 3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
  - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
  - 1. The words "WARNING - PENETRATION FIRESTOPPING - DO NOT DISTURB. NOTIFY BUILDING MANAGEMENT OF ANY DAMAGE."
  - 2. Contractor's name, address, and phone number.
  - 3. Designation of applicable testing and inspecting agency.

4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

### 3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

### 3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

### 3.7 PENETRATION FIRESTOPPING SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Listed Building Products" under "Firestop Systems."
- C. Where FM Global-approved systems are indicated, they refer to design numbers listed in FM Global's "Building Materials Approval Guide" under "Wall and Floor Penetration Fire Stops."

END OF SECTION

(NO TEXT ON THIS PAGE)

## SECTION 07 84 43

### JOINT FIRESTOPPING

#### PART 1 GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.

###### B. Related Requirements:

1. Section 07 84 13 - Penetration Firestopping

##### 1.2 SUBMITTALS

- ###### A. General: Provide all submittals, including the following, as specified in Division 1.

##### 1.3 ACTION SUBMITTALS

- ###### A. Product Data: For each type of product required.

- ###### B. Product Schedule: For each joint firestopping system. Include location, illustration of joint firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular joint firestopping system, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

##### 1.4 INFORMATIONAL SUBMITTALS

- ###### A. Qualification Data: For Installer.

- ###### B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

##### 1.5 CLOSEOUT SUBMITTALS

- ###### A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."
- B. Source Limitations: Obtain each type of building joint firestopping through one source from a single manufacturer.

## 1.7 ENVIRONMENTAL LIMITATIONS:

- A. Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
  - 1. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

## 1.8 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
  - 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
  - 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
    - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
      - (1) UL in its "Fire Resistance Directory."
      - (2) Intertek Group in its "Directory of Listed Building Products." UL in its "Fire Resistance Directory."

## 2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist the spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
  - 1. Acceptable manufacturers are listed below. Subject to compliance with requirements other manufacturers of equivalent products may be submitted:
    - a. 3M Fire Protection Products.
    - b. Hilti, Inc.
    - c. Specified technologies Inc.
  - 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- D. VOC Content: Fire-resistive joint system sealants shall comply with the following limits for VOC content:
  - a. Architectural Sealants: 250 g/L.
  - b. Sealant Primers for Nonporous Substrates: 250 g/L.
  - c. Sealant Primers for Porous Substrates: 775 g/L.
- E. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
  - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
  - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

### 3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
  - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:
  - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
  - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.

3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

#### 3.4 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels.
- B. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
  1. The words "WARNING - JOINT FIRESTOPPING - DO NOT DISTURB. NOTIFY BUILDING MAINTENANCE OF ANY DAMAGE."
  2. Contractor's name, address, and phone number.
  3. Designation of applicable testing agency.
  4. Date of installation.
  5. Manufacturer's name.
  6. Installer's name.

#### 3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

#### 3.6 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of

Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION

## SECTION 07 90 00

### JOINT SEALANTS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Sealing and caulking for perimeter joints around all doors, windows, louvers and frames, control joints, expansion and contraction joints, pressure relieving joints, masonry joints, precast concrete joints, and joints at the perimeter of ducts and conduits at walls and partitions and at all joints requiring weathertight sealing.
- B. Related work specified in other sections includes, but is not limited to, the following:
  - 1. Section 04 20 00 - Masonry
  - 2. Section 08 11 13 - Steel Doors and Frames
  - 3. Section 08 51 13 - Aluminum Windows
  - 4. Section 08 91 00 – Metal Louvers

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ASTM C 920 - Elastomeric Joint Sealants

##### 1.3 PERFORMANCE REQUIREMENTS

- A. Provide joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

##### 1.4 PRECONSTRUCTION TESTING

- A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
  - 1. Locate test joints where indicated on Project or, if not indicated, as directed by Engineer.
  - 2. Conduct field tests for each kind of sealant and joint substrate.

3. Notify Engineer seven days in advance of dates and times when test joints will be erected.
  - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
    - (1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
4. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, re-test until satisfactory adhesion is obtained.
5. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

#### 1.5 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.

#### 1.6 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Product Data and Information: Submit manufacturer's installation instructions. Indicate special procedures, surface preparation, perimeter conditions requiring special attention, and written recommendations for primer, backup materials and solvents.
- D. Joint-Sealant Schedule: Include the following information:
  1. Joint-sealant application, joint location, and designation.
  2. Joint-sealant manufacturer and product name.
  3. Joint-sealant formulation.
  4. Joint-sealant color.

## 1.7 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- C. Qualification Data: For qualified Installer.
- D. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
  - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
  - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- E. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- F. Field-Adhesion Test Reports: For each sealant application tested.
- G. Warranties: Sample of standard warranties.

## 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
  - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
  - 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
- D. Mockups: Install sealants in mockups, to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for

materials and execution. Use materials and installation methods specified in this Section.

## 1.9 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
  - 2. When joint substrates are wet.
  - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  - 4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

## 1.10 WARRANTY

- A. Installer's Standard Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
- B. Manufacturer's Standard Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

## PART 2 PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

- D. Colors of Exposed Joint Sealants: As selected by Engineer from manufacturer's full range.
- E. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
  - 1. Architectural Sealants: 250 g/L or less.
  - 2. Sealant Primers for Nonporous Substrates: 250 g/L or less.
  - 3. Sealant Primers for Porous Substrates: 775 g/L or less.
- F. Colors of Exposed Joint Sealants: Custom colors to match adjacent materials.

## 2.2 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.
- B. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 790.
    - b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
    - c. Pecora Corporation; 301 NS.
    - d. Sika Corporation, Construction Products Division; SikaSil-C990.
    - e. Tremco Incorporated; Spectrem 1.
- C. Single-Component, Pourable, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade P, Class 100/50, for Use T.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 890-SL.
    - b. May National Associates, Inc.; Bondaflex Sil 728 SG.

- c. Pecora Corporation; 300 SL.
  - d. Tremco Incorporated; Spectrem 900 SL.
- D. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
- 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 786 Mildew Resistant.
    - b. GE Advanced Materials - Silicones; Sanitary SCS1700
    - c. May National Associates, Inc.; Bondaflex Sil 100 WF.
    - d. Tremco Incorporated; Tremsil 200 Sanitary.

### 2.3 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. BASF Construction Chemicals - Building Systems; MasterSeal TX1.
    - b. Pecora Corporation; Dynatrol I-XL.
    - c. Polymeric Systems, Inc.; Flexiprene 1000.
    - d. Schnee-Morehead, Inc., an ITW company; Permathane SM7108.
    - e. Tremco Incorporated; Dymonic.
- B. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT.
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. BASF Construction Chemicals - Building Systems; MasterSeal SL 1.
    - b. Pecora Corporation; NR-201.

- c. Polymeric Systems, Inc.; Flexiprene 952.
- d. Schnee-Morehead, Inc.; an ITW company; Permthane SM7101.

#### 2.4 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. BASF Building Systems; Sonolac.
    - b. Bostik, Inc.; Chem-Calk 600.
    - c. May National Associates, Inc.; Bondaflex 600.
    - d. Pecora Corporation; AC-20+.
    - e. Schnee-Morehead, Inc.; SM 8200.
    - f. Tremco Incorporated; Tremflex 834.

#### 2.5 BUTYL JOINT SEALANTS

- A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Bostik, Inc.; Chem-Calk 300.
    - b. Pecora Corporation; BC-158.

#### 2.6 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Pecora Corporation; AC-20 FTR.
    - b. USG Corporation; SHEETROCK Acoustical Sealant.

## 2.7 PREFORMED, PRE-COMPRESSED, SELF-EXPANDING, SEALANT

- A. Silicone pre-coated, preformed, pre-compressed, self-expanding, sealant system. Expanding cellular foam impregnated with a water-based, non-drying, 100% acrylic dispersion combining factory-applied, low-modulus silicone and a backing of acrylic-impregnated expanding foam into a unified hybrid sealant system. Meeting the requirements of curtain wall performance tests per ASTM E330, E283-04, and E331 and passing the requirements of ASTM E330-02 procedure A when tested at 200,ph.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. COLORSEAL as manufactured by EMSEAL JOINT SYSTEMS, LTD
    - b. Expansion-compression: +25%,-25% (50% total) of nominal material size.

## 2.8 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

## 2.9 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Non staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete
    - b. Masonry
    - c. Unglazed surfaces of ceramic tile
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    - a. Metal
    - b. Glass
    - c. Glazed surfaces of ceramic tile.

5. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
6. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  1. Do not leave gaps between ends of sealant backings.
  2. Do not stretch, twist, puncture, or tear sealant backings.
  3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  1. Place sealants so they directly contact and fully wet joint substrates.
  2. Completely fill recesses in each joint configuration.
  3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to

eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
  - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

G. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

### 3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
1. Extent of Testing: Test completed and cured sealant joints as follows:
    - a. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
  2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
    - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  3. Inspect tested joints and report on the following:
    - a. Whether sealants filled joint cavities and are free of voids.

- b. Whether sealant dimensions and configurations comply with specified requirements.
    - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
  - 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
  - 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory.
- C. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

### 3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

### 3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces (JS-1).
  - 1. Joint Locations:
    - a. Isolation and contraction joints in cast-in-place concrete slabs.

- b. Tile control and expansion joints.
    - c. Joints between different materials listed above.
    - d. Other joints as indicated.
  - 2. Silicone Joint Sealant: Single component, pourable, traffic grade, neutral curing.
  - 3. Joint-Sealant Color: Custom color to match adjacent materials.
- B. Joint-Sealant Application: Interior joints in horizontal traffic surfaces. (JS-2)
  - 1. Joint Locations:
    - a. Isolation joints in cast-in-place concrete slabs.
    - b. Control and expansion joints in tile flooring.
  - 2. Joint Sealant: Urethane, S, P, 25, T, NT.
  - 3. Joint-Sealant Color: Custom color to match adjacent materials.
- C. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces (JS-3).
  - 1. Joint Locations:
    - a. Construction joints in cast-in-place concrete.
    - b. Control and expansion joints in unit masonry.
    - c. Joints between metal panels.
    - d. Joints between different materials listed above.
    - e. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
    - f. Control and expansion joints in ceilings and other overhead surfaces.
    - g. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
  - 3. Joint-Sealant Color: Custom color to match adjacent materials.

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces (JS-4).

1. Joint Locations:
  - a. Control and expansion joints on exposed interior surfaces of exterior walls.
  - b. Perimeter joints of exterior openings where indicated.
  - c. Tile control and expansion joints.
  - d. Vertical joints on exposed surfaces of interior unit masonry, walls, and partitions.
  - e. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
  - f. Other joints as indicated.
2. Joint Sealant: Latex.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces (JS-5)

1. Joint Sealant Location:
  - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
  - b. Tile control and expansion joints where indicated.
2. Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, Silicone.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

F. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces (JS-6).

1. Joint Location:
  - a. Acoustical joints where indicated.

2. Joint Sealant: Acoustical.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range.
- G. Joint-Sealant Application: Exterior expansion joints in vertical nontraffic surfaces (JS-7).
1. Joint Location:
    - a. Exterior vertical masonry expansion joints.
  2. Joint Sealant: Preformed, Pre-Compressed, Self-Expanding.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range.
- H. Joint-Sealant Application: Concealed mastics. (JS-8)
1. Joint Locations:
    - a. Aluminum thresholds.
    - b. Sill plates.
    - c. Other joints as indicated on Drawings.
  2. Joint Sealant: Butyl-rubber based.

END OF SECTION

(NO TEXT ON THIS PAGE)

SECTION 08 11 13  
STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Steel doors, hollow metal steel door frames, stainless steel doors and frames, and interior glazed light frames.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 04 05 00 - Mortar and Masonry Grout
  - 2. Section 05 05 13 - Galvanizing
  - 3. Section 08 71 00 - Finish Hardware
  - 4. Section 08 80 00 - Glass and Glazing
  - 5. Section 09 96 00 - High Performance Coatings

1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ASTM E 152 - Methods of Fire Tests of Door Assemblies
  - 2. HMMA 862 - Commercial Security Hollow Metal Doors
  - 3. ASTM A 36/A36M - Specification for Carbon Structural Steel
  - 4. ASTM A 569 - Carbon, Hot Rolled Sheet and Strip Commercial Quality
  - 5. FS HH-1-558 - Federal Specification for Insulation
  - 6. UL - Fire Tests of Door Assemblies

1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
- B. Shop Drawings: Submit shop drawings of head and jamb details, locations and types of anchors and frame corner construction.

- C. Finished Products: Submit three samples of finished metal for color selection and approval.

#### 1.4 QUALITY ASSURANCE

- A. Standards: Conform to requirements of HMMA 862.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURER

- A. Acceptable manufacturers are listed below. Other manufacturers of equivalent product may be submitted.
  - 1. Hollow Metal Doors and Frames
    - a. Ceco Doors, Milan, TN
    - b. Steelcraft, Blue Ash, OH
    - c. Pioneer Industries, Carlstadt, NJ

#### 2.2 MATERIALS

- A. General: Provide steel sheet for covering doors, transoms and for pressed frames of cold-rolled furniture stock steel, fully pickled, annealed, patent or stretcher leveled and oiled and free from scale, pits, waves or other surface imperfections. Galvanize exterior doors, transoms and pressed frames as specified in Section 05 05 13.
- B. Stainless Steel Sheet and Strip: Provide Type 316 stainless steel sheet and strip for covering doors and pressed steel frames, fully pickled, and free from scale, pits, waves, or other surface imperfections and with No. 4 finish.
- C. Structural Shapes: Provide structural steel rolled shapes conforming to ASTM A 36.
- D. Insulation: Provide fiberglass soundproofing insulating material for nonlabeled doors complying with Fed. Spec. HH-1-558, Form B, Type 1, Class 6B-1, solidly filled between faces to reduce metallic ring and to act as an insulator. Provide noncombustible cores for labeled doors meeting Underwriter's Laboratories, Inc., (UL) requirements.
- E. Transom Panels: Provide transom panels of the same construction as the doors.
- F. Material Gauges:
  - 1. Use 12-gauge steel for exterior and interior frames.

2. Use 14-gauge steel for face sheets of interior doors and exterior doors.
  3. Use pressed sheet steel not thinner than 16-gauge for hollow metal glazed partitions and for borrowed light frames.
  4. Use 14-gauge for doors and frames where stainless steel is required.
  5. Use 16-gauge steel for moldings for combination door frames with side lights, and for borrowed light frames with mullions.
- G. Frames: Assemble frames in the shop with welded mitered head corners.
1. Insulate exterior door frames with closed cell expanding insulating foam.
- H. Glazing Stops: Provide removable glazing stops with countersunk, oval Phillips head machine screws not over 16 inches on centers.
- I. Combination Door Frames: Provide combination door frames with side lights, and borrowed light frames complete with mullions and impost sections. Provide glazing stops with countersunk, oval Phillips head machine screws not over 16 inches on center for all frames shown to be glazed. Provide separately formed moldings.
- J. Silencers: Prepare jamb and head rebates for rubber door silencers. Locate three silencers in the jamb for single doors and two silencers in the head for each leaf of pairs of doors. Door silencers are as specified in Section 08 71 00.
- K. Anchors: Provide frames with wall anchors spaced 12 inches from tops and bottoms of frames and intermediate anchors spaced not more than 30 inches apart, on both sides. Provide adjustable 14-gauge loose "T" anchors not less than 2 by 10 inches in size.
1. Provide, at bottoms of door frames extending to the floor, anchors consisting of No. 14-gauge angles attached to the back of the jamb with two holes in the horizontal leg.
  2. Provide anchors or other devices for fastening the frames to the wall as shown or approved.
  3. Provide spreaders of an approved type of steel channel of full width of the jambs.
- L. Accessories: Provide foot anchors for all door and cased opening frames (adjustable foot anchors where the structural slab is below the finished floor line), removable spreaders, strike boxes, and all other accessories shown.
- M. Stiffeners: Provide heads of frames with 12-gauge bent steel stiffeners where required.

- N. Fire-Rated Doors: Provide fire-rated doors and frames of fire resistance classifications and ratings to match or exceed that of the wall rating where they are installed and of types that have been fire tested and rated in accordance with ASTM Method E152, with variances as approved by the labeling agency. Provide labels of U.L., Inc. or Factory Mutual as evidence of rating. Indicating the applicable fire testing rating for the door construction provided. The construction details necessary for labeled doors and frames take precedence over details shown or specified. Provide labels of construction for fire doors, transoms and frames that cannot be labeled.

## 2.3 FABRICATION

- A. General: Accurately fabricate metalwork and neatly assemble free from dents or tool marks, warpage, buckle and open joints. Provide cutouts as required by door details and for hardware.
- B. Welding: Weld face sheets of all doors for flush pan assembly with internal reinforcement consisting of 18-gauge vertical channels spaced not over 8 inches on centers, extending vertically through full door height, uniformly spot welded to mated pans. Provide the top and bottom edges of doors with 12-gauge channels welded the full width forming solid flush edges. Close the top edge of the door with a flush filler channel.
- C. Insulation: Provide soundproofing insulating filler materials as specified.
- D. Watertight: Construct edges of doors watertight.
- E. Drip Molding: Provide a drip molding at the bottom of exterior doors.
- F. Transoms: Secure transoms to door frames with concealed fasteners and seal exterior transoms weathertight.
- G. Oversized Doors: Provide reinforcement for doors over 7 feet high or 3-1/2 feet wide. In addition to the reinforcement called for, spot weld No. 14-gauge steel channels in place all around the full girth of door.
- H. Louvers: Provide louvers in hollow metal doors of the manufacturer's standard sightproof type of not less than No. 14-gauge steel.
- I. Accessories: Provide sinkage or mortises as required for hardware and accurately form to templates so that the hardware will fit neatly into the depression and will be flush with the member where so designed. Securely fasten members of metalwork together to provide rigid construction in the assembled Work unless otherwise required. Continuously weld connections and dress smooth and flush, except where otherwise specified.

- J. Reinforcements: Provide concealed reinforcement of bar steel for hardware and for other attached work. Provide hardware reinforcement of sufficient size to receive all screws, bolts and other securing members used for fastening hardware and of the form and dimension required to stiffen the member against all strains transmitted through the hardware.
1. Provide all reinforcement for machine screws not less than 3/16-inch thickness of metal for tapping for regular doors, and not less than 1/4-inch thickness for doors over 7 feet in height, unless otherwise specified.
  2. Provide reinforcement for door butts, unless otherwise shown, of 3/16-inch plate at least 8 inches longer than the butt. Provide 3/16-inch plate reinforcement for door checks and overhead door holders. Install reinforcement for the support of the bracket where the distance between the door, opened at an angle of 90 degrees, and an adjacent transverse partition is less than 6 inches.
  3. Provide lock reinforcement not lighter than No. 12-gauge metal and of a form and size that will adequately reinforce the stiles for lock faces and escutcheons or other lock trim.
  4. Provide reinforcement for other items of hardware as approved to fulfill the specified general requirements.
  5. House the back of all hardware cutouts and tapped reinforcement, which may become plugged with mortar, using No. 26-gauge metal.
- K. Drilling and Tapping: Drill and tap metalwork as required for the attachment of hardware. Locate all drilling and tapping by templates for accurate alignment of the hardware.
- L. Stainless Steel Doors: Fabricate stainless steel doors and frames to the same requirements as hollow metal steel doors.
- M. Finish: Finish doors and frames in the manufacturer's standard baked on factory finish. (Paint doors as specified in Section 09 96 00.)

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install doors, frames and hardware in accordance with HMMA and the manufacturer's recommendations and approved shop drawings and as specified in Division 1.

- B. Frame Installation: Set frames in designated positions, plumb and square, rigidly braced and built in with the masonry and other adjacent Work. Securely fasten floor angles on jambs in position with expansion bolts.
- C. Metalwork Installation: Neatly install metalwork, with fixed units securely fastened in place and operative units adjusted to work or swing without binding.
- D. Frame Grouting: Grout hollow metal frames solid into masonry.

END OF SECTION

## SECTION 08 31 00

### ACCESS DOORS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Access doors and frames for walls and ceilings.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 03 31 00 - Cast-in-Place Concrete
  - 2. Section 04 20 00 - Masonry
  - 3. Section 05 50 00 - Metal Fabrications
  - 4. Section 09 96 00 - High Performance Coatings

##### 1.2 SUBMITTALS

- A. Product Data: For each type of access door and frame indicated. Include construction details, fire ratings, materials, individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each door face material, at least 3 by 5 inches in size, in specified finish.
- D. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.
- E. Ceiling Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim are shown and coordinated with each other.

##### 1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of access door and frame through one source from a single manufacturer.

- B. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics per the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. NFPA 252 or UL 10B for vertical access doors and frames.
  - 2. ASTM E 119 or UL 263 for horizontal access doors and frames.
- C. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

#### 1.4 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

### PART 2 PRODUCTS

#### 2.1 STEEL MATERIALS

- a. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- 2. ASTM A 153, for galvanizing steel and iron hardware.
  - a. Rolled-Steel Floor Plate: ASTM A 786, rolled from plate complying with ASTM A 36 or ASTM A 283, Grade C or D.
    - (1) ASTM A 123, for galvanizing steel and iron products
    - (2) ASTM A 153, for galvanizing steel and iron hardware.
  - b. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
    - (1) Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
    - (2) Factory-Primed Finish: Apply shop primer immediately after cleaning and pretreating.

- (3) Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

## 2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Acudor Products, Inc.
2. Babcock-Davis; A Cierra Products Co.
3. Bar-Co, Inc. Div.; Alfab, Inc.
4. Cendrex Inc.
5. Dur-Red Products.
6. Elmdor/Stoneman; Div. of Acorn Engineering Co.
7. Jensen Industries.
8. J. L. Industries, Inc.
9. Karp Associates, Inc.
10. Larsen's Manufacturing Company.
11. MIFAB, Inc.
12. Milcor Inc.
13. Nystrom, Inc.

- B. Flush Access Doors and Frames with Exposed Trim: Fabricated from steel sheet.

1. Locations: Wall and ceiling surfaces.
  - a. Door: Minimum 0.060-inch- thick sheet metal, set flush with exposed face flange of frame.
  - b. Frame: Minimum 0.060-inch- thick sheet metal with 1-1/4-inch-wide, surface-mounted trim.

- c. Hinges: Spring-loaded, concealed-pin type.
  - d. Lock: Mortise cylinder.
- C. Fire-Rated, Insulated, Flush Access Doors and Frames with Exposed Trim: fabricated from steel sheet.
  - 1. Locations: Wall and ceiling surfaces.
  - 2. Fire-Resistance Rating: Not less than that of adjacent construction.
  - 3. Temperature Rise Rating: 250 deg F at the end of 30 minutes.
  - 4. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 0.036 inch.
  - 5. Frame: Minimum 0.060-inch- thick sheet metal
  - 6. Hinges: Concealed-pin type.
  - 7. Automatic Closer: Spring type.
  - 8. Lock: Self-latching device with mortise cylinder lock.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
  - 1. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
  - 2. Install doors flush with adjacent finish surfaces or recessed to receive finish material.
- B. ADJUSTING AND CLEANING
  - 1. Adjust doors and hardware after installation for proper operation.
  - 2. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

## SECTION 08 33 23

### OVERHEAD COILING DOORS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Overhead coiling doors, operating hardware, and both manual and electric operation.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 09 90 00 - Painting
  - 2. Section 05 05 13 - Galvanizing
  - 3. Section 26 05 33 - Electrical Raceway Systems
  - 4. Section 26 05 19 - Wires and Cables: 600 Volts and Below
  - 5. Section 26 05 60 - Electrical Requirements for Shop-Assembled Equipment
  - 6. Section 26 05 80 - Electric Motors
  - 7. Section 26 28 16 - Disconnect Switches

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. NAAMM - Metal Finishes Manual
  - 2. Underwriters Laboratory – U.L.325, Standard for Safety: Door Drapery, Gate, Louver, and Window Operators and Systems.
  - 3. ASTM A229 – Steel Wire, oil-tempered for mechanical springs.
  - 4. ASTM A653 – Steel sheet, zinc-coated galvanized by the hot-dipped process, commercial quality.
  - 5. ASTM E 330 – Structural performance of exterior windows, curtain walls, and doors by uniform static air pressure difference.
  - 6. ASTM E 413 – Classification for Rating Sound Insulation.

##### 1.3 DESIGN REQUIREMENTS

- A. General: Provide door bearing the UL325 mark. Design the door assembly to withstand wind/suction load of 30 psf, without undue deflection or damage to door or assembly components.

- B. Insulation: Insulate the door for an minimum R-value of 4.75 per Illinois ECC 2018.

#### 1.4 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
- B. Manufacturer's Installation Instructions: Submit the manufacturer's installation instructions, including installation sequence and procedures, adjustment and alignment procedures.
- C. Product data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- D. Shop Drawings:
  - 1. Provide drawings indicating track details, head and jamb conditions, spring shafts, anchorage, accessories, finish colors, patterns and textures, operator mounts and other related information.
- E. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- F. Verification Samples: For each finish product specified, two samples, minimum size 6 inches square, representing actual product, color, and patterns.
- G. Provide manufacturer's maintenance instructions that include recommendations for periodic checking, adjustment and lubrication of components.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Utilize an installer having demonstrated experience on projects of similar size and complexity, trained and authorized by the door manufacturer to perform the work of this section.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.

1. Wayne-Dalton
  2. Overhead Door Company
- B. Door Types:
1. OHCD-T1: Exterior Insulated and Motor Operated.
    - a. ThermoTite 800C Series Insulated Rolling Service Door.
    - b. Rapidslat 626 Series Advanced Performance Insulated Rolling Service Door.
  2. OHCD-T2: Interior Fire-Rated and Motor Operated.
    - a. FireStar 700C Series Insulated Rolling Steel Fire Door.
    - b. FireKing 635 Series Insulated Rolling Service Door.

## 2.2 MATERIALS

- A. Doors: Provide aluminum operated overhead coiling doors with thermal insulating system. Include hardware, operating mechanisms and weather protection features.
- B. Electric Operators: Provide electric operation as follows:
1. Provide the electric motor of horsepower recommended by the manufacturer. Provide a worm gear reducer of the highest-grade bronze driven by a worm of steel alloy, case hardened, ground and immersed in lubricant to connect the motor to the door. Provide an adjustable torque limiter for output via chain to drive arms on door. Provide an emergency disconnect for manual operation.
  2. Provide electrical controls for the door, including a solenoid brake, interlock switch and limit switches and starter. Provide easily adjustable limit switches to stop doors at limits of travel. Have removal of the motor such that it does not affect the limit setting.
  3. Self-monitoring Sensor Bar: Provide bottom bar with a self-monitoring sensor capable of providing protection from primary and secondary entrapment per UL 325. Provide sensor designed to trigger the operator to set the door in the open position if it detects a failure in the sensing system (such as a short).

## 2.3 FABRICATION

- A. General: Form the curtain of interlocking flat-faced slats as follows:
  - 1. 18-gauge aluminum front slat with 24-gauge back slat.
- B. End Reinforcement: Fit the ends of alternate interlocking slats with aluminum reinforcements which act as a wearing surface in the guides to prevent lateral movement of the curtain slats.
- C. Guides: Roll-formed steel channel bolted to three structural angle guide assembly forming a slot to retain curtains in guides fabricated of steel.
- D. Brackets: Design to enclose ends of coil and provide support for counterbalance pipe at each end. Fabricate from minimum 1/4 inch steel plate with permanently sealed ball bearings.
- E. Counterbalance: Curtain to be coiled on a pipe of sufficient size to carry door load with deflection not to exceed 0.03 inch per foot of door span. Curtain to be correctly balanced by helical springs, oil tempered torsion type.
- F. Hood: Provide hood to enclose curtain coil and counterbalance mechanism. Hood fabricated of sheet metal, flanged at top for attachment to header and flanged at bottom to provide longitudinal stiffness. Fabricate of minimum 24-gauge galvanized steel.
- G. Hardware: Provide hardware consisting of not less than two heavy-duty, needle-bearing trolleys per door section plus stay roller, stops and pull handles.
- H. Air Infiltration and Weatherstripping Package: Meets ASHRAE 90.1 & IECC 2012/2015 C402.4.3 Air leakage <1.00 cfm/ft<sup>2</sup>.
  - 1. Air infiltration perimeter seal package includes: guide cover, guide cap, dual brush exterior guide seal, 3 inch lintel rubber seal, internal hood baffle and bottom astragal.
  - 2. Vinyl bottom seal, exterior guide, internal hood seals and interior guide weather seal.
- I. Electrical System: Furnish and install a complete electrical system for the doors including conduits, wiring and necessary appurtenances for all power and control equipment. Provide a power disconnect switch near the doors.
- J. Finishes:
  - 1. Aluminum Finish: Finish aluminum doors with an anodized finish equal to the National Association of Architectural Metal Manufacturers (NAAMM) Architectural Class 1, AA-A42 selected by the OWNER.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install door unit assembly in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.
- B. Fasteners and Bracing: Use anchoring devices to securely fasten the assembly to wall construction and building framing without distortion or stress. Securely brace components suspended from the structure.

### 3.2 PROTECTION

- A. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.
- B. Remove temporary coverings and protection of adjacent work areas. Repair or replace installed products damaged prior to or during installation.
- C. Protect installed products until completion of project.
- D. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 08 51 13

### ALUMINUM WINDOWS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Aluminum fixed windows and all components of the window system.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 04 20 00 - Masonry
  - 2. Section 07 90 00 - Joint Sealants
  - 3. Section 08 80 00 - Glass and Glazing

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. AAMA/NWWDA - Voluntary Specifications for Aluminum, Vinyl (PVC) 101/I.S.2 and Wood Windows and Glass Doors
  - 2. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections
  - 3. ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
  - 4. ASTM E 283 - Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors
  - 5. ASTM E 330 - Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference
  - 6. ASTM E 331 - Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference
  - 7. ASTM E 413 - Classification for Rating Sound Insulation
  - 8. NAAMM - Metal Finishes Manual

### 1.3 PERFORMANCE REQUIREMENTS

- A. AAMA/NWWDA Performance Requirements: Provide aluminum windows of the performance class and grade indicated that comply with AAMA/NWWDA 101/I.S.2.
  - 1. Performance Class/Grade: AP-AW50
- B. Condensation-Resistance Factor: Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.
- C. Air infiltration: Provide windows having a maximum air infiltration of 0.10 cfm per foot of crack length at 6.24 psf pressure differential in accordance with ASTM E 283.
- D. Water Resistance: Provide windows with no uncontrolled water leakage at 10.00 psf pressure differential with a water rate of 5 gallons/hr./sf when tested in accordance with ASTM E 331.
- E. Thermal Movements: Provide aluminum windows, including anchorage, that accommodate thermal movements of units resulting from the following maximum change (range) in ambient and surface temperatures without buckling, distortion, opening of joints, failure of joint sealants, damaging loads and stresses on glazing and connections, and other detrimental effects. Base Architecting calculation on actual surface temperatures of materials due to solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F material surfaces
- F. Sound Transmission Class: Provide glazed windows rated for not less than 30 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
- G. Uniform Load Deflection: Provide windows that will allow no glass breakage, permanent damage to fasteners, hardware, or damage to make windows inoperable or deflection in any unsupported span in excess of L/175 at the minimum positive and negative wind load of 60 psf (design pressure) when tested in accordance with ASTM E 330 Do not transfer window loads to architectural veneers, panels, cladding or finishes. Provide stainless steel clip angles of suitable length to fully engage windows directly to the building structure.
- H. Thermal Transmittance: Provide aluminum windows with a whole-window U-value maximum indicated at 15-mph exterior wind velocity and winter condition temperatures when tested according to AAMA 1503

1. U-Value: 0.38 Btu/sq. ft. x h x deg F. (maximum)

#### 1.4 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
- B. Testing: Submit structural load, water and air infiltration and thermal test reports from an AAMA-accredited laboratory.
- C. Samples: Submit three samples illustrating finished aluminum surface for color selection and approval.
- D. Shop drawings: window location chart; typical window elevations; details of assemblies; details of anchorage to building structure and glazing details for units glazed by window manufacturer.
- E. Product data: manufacturer's specifications and test reports from an AAMA-accredited laboratory.
- F. Sample Warranty: manufacturer's standard warranty..

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.
- B. Source Limitations: Obtain aluminum windows, store front entrance and curtain wall through one source from a single manufacturer.
- C. Fenestration Standard: Comply with AAMA/NWWDA 101/I.S.2, "Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors," for minimum standards of performance, materials, components,
- D. Provide AAMA-certified aluminum windows with an attached label.

#### 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.

#### 1.7 WARRANTY

- A. Manufacturer's Standard Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:

1. Failure to meet performance requirements.
2. Structural failures including excessive deflection.
3. Water leakage, air infiltration, or condensation.
4. Faulty operation of movable sash and hardware.
5. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
6. Insulating glass failure.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.
  7. Wausau Metals Corp.
  8. Oldcastle Building Envelope.
  9. Kawneer Company, Inc.
  10. EFCO Corporation.

### 2.2 MATERIALS

- A. Structural Members: Provide extruded and sheet aluminum alloys compatible with the color finish specified.
- B. Sealants: Provide sealants, tape, gaskets, and caulking materials as recommended by the window manufacturer and as approved.
- C. Fasteners: Provide all anchors, clips and bolts necessary to adequately secure windows to building structure, and other items of nonmagnetic stainless steel. Do not attached to veneers or finishes.
- D. Compatibility: Provide stainless steel made of alloys which are compatible with aluminum.
- E. Screens: Provide screens at all operating sash with extruded tubular aluminum frames filled with 18 x 16 charcoal colored aluminum mesh and fastenings permitting easy attachment or removal from inside.

- F. Hardware: Provide manufacturer's hardware fabricated from nonmagnetic stainless steel, complying with AAMA 907 designed to smoothly operate, tightly close, and securely lock aluminum windows and sized to accommodate sash or ventilator weight and dimensions. Do not use aluminum in frictional contact with other metals. Where exposed, provide nonmagnetic stainless steel.

## 2.3 FABRICATION

- A. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.
- B. Factory-Glazed Fabrication: Glaze aluminum windows in the factory where practical and possible for applications indicated. Comply with requirements in Section 08800 - Glazing and with AAMA/NWWDA 101/I.S.2.
- C. Fabricate aluminum windows with thermal-break construction tested according to AAMA 505; determine the allowable design shear flow per the appendix in AAMA 505.
  - 1. Provide hardware with low conductivity or nonmetallic material for hardware bridging thermal breaks at frame or vent sash.
- D. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator
- E. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- F. Mullions and frames: Provide mullions and frames complete with anchors for support to building structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.
  - 1. Glazing Stops: Provide snap-on glazing stops coordinated with Section 08 80 00 - Glazing and glazing system indicated. Provide glazing stops to match sash and ventilator frames.
- G. Sill pans: Provide sill pans at bottom of windows matching window color.

## 2.4 FINISHES

- A. Finish windows, frames, and mullions with an anodic finish equal to the National Association of Architectural Metal Manufacturers (NAAMM):

- B. Anodized Finish: Class I finish, 0.7 mils thick.
  - 1. AA-M10C12C22A41, Class I, 0.7 mils thick.
    - a. Color: As selected by Architect from manufacturers full color palette.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances; rough opening dimensions; levelness of sill plate; coordination with wall flashings, vapor retarders, and other built-in components; operational clearances; and other conditions affecting performance of work.
  - 1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
  - 2. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components; Drawings, Shop Drawings and as specified in Division 1.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction. Provide stainless steel clip angles of suitable length to fully engage windows directly to the building structure.
- C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.
- D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- E. Metal Protection: Separate aluminum and other corrodible surfaces from concrete, masonry, and other sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified in "Dissimilar Materials" Paragraph in Appendix B in AAMA/NWWDA 101/I.S.2.

### 3.3 PROTECTION AND CLEANING

- A. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.
- B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- C. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels and clean surfaces.
- D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 08 62 00

### SKYLIGHTS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section includes:
  - 1. Curb mounted impact modified plastic glazed skylights.
- B. Related Sections:
  - 1. Section 06 10 00 - Rough Carpentry.
  - 2. Section 07 72 00 - Roof Accessories.
  - 3. Section 07 62 00 - Sheet Metal Flashing and Trim.
- C. Refer to roofing system sections for roofing accessories to be built into the roofing system to accommodate work of this section.

##### 1.2 PERFORMANCE REQUIREMENTS

- A. General: Provide unit skylights capable of withstanding loads indicated without failure.
- B. Units shall be tested to compliance with AAMA\WDMA\CSA\101\I.S.2\A440 as Required by The Evanston Building Code.
- C. Units shall be impact tested to 775 ft-lbs to comply with the intent of OSHA fall protection regulation 29 CFR 1910.

##### 1.3 SUBMITTALS

- A. General: Provide all submittals, including the following as specified in Division 1.
- B. Product Data Sheet: For each type of skylight specified, include details of construction and installation, relative to applicable roofing materials.
- C. Shop drawing: Show overall roof layout, dimensioned sections, and details.
- D. Samples for Selection: Manufacturer's color charts showing a full range of colors available for each type of skylight glazing and Aluminum Finish.

## 1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide Thermoformed domes or pyramids fabricated from sheets identical to those tested for the following fire-test-response characteristics, per ASTM test method indicated below, by UL or other testing and inspecting agencies acceptable to authorities having jurisdiction. Identify plastic sheets with appropriate markings of applicable testing and inspecting organization.
  - 1. Self-Ignition Temperature: 651 deg F or greater when tested per ASTM D 1929 on plastic sheets in the thickness intended for use.
  - 2. Smoke density of 75 or less when tested per ASTM D 2843 on plastic sheets in the thickness intended for use.
  - 3. Relative- Burning Characteristics: As follows, when tested per ASTM D 635:
    - a. Impact Glazing: Burning rate of 2.5 inches per minute or less when tested on plastic glazing indicated above with a nominal thickness of 0.060 inch or the thickness intended for use.

## 1.5 WARRANTY

- A. Manufacturer's Standard Skylight Warranty: Provide written warranty signed by manufacturer, agreeing to repair or replace work that exhibits defects in materials or workmanship and guaranteeing weather-tight and leak-free performance. "Defects" is defined as uncontrolled leakage of water and abnormal aging or deterioration.
- B. Manufacturer's Standard Plastic Warranty: Provide written warranty signed by manufacturer agreeing to repair or replace work that has or develops defects in the plastic. "Defects" is defined as abnormal aging or deterioration.
- C. Manufacturer's Standard Finish Warranty: Provide written warranty signed by manufacturer agreeing to repair or replace work with finish defects. "Defects" is defined as peeling, chipping, chalking, fading, abnormal aging or deterioration, and failure to perform as required.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Wasco Products, Inc., Wells, ME. (Basis of design)
2. Other as approved equal by engineer.

## 2.2 MATERIALS

- A. Curb Frame: Bright white high-performance PVC with minimum effective thickness of 0.60 inch. Provide integral condensation gutter system with corners fully welded for waterproof quality.
- B. Curbs: Minimum 1-1/2-inch-wide field built or prefabricated curb.
- C. Retainer Frame: Extruded aluminum alloy 6063-T5 (min). ASTM B 221 (ASTM B 221 M) with minimum effective thickness of 0.60 inch.
- D. Plastic Sheets: Weather and impact resistant monolithic, formable, transparent colorless and tinted plastic sheets.
- E. Impact Glazing: ASTM D 4802, thermoformable, Category C-2 or CC-2 Type UVA (formulated with ultraviolet absorber), with Finish 1 (smooth or polished), unless otherwise indicated.
- F. Thermal Break: Fabricate skylight units with thermal chambered PVC frame.
- G. Gaskets: Structural glazing tape to form adhesive bond between PVC curb and inner dome, between inner and outer dome, and between outer dome and extruded aluminum retainer. Gaskets form an air and water impenetrable barrier between adjacent surfaces.
- H. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other non-corrosive metal as recommended by manufacturer.
- I. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil dry film thickness per coating.
- J. Fall Protection: Provide skylights with a screen per OSHA requirements for fall protection through openings.

## 2.3 PLASTIC SKYLIGHT UNITS

- A. General: Factory-assembled, curb-mounted unit consisting of impact plastic glazing, gasketing, inner frame designed to mount on separate curb.
- B. Products: Provide Sentinel Model SS Fall Guard meeting the requirements of this section.
- C. Condensation Control: Fabricate skylight units with integral internal gutters and weeps to collect and dispose of condensation.

- D. Thermal Break: Fabricate skylight units with thermal chambered PVC frame.
- E. Shape and Size: As indicated by model number.
- F. Outer Glazing: Thermoformed Dome:
  - a. Acrylic White.
- G. Inner Glazing: Dome or pyramid thermoformed:
  - b. Acrylic Clear

## 2.4 FABRICATION

- A. Framing Components: As follows:
  - 1. Factory fit and assemble components.
  - 2. Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.
  - 3. Fabricate components to drain water passing joints and condensation the exterior.
  - 4. Fabricate components to accommodate expansion, contraction, and field adjustment, and to provide for minimum clearance and shimming at skylight perimeter.
  - 5. Fabricate components to ensure that glazing is thermally and physically isolated from framing members.
  - 6. Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.
  - 7. Fit and secure aluminum joints by heliarc welding.

## 2.5 ALUMINUM FINISHES

- A. General: Comply with NAAMM “Metal Finishes Manual” recommendations for application and designations of finishes.
- B. Finish designations prefixed by AA conform to the system for designations of aluminum finishes established by the Aluminum Association.
  - 1. Clear-Anodized Finish, Class I: AA-C22A41 complying with AAMA 611.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with installer present, for compliance with requirements for installation tolerances and other conditions affecting skylight performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Metal Protection: As follows:
  - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
  - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
  - 3. Where aluminum will contact pressure-treated wood, separate dissimilar materials by methods recommended by manufacturer.

### 3.3 INSTALLATION

- A. General: Comply with manufacturer's written instructions for protecting, handling, and installing skylight components.
- B. Coordinate with installation of roof deck and other substrates to receive skylight units.
- C. Coordinate with installation of vapor barriers, roof insulation, roofing, and flashing as required to assure that each element of the work performs properly and that combined elements are waterproof and weathertight. Anchor units securely to supporting structural substrates, adequate to withstand lateral and thermal stresses as well as inward and outward loading pressures.
- D. Counter Flashing: Where counter flashing is required as component of the skylight, install to provide an adequate waterproof overlap with roofing or roof flashing (as counter flashing). Seal with thick bead of mastic sealant, except where overlap is indicated to be left open for ventilation.

3.4 CLEANING AND PROTECTION

- A. Clean exposed metal and plastic surfaces according to manufacturer's instructions.
- B. Touch up damaged metal coatings.

END OF SECTION

SECTION 08 71 00  
FINISH HARDWARE

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes commercial door hardware for swinging doors.
- B. Related Work Specified in Other Sections Includes, but is Not Limited to, the Following:
  - 1. Section 05 50 00 - Metal Fabrications
  - 2. Section 08 11 13 - Steel Doors and Frames.

1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. BHMA A156.1 - Butts and Hinges
  - 2. BHMA A156.2 - Bored and Preassembled Locks and Latches
  - 3. BHMA A156.4 - Door Controls and Closers
  - 4. NFPA80 - Fire Doors and Windows
  - 5. NFPA101 - Life Safety Code
  - 6. UL10B - Fire Tests of Door Assemblies
  - 7. UL305 - Panic Hardware

1.3 DEFINITIONS

- A. Fire-Rated Opening: Fire-rated doors, frames and hardware that conform to all applicable requirements of a governing authority and bear the inspecting authority's identification label.

1.4 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
- B. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

- C. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for locks, exit device and closers.
- D. Maintenance Data: For each type of door hardware to be included in maintenance manuals. Include final hardware and keying schedule.
- E. Warranty: Standard warranty specified in this Section.
- F. Other Action Submittals:
  - 1. Door Hardware Sets: Prepared by or under the supervision of Architectural Hardware Consultant, detailing fabrication, and assembly of door hardware, as well as procedures and diagrams. Coordinate the final door hardware sets with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
    - a. Format: Use the same scheduling sequence and vertical format and use same door numbers as in the Contract Documents.
    - b. Content: Include the following information:
      - (1) Identification number, location, hand, fire rating, and material of each door and frame.
      - (2) Type, style, function, size, quantity, and finish of each door hardware item.
      - (3) Complete designations of every item required for each door or opening including name and manufacturer.
      - (4) Fastenings and other pertinent information.
      - (5) Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
      - (6) Explanation of abbreviations, symbols, and codes contained in schedule.
      - (7) Mounting locations for door hardware.
      - (8) Door and frame sizes and materials.
    - c. Submittal Sequence: Submit the final door hardware sets at the earliest possible date, particularly where approval of the door hardware sets must precede fabrication of other work that is critical in Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the door hardware sets.

2. Keying Schedule: Prepared by or under the supervision of Architectural Hardware Consultant, detailing OWNER's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Substantial documented experience required for company specializing in performing the Work of this Section.
- B. Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.
- C. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.
- D. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
- E. Pre-installation Conference: Conduct conference at Project site.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle hardware as specified in Division 1 and as follows:
- B. Identification: Have the hardware supplier package and label each item of hardware separately. Tag each item in accordance with the approved final hardware schedule. Have each package contain the appropriate fastenings, instructions, and installation templates.
- C. Schedule: Furnish a complete hardware supplier's schedule when the hardware is delivered. Direct supplier to deliver applicable items of hardware to door fabricators for factory installation.
- D. Storage: When received, properly store the hardware in a safe place.
- E. Keys: Deliver the keys to the OWNER, tagged, and plainly marked on the face of the envelope with the key change number, door designation, and all other required identifying information.

## 1.7 COORDINATION

- A. Coordinate all Work involving manufacture or fabrication of internal reinforcement for door hardware.
- B. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

## 1.8 WARRANTY

- A. Provide manufacturer's standard warranty. Warranty period will begin at substantial completion.

## 1.9 MAINTENANCE MATERIALS

- A. Provide the following maintenance materials:
  - 1. Provide special wrenches, tools and accessories applicable to each different or special hardware component.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.

### 2.2 MATERIALS

- A. General: Provide hardware needed for the Work as shown, meeting or exceeding the following standards of quality.

### 2.3 HINGES, GENERAL

- A. Quantity: Provide the following, unless otherwise indicated:
  - 1. Three Hinges: For doors with heights 61 to 90 inches
  - 2. Four Hinges: For doors with heights 91 to 120 inches
- B. Template Requirements: Provide only template-produced units.
- C. Hinge Weight: Unless otherwise indicated, provide the following:
  - 1. Entrance Doors: Heavy-weight hinges.

2. Doors with Closers: Heavy-weight, antifriction-bearing hinges.
  3. Interior Doors: Heavy-weight hinges.
- D. Hinge Base Metal: Stainless steel, with stainless-steel pin.
- E. Hinge Options: Where indicated in door hardware sets or on Drawings:
1. Non-removable Pins (NRP): Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for out-swinging exterior doors and out-swinging corridor doors with locks.
- F. Fasteners: Comply with the following:
1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.

## 2.4 HINGES

- A. Butts and Hinges: BHMA A156.1
- B. Template Hinge Dimensions: BHMA A156.7.
- C. Available Manufacturers:
1. Bommer Industries, Inc. (BI).
  2. Hager Companies (HAG).
  3. McKinney Products Company; an ASSA ABLOY Group company (MCK).
  4. Stanley Hardware (STA).

## 2.5 LOCKS AND LATCHES, GENERAL

- A. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
- B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Provide Latches that require no more than 15 lbf. to release the latch. Locks must not require use of a key, tool, or special knowledge for operation. Certified to meet 10 million cycle tests.
- C. Lock Trim:
1. Levers: Cast.

- a. Dorma – LTA
  - b. Best – 3H
  - c. Schlage – 03A
  - d. Sargent – LNJ
- D. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
- 1. Mortise Locks: Minimum 3/4-inch latchbolt throw.
- E. Backset: 2-3/4 inches, unless otherwise indicated.
- F. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, and as follows:
- 1. Strikes for Mortise Locks and Latches: BHMA A156.13.
  - 2. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.

## 2.6 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: Function numbers and descriptions indicated in door hardware sets comply with the following:
- 1. Mortise Locks: BHMA A156.13.
- B. Mortise Locks: Stamped steel case with steel or brass parts:
- 1. BHMA A156.13, Grade 1; Series 1000
- C. Available Manufacturers:
- 1. Dorma Americas (DOR).
  - 2. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
  - 3. Schlage Commercial Lock Division; an Ingersoll-Rand Company (SCH).
  - 4. Best Access Systems (BES).

## 2.7 EXIT DEVICES

- A. Exit Devices: BHMA A156.3, Grade 1

B. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Provide exit devices that require no more than 15 lbf. to release the latch and locks that do not require use of a key, tool, or special knowledge for operation. Certified to meet 2.5 million cycle tests.

C. Available Manufacturers:

1. Dorma Americas (DOR).
2. Precision Hardware Inc. (PRI).
3. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).
4. Von Duprin; an Ingersoll-Rand Company (SCH).

## 2.8 LOCK CYLINDERS

A. Standard Lock Cylinders: BHMA A156.5, Grade 1

1. Provide final cores that are keyed alike and conform to the existing system with standard 7 pin tumbler cylinders.
2. Manufacturer: Best Lock Company
3. Provide locks with cylinders equipped for interchangeable-core pin tumbler inserts.
4. Furnish and install final cores and provide keys, including construction keys, to the OWNER after final acceptance, unless otherwise directed.
5. Furnish only temporary inserts for the construction period and remove when directed.

## 2.9 KEYING

A. Key System:

1. Comply with owner instructions for master keying and, except as otherwise indicated, provide individual change key for each lock that is not designated to be keyed alike. Permanently inscribe each key with the number of the lock that identifies the cylinder manufacturer's key symbol and notate each key "DO NOT DUPLICATE."

B. Quantities: Furnish 3 change keys for each lock, 5 master keys for each master system, and 5 grandmaster keys for each grandmaster system.

1. Furnish one extra blank for each lock.
  2. Deliver keys to the owner.
- C. Key Numbering: Provide keys stamped with factory key numbers.
- D. Provide keys of nickel silver only.

#### 2.10 OPERATING TRIM

- A. Standard: BHMA A156.6
- B. Materials: Fabricate from stainless steel, unless otherwise indicated.
- C. Available Manufacturers:
1. Burns Manufacturing Incorporated (BM).
  2. Hager Companies (HAG).
  3. Trimco. (TRI).
  4. IVES Hardware; an Ingersoll-Rand Company (IVS).

#### 2.11 CLOSERS

- A. Comply with the following maximum opening-force requirements:
1. Interior, Non-Fire-Rated Hinged Doors: 5 lbf. applied perpendicular to door.
  2. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
- B. Door Closers for Means of Egress Doors: Comply with NFPA 101. Provide door closers that require no more than 30 lbf. to set door in motion and not more than 15 lbf to open door to minimum required width.
- C. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
- D. Surface Closers: BHMA A156.4, Grade 1 Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated. Certified to meet 10 million cycle tests.

1. Available Manufacturers:
  - a. Dorma Americas (DA).
  - b. LCN Closers; an Ingersoll-Rand Company (LCN).
  - c. SARGENT Manufacturing Company; an ASSA ABLOY Group company (SGT).

## 2.12 STOPS AND HOLDERS

- A. Stops and Bumpers: BHMA A156.16, Grade 1
  1. Provide wall stops for doors unless other type stops are scheduled or indicated.
  2. Where floor or wall stops are not appropriate, provide overhead stops or holders.
- B. Combination Overhead, Floor and Wall Stops and Holders: BHMA A156.8, Grade 1
- C. Silencers for Metal Door Frames: BHMA A156.16, Grade 1; neoprene or rubber, minimum diameter 1/2 inch; fabricated for drilled-in application to frame.
  1. Available Manufacturers:
    - a. Architectural Builders Hardware Mfg., Inc. (ABH).
    - b. Glynn-Johnson; an Ingersoll-Rand Company (GJ).
    - c. Trimco (TRI).
    - d. IVES Hardware; an Ingersoll-Rand Company (IVS).

## 2.13 DOOR GASKETING

- A. Standard: BHMA A156.22
- B. General: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.
  1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
  2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.
- C. Air Leakage: Not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283.
- D. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated, based on testing according to UL 1784.
  1. Provide smoke-labeled gasketing on 20-minute-rated doors and on smoke-labeled doors.
- E. Fire-Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
  1. Test Pressure after 5 minutes into the test, neutral pressure level in furnace will be established at 40 inches or less above the sill.
- F. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.
- G. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- H. Gasketing Materials: ASTM D 2000 and AAMA 701/702.
  1. Available Manufacturers:
    - a. Hager Companies (HAG).
    - b. Pemko Manufacturing Co. (PEM).
    - c. Legacy Manufacturing (LEG).
    - d. Zero International (ZRO).
    - e. K.N. Crowder (KNC).

## 2.14 THRESHOLDS

- A. Standard: BHMA A156.21
- B. Bevel raised thresholds with a slope of not more than 1:2.

- C. Thresholds for Means of Egress Doors: Comply with NFPA 101. Maximum 1/2 inch high.
- D. Available Manufacturers:
  - 1. Hager Companies (HAG).
  - 2. Pemko Manufacturing Co. (PEM).
  - 3. Legacy Manufacturing (LEG).
  - 4. Zero International (ZRO).
  - 5. K.N. Crowder (KNC).

## 2.15 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by OWNER.
  - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.
- C. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
  - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
  - 2. Steel Machine: For the following fire-rated applications:
    - a. Mortise hinges to doors.
    - b. Strike plates to frames.

- c. Closers to doors and frames.
- 3. Steel Through Bolts: For the following fire-rated applications unless door blocking is provided:
  - a. Surface hinges to doors.
  - b. Closers to doors and frames.
  - c. Surface-mounted exit devices.
- 4. Spacers or Sex Bolts: For through bolting of hollow-metal doors.

## 2.16 FINISHES

- A. Standard: BHMA A156.18, as indicated in door hardware sets.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Steel Doors and Frames: Comply with DHI A115 Series.
  - 1. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A250.6.

### 3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.
  - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9. Do not install surface-mounted items until finishes have been completed on substrates involved.
- C. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
  - 1. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

### 3.4 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
  - 1. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.
- B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant will examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

### 3.5 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes.

3.7 DOOR HARDWARE SETS

- A. Furnish products as listed in the following hardware sets:
- B. Manufacturers, finish and their abbreviations used in the schedule:

DOR	Dorma Americas.
LUN	Lund Equipment Co., Inc.
LEG	Legacy Manufacturing
PEM	Pemko Manufacturing.
STA	Stanley.
TRI	Trimco Manufacturing.
600	Primed Coat
626	Brass/Satin Chrome
628	Anodized Aluminum
630	Satin Stainless Steel
652	Steel/Satin Chrome
689	Aluminum
Blu-Wht	Blue & White
Gry	Gray
Wht	White
AMS	All Machine Screws
AWS	All Wood Screws
B4E	Beveled Four Edges
F	Fire Rated
FSV	Field Selectable Voltage
H	Height
LM	Latch Monitor
MLR	Motorized Latch Retraction
MS	Machine Screws
MS/ES	Machine Screws/Expansion Shields
WS	Wood Screws
SMS	Sheet Metal Screws
SNB	Sex Nuts & Bolts
SSMS/ES25	1/4-inch– 20 Stainless Steel Machine Screws/Expansion Shields
STK	Strike Plate
STMS	Strike Template Machine Screws
T	Temporary Construction Core
T.B.	Toggle Bolt
W	Width
.050	16 Gauge

### 3.8 SCHEDULE

- A. General: Provide hardware for each door in accordance with the Hardware Schedule. In the event of a discrepancy between the hardware items and the Hardware Schedule, the Hardware Schedule governs.
- B. Listing: The items of hardware listed in the following schedule are as required for each door or each pair of doors as indicated. Where the symbol "NF" is used after a lockset number, provide a case with nonferrous parts.
- C. Completeness of Schedule: Do not construe the schedule of hardware included to be complete. Provide all hardware required for the intended operation and for all doors unless otherwise specified. Provide hardware for doors not scheduled similar in type and quality to that provided for scheduled doors that are to be used for similar purposes.
- D. Intent of Schedule: Provide hardware of the type, materials, strength, design, quality, weight, mechanical construction and operation of hardware as described by the catalog numbers specified, or equal.
- E. The numbers and descriptions shown in the following Hardware Schedule refer to the following manufacturers:
  - 1. Hinges: Hager Hinge Company (HH), Stanley (STA) or equal.
  - 2. Locksets and Latchsets: Dorma Architectural Hardware (DOR) or equal.
  - 3. Closers: Dorma Architectural Hardware (DOR) or equal
  - 4. Exit Devices: Dorma Architectural Hardware (DOR) or equal.
  - 5. Flush Bolts and Dustproof Strikes Trimco (TRI), and Glynn-Johnson (G-J) or equal
  - 6. Kickplates: Trimco (TRI), and Brookline Industries, Inc. (BL), or equal
  - 7. Door Coordinators: Trimco (TRI), and Glynn-Johnson (G-J) or equal
  - 8. Door weatherproofing PEMKO, Legacy or equal.
- F. Schedule: Provide products as listed in the following schedule:

**Set No. 1 SNG Leaf Galvanized Steel Door**

<u>DOOR</u>	<u>Fire Rating</u>	<u>FROM</u>	<u>TO</u>	<u>HANDING</u>	<u>Notes</u>
100-1	NR	Exterior	Garage No.4	RHR	Door Stop
100-4	NR	Exterior	Garage No.4	LHR	
204-4	NR	Exterior	Exit Passageway	LH	

<u>QTY</u>	<u>LEAF</u>	<u>DESCRIPTION</u>	<u>FINISH</u>	<u>MFR</u>
2 EA	--	Hinges – FBB199, 4.5” X 4.5” NRP AMS	630	STA
1 EA	--	Electrified Hinge CEFBB199 4.5” X 4.5” NRP 4 Wire AMS	630	STA
1 EA	--	Electrified Mortise Lock, Security Entrance - M9080-EU x 5007 Fail-Secure	626	DOR
1 EA	--	Permanent Core 77XX 6 or 7 Pin MKD	626	DOR
1 EA	--	Door Closer - 8916 FHP Friction Hold Open Parallel Arm (DR. 100-1, 100-4)	689	DOR
1 EA	--	Door Closer – 8916 FH Friction Hold Open Regular Arm (DR. 204-4)	689	DOR
1 EA	--	Head/ Jamb Seals 5623CA	628	LEG
1 EA	--	Wall Stop 1270CV	630	TRI
1 EA	--	Adjustable Brush Door Sweeps 78918CA	628	LEG
1 EA	--	Threshold - THRS-2 flat ½” X 5” 3556MA MSA	628	LEG
1 EA	--	Power Supply DKPS-2 Amp	--	DOR
1 EA	--	Wiring Diagram	--	DOR

Conduit, wiring and rough-in by Contractor’s Electrician.

Card or Keyfob, Reader and Request to Exit, if required, provided by Security Contractor.

Provide door to be secure at all times except when a valid card reader enables the lockset and allows passage. Rotating the lever from the inside always allows egress out.

In case of emergency or power failure the door remains secured from the exterior.

**Set No. 2 SNG Leaf Galvanized Steel Door**

<u>DOOR</u>	<u>Fire Rating</u>	<u>FROM</u>	<u>TO</u>	<u>HANDING</u>	<u>Notes</u>
103-1	1.5 HR	Garage No. 4	Stairway	RHR	
103-2	1.5 HR	Stairway	Garage No. 3	LHR	

204-1	1.5 HR	Unfinished Office	Exit Passageway	RHR	ADA
204-3	1.5 HR	Garage No. 5	Exit Passageway	LHR	

<u>QTY</u>	<u>LEAF</u>	<u>DESCRIPTION</u>	<u>FINISH</u>	<u>MFR</u>
3 EA	--	Hinges – FBB199, 4.5”X4.5” AMS	630	STA
1 EA	--	Mortise Lock, Passage - M9010 x LRB x 5007	626	DOR
1 EA	--	Door Closer - 8916 SDS Spring Assist Parallel Dead Stop Arm (Mount on the Push Side)	689	DOR
1 EA	--	Head and Jamb Seals 5623CA	628	LEG
1 EA	--	Adjustable Door Sweeps 7823CA	628	LEG
1 EA	--	Threshold - THRS-5 flat 1/4” X 5” 3545MA MSA	628	LEG

**Set No. 3 DBL Leaf Galvanized Steel Door**

<u>DOOR</u>	<u>Fire Rating</u>	<u>FROM</u>	<u>TO</u>	<u>HANDING</u>	<u>Notes</u>
100-8	1.5 HR	Garage No. 4	Gallery	RHR-A	

<u>QTY</u>	<u>LEAF</u>	<u>DESCRIPTION</u>	<u>FINISH</u>	<u>MFR</u>
6 EA	--	Hinges – FBB199, 4.5”X4.5” NRP AMS	630	STA
1 EA	Active	Mortise Lock, Passage - M9010 x LRB x 5007	626	DOR
1 EA	--	Dust Proof Strike 3911 MS/ES	630	TRI
1 PR	Inactive	Auto Flush Bolts 3810X3810 – Metal	630	TRI
1 EA	--	Coordinator 3094B2-72 with filler bar	600	TRI
1 EA	--	Coordinator Brackets 3095 or 3096 (as required)	600	TRI
2 EA	--	Closer - 8916 AF89P Parallel Arm	689	DOR
2 EA	--	Wall Stop 1270CV	630	TRI
1 EA	--	Head and Jamb Seals 5623CA	628	LEG
2 EA	--	Adjustable Door Sweeps 7823CA	628	LEG
1 EA	--	Threshold - THRS-4 ½” X 7” 3756MA MSA	628	LEG
2 EA	--	Armor Plate 8400, 34” – S.STL KA050 2” LDW .050 B4E	630	TRI

**Set No. 4 DBL Leaf Galvanized Steel Door**

<u>DOOR</u>	<u>Fire Rating</u>	<u>FROM</u>	<u>TO</u>	<u>HANDING</u>	<u>Notes</u>
100-7	1.5 HR	Garage No. 4	Lower-Level Workshop	RH-A	--

<u>QTY</u>	<u>LEAF</u>	<u>DESCRIPTION</u>	<u>FINISH</u>	<u>MFR</u>
8 EA	--	Hinges – FBB199, 5.0”X4.5” AMS	630	STA
1 EA	Active	Mortise Lock, Passage - M9010 x LRB x 5007	626	DOR
1 PR	Inactive	Manual Flush Bolts 3917 – 1/24” TOP & 1/12” Bottom Rod	630	TRI
1 EA	--	Dust Proof Strikes 3911 MS/ES	630	TRI
1 EA	--	Closer - 8916 SIS Spring Assist Integra Stop Arm (Active Leaf)	689	DOR
1 EA.	--	Surface Over Head Stop 900S Series 7090 BRKTS (Inactive Leaf)	689	DOR
1 EA	--	Head and Jamb Seals 5623CA	628	LEG
2 EA	--	Adjustable Door Sweeps 7823CA	628	LEG
2 EA	--	Armor Plate 8400, 34” – S.STL KA050 2” LDW .050 B4E	630	LEG

MOUNT CLOSER AND OVERHEAD STOP ON THE PULL SIDE.

**Set No. 5 DBL Leaf Galvanized Steel Door**

<u>DOOR</u>	<u>Fire Rating</u>	<u>FROM</u>	<u>TO</u>	<u>HANDING</u>	<u>Notes</u>
102-2	1.5 HR	Garage No. 4	Generator Room	RHR-A	--

<u>QTY</u>	<u>LEAF</u>	<u>DESCRIPTION</u>	<u>FINISH</u>	<u>MFR</u>
7 EA	--	Hinges – FBB199,5.0”X4.5” AMS	630	STA
1 EA	--	Electrified Hinge CEFBB199 4.5” X 4.5” NRP 4 Wire AMS	630	STA
1 EA	Active	Electrified Mortise Lock, Security Entrance - M9080-EU x 5007 Fail-Secure (knurled 660002)	626	DOR
1 PR	Inactive	Manual Flush Bolts 3917 – 1/24” TOP & 1/12” Bottom Rod	630	TRI
1 EA	--	Dust Proof Strikes 3911 MS/ES	--	--

1 EA	--	Closer – 8916 DS Parallel Dead Stop Arm (Active Leaf)	689	DOR
1 EA	--	Surface Overhead Stop 900S Series (Inactive Leaf)	689	DOR
1 EA	--	Head and Jamb Seals - Smoke Proof 5623CA	628	LEG
2 EA	--	Adjustable Door Sweeps 7823CA - Smoke Proof	628	LEG
1 EA	--	Solid Threshold - ¼" X 5" 396MA-3376MA-396MA Welded	628	LEG
1 EA	--	Power Supply DKPS-2 Amp	--	DOR
1 EA	--	Wiring Diagram	--	DOR

ASTRAGAL PROVIDED BY HOLLOW METAL DOOR MANUFACTURER.

Conduit, wiring and rough-in by Contractor's Electrician.

Card or Keyfob, Reader and Request to Exit, if required, provided by Security Contractor.

Provide door to be secure at all times except when a valid card reader enables the lockset and allows passage. Rotating the lever from the inside always allows egress out.

In case of emergency or power failure the door remains secured from the exterior.

**Set No. 6 SNG Leaf Galvanized Steel Door**

<u>DOOR</u>	<u>Fire Rating</u>	<u>FROM</u>	<u>TO</u>	<u>HANDING</u>	<u>Notes</u>
102-1	1.5 HR	Garage No. 4	Generator Room	LHR	--
102-3	1.5 HR	Garage No. 4	Generator Room	LHR	--
204-2	1.5 HR	Exit Passageway	Medium Voltage Switchgear Room	RHR	--

<u>QTY</u>	<u>LEAF</u>	<u>DESCRIPTION</u>	<u>FINISH</u>	<u>MFR</u>
3 EA	--	Hinges – FBB199, 4.5" X 4.5" AMS	630	STA
1 EA	--	Concealed Power Transfer ES105	630	DOR
1 EA	--	Electrified Mortise Exit Device Storeroom – MRLF9500 x YR09 (Knurled 660002) Fail Secure	630	DOR
1 EA	--	I.C. Mortise Cylinder 97D10BLK138	626	DOR
1 EA	--	Permanent Core 77XX 6 or 7 Pin MKD	626	DOR
1 EA	--	Door Closer - 8916 DS Parallel Dead Stop Arm	689	DOR
1 EA	--	Head/ Jamb Seals - Smoke Proof 5623CA	628	LEG
1 EA	--	Adjustable Door Sweeps 7823CA - Smoke Proof	628	LEG
1 EA	--	Rabbeted Threshold ½" X 5" 3665MA MSA	628	LEG
1 EA	--	Power Supply DKPS-2 Amp	--	DOR
1 EA	--	Wiring Diagram	--	DOR

Conduit, wiring and rough-in by Contractor's Electrician.

Card or Keyfob, Reader and Request to Exit, if required, provided by Security Contractor.

Provide door to be secure at all times except when a valid card reader enables the lockset and allows passage. Depressing the touch bar from the inside always allows egress out.

In case of emergency or power failure the door remains secured from the exterior.

**Set No. 7 SNG Leaf Galvanized Steel Door**

<u>DOOR</u>	<u>Fire Rating</u>	<u>FROM</u>	<u>TO</u>	<u>HANDING</u>	<u>Notes</u>
203-2	NR	Medium Voltage Switchgear Room	Low Voltage Switchgear Room	RHR	--

<u>QTY</u>	<u>LEAF</u>	<u>DESCRIPTION</u>	<u>FINISH</u>	<u>MFR</u>
3 EA	--	Hinges – FBB199, 4.5” X 4.5” AMS	630	STA
1 EA	--	Mortise Exit Device Storeroom - F9500 x YR09	630	DOR
1 EA	--	I.C. Mortise Cylinder 97D10BLK138	630	DOR
1 EA	--	Permanent Core 77XX 6 or 7 Pin MKD	626	DOR
1 EA	--	Door Closer - 8916 DS Parallel Dead Stop Arm	689	DOR
3 EA	--	Metal Door Silencer – 1229A	GRY	TRI

**Set No. 8 DBL Leaf Galvanized Steel Door**

<u>DOOR</u>	<u>Fire Rating</u>	<u>FROM</u>	<u>TO</u>	<u>HANDING</u>	<u>Notes</u>
202-1	NR	Passageway	Low Voltage Switchgear Room	RHR-A	--
203-1	NR	Passageway	Medium Voltage Switchgear Room	RHR-A	--

<u>QTY</u>	<u>LEAF</u>	<u>DESCRIPTION</u>	<u>FINISH</u>	<u>MFR</u>
6 EA	--	Hinges – FBB199, 4.5” X 4.5” NRP AMS	630	BOM
1 PR	Inactive	Manual Flush Bolts 3917 – 1/18” Top & 1/12” Bottom Rod	630	TRI
1 EA		Dust Proof Strike 3911 MS/ES	630	TRI
1 EA	Active	Mortise Exit Device - F9500 x YR09	630	DOR
1 EA	--	I.C. Mortise Cylinder 97D10BLK138	630	DOR
1 EA	--	Permanent Core 77XX 6 or 7 Pin MKD	626	DOR
1 EA	Active	Door Closer - 8916 DS Parallel Dead Stop Arm	689	DOR
1 EA	Inactive	Surface Overhead Stop 900S Series	689	DOR
2 EA	--	Metal Door Silencer – 1229A	GRY	TRI

ASTRAGAL PROVIDED BY HOLLOW METAL DOOR MANUFACTURER.

**Set No. 9 DBL Leaf Galvanized Steel Door**

<u>DOOR</u>	<u>Fire Rating</u>	<u>FROM</u>	<u>TO</u>	<u>HANDING</u>	<u>Notes</u>
201-1	1.5 HR	Lobby	Passageway	RHR-A	--

<u>QTY</u>	<u>LEAF</u>	<u>DESCRIPTION</u>	<u>FINISH</u>	<u>MFR</u>
6 EA	--	Hinges – FBB199, 4.5” X 4.5” AMS	630	STA
1 EA		Concealed Power Transfer ES105	630	DOR
1 EA	Active	Electrified Mortise Exit Device Storeroom – MLRF9500 x YR09 (Knurled 660002) Fail-Secure	630	DOR
1 EA	--	I.C. Mortise Cylinder 97D10BLK138	630	DOR
1 EA	--	Permanent Core 77XX 6 or 7 Pin MKD	630	DOR
1 PR	Inactive	Auto Flush Bolts 3810x3810 – Metal	630	TRI
1 EA	--	Dust Proof Strike 3911 MS/ES	630	TRI
2 EA	--	Door Closer - 8916 DS Parallel Dead Stop Arm	689	DOR
1 EA	--	Coordinator 3094B2-72 with filler bar	600	TRI
1 EA	--	Coordinator Brackets 3095 or 3096 (as required)	600	TRI
2 EA	--	Head/ Jamb seals 5623CA	628	LEG
2 EA	--	Adjustable Door Sweeps 7823CA	628	LEG
1 EA	--	Threshold - THRS-4 ¼” X 7” 3745MA MSA	628	LEG
1 EA	--	Power Supply DKPS-2 Amp	--	DOR
1 EA	--	Wiring Diagram	--	DOR

ASTRAGAL PROVIDED BY HOLLOW METAL DOOR MANUFACTURER.

Conduit, wiring and rough-in by Contractor’s Electrician.

Card or Keyfob, Reader and Request to Exit, if required, provided by Security Contractor.

Provide door to be secure at all times except when a valid card reader enables the lockset and allows passage. Depressing the touch bar from the inside always allows egress out.

In case of emergency or power failure the door remains secured from the exterior.

**Set No. 10 DBL Leaf Galvanized Steel Door**

<u>DOOR</u>	<u>Fire Rating</u>	<u>FROM</u>	<u>TO</u>	<u>HANDING</u>	<u>Notes</u>
101-1	1.5 HR	Garage No.4	Transformer Room	RHR-A	--

<u>QTY</u>	<u>LEAF</u>	<u>DESCRIPTION</u>	<u>FINISH</u>	<u>MFR</u>
6 EA	--	Hinges – FBB199, 4.5” X 4.5” NRP AMS	630	STA
1 EA	--	Concealed Power Transfer ES105	630	DOR

1 EA	Active	Electrified Mortise Exit Device Storeroom – MLRF9500 x YR09 (Knurled 660002) Fail-Secure	630	DOR
1 EA	--	I.C. Mortise Cylinder 97D10BLK138	630	DOR
1 EA	--	Permanent Core 77XX 6 or 7 Pin MKD	626	DOR
1 PR	Inactive	Manual Flush Bolts 3917 – 12” Rod	630	DOR
1 EA	--	Dust Proof Strikes 3911 MS/ES	630	TRI
1 EA	Active	Door Closer – 8916 DS Parallel Dead Stop	689	DOR
1 EA	Inactive	Surface Overhead Stop 900S Series	689	DOR
1 EA	--	Head/ Jamb seals 5623CA	628	LEG
2 EA	--	Adjustable Door Sweeps 7823CA	628	628
1 EA	--	Power Supply DKPS-2 Amp	--	DOR
1 EA	--	Wiring Diagram	--	DOR

ASTRAGAL PROVIDED BY HOLLOW METAL DOOR MANUFACTURER.

Conduit, wiring and rough-in by Contractor’s Electrician.

Card or Keyfob, Reader and Request to Exit, if required, provided by Security Contractor.

Provide door to be secure at all times except when a valid card reader enables the lockset and allows passage. Depressing the touch bar from the inside always allows egress out.

In case of emergency or power failure the door remains secured from the exterior.

**Set No. 11 SNG Leaf Galvanized Steel Door**

<u>DOOR</u>	<u>Fire Rating</u>	<u>FROM</u>	<u>TO</u>	<u>HANDING</u>	<u>Notes</u>
200-1	1.5 HR	Stairway	Unfinished Office	RH	ADA
200-2	1.5 HR	Service Area	Stairway	RH	ADA

<u>QTY</u>	<u>LEAF</u>	<u>DESCRIPTION</u>	<u>FINISH</u>	<u>MFR</u>
3 EA	--	Hinges – FBB199, 4.5” X 4.5” AMS	630	STA
1 EA	--	Mortise Lock, Passage - M9010 x LRB x 5007	626	DOR
1 EA	--	Electric Strike ES96F FSV 12/24VDC	630	DOR
1 EA	--	Automatic Door Opener/Closer ED900 J8	689	DOR
1 EA	--	Wall Stop 1270CV	630	TRI
1 EA	--	Wall Push Buttons WS-1 SQ4 4-1/2”	630	DOR
1 EA	--	Frame Push Buttons FS-1 1-3/4” x 4-1/2”	630	DOR
2 EA	--	Head/ Jamb seals 5623CA	628	LEG
2 EA	--	Adjustable Door Sweeps 7823CA	628	LEG
1 EA	--	Threshold - THRS-5 flat 1/4” X 5” 3545MA MSA	628	LEG
1 EA	--	Power Supply DKPS-2AMP	--	DOR
1 EA	--	Wiring Diagram	--	DOR
2 EA	--	Protection Plate – 12” – S.STL K0050 2” LDW .050 B4E	630	TRI

CONDUIT, WIRING AND ROUGH-IN BY ELECTRICIAN.

DOOR HARDWARE SCHEDULE

- A. Furnish products as listed in the following hardware sets:  
B. Manufacturers, finish, and their abbreviations used in the schedule:

DOR	DormaKaba
LEG	Legacy Manufacturing
LUN	Lund Key Control Cabinet, Inc.
STA	Stanley Hinges
TRI	Trimco Hardware
606	Satin Brass
626	Satin Chrome
628	Anodized Aluminum
630	Satin Stainless Steel
652	Steel/Satin Chrome
689	Aluminum
GRY	Grey
BLK	Black Temporary Construction Core
CD	Cylinder Dogging
EO	Exit Only
FC	Full Cover
FHUC	#12-24 X 7/16" Type C Phillips, Flat Head, Undercut Screws
FSV	Field Selectable Voltage
I.C.	Interchangeable Core Cylinders
LDW	Less Door Width
MKD	Master Keyed
MS	Machine Screws
MS/ES	Machine Screws/Expansion Shields
NRP	Non-Removable Pins
SMS	Sheet Metal Screws
S3	Strike
T	Temporary Construction Core
T.B.	Toggle Bolt
UMB	Universal Mounting Box
.050	16 Gauge

END OF SECTION

(NO TEXT ON THIS PAGE)

SECTION 08 80 00  
GLASS AND GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
  - 1. Interior and exterior window glazing
  - 2. Fire rated glazing for fire door assemblies.

1.2 RELATED SPECIFICATIONS

- A. Section 07 90 00 – Joint Sealants
- B. Section 08 11 13 – Steel Doors and Frames
- C. Section 08 51 13 – Aluminum Windows

1.3 DEFINITIONS

- A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thickness: Indicated by thickness designations in millimeters according to ASTM C 1036; provide equivalent thickness in inches.
- C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.
- D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.
- E. Sealed Insulating Glass Unit Surface Designations:
  - 1. Surface 1 - Exterior surface of the outer glass lite.
  - 2. Surface 2 - Interspace surface of the outer glass lite.

3. Surface 3 - Interspace surface of the inner glass lite.
4. Surface 4 - Interior surface of the inner glass lite.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement, wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following:
  1. Defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer to design glazing.
- C. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
  1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
    - a. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures" based on mean roof heights above grade indicated on Drawings.
      - 1) Basic Wind Speed: 90 MPH
      - 2) Importance Factor: IV.
      - 3) Exposure Category: C.
    - b. Probability of Breakage for Vertical Glazing: No greater than 0.001 for lites set vertically or not more than 15 degrees off vertical and under wind action.
      - 1) Load Duration: 60 seconds or less
    - c. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch, whichever is less.

- 1) For monolithic-glass lites heat treated to resist wind loads.
  - 2) For insulating glass.
- d. Minimum Glass Thickness for Exterior Lites: Not less than 1/4 inch.
- D. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- E. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- F. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
1. For monolithic-glass lites, properties are based on units with lites 1/4 inch thick.
  2. For insulating-glass units, properties are based on units with lites 1/4 inch and a nominal 1/2-inch- wide interspace.
  3. Center-of-Glass Values: Based on using LBL's WINDOW 7.8 computer program for the following:
    - a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F
    - b. Solar Heat Gain Coefficient and Visible Transmittance: NFRC 200
    - c. Visible Reflectance Solar Optical Properties: NFRC 300
- G. Fire-rated glass: laminated clear glazing material listed for use in impact safety-rated locations such as doors, transoms and borrowed lites with fire rating requirements ranging from 20 to 180 minutes with required hose stream test.

## 1.5 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
- B. Product Data: For each glass product and glazing material indicated.

- C. Samples: For the following products, in the form of 12-inch- square Samples for glass.
  - 1. Float glass
  - 2. Coated vision glass
  - 3. Each color of laminated glass interlayer
  - 4. Insulating glass for each designation indicated
  - 5. For each color of exposed glazing sealant indicated
- D. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
- E. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
  - 1. For solar-control low-e-coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.
- F. Product Test Listings: For fire rated glass from UL indicating fire-rated glass complies with requirements, based on comprehensive testing of current product.
- G. Qualification Data: For installers.
- H. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.
- I. Product Test Reports: For each of the following types of glazing products:
  - 1. Tinted float glass
  - 2. Coated float glass
  - 3. Insulating glass
  - 4. Glazing sealants
  - 5. Fire Rated glass
- J. Warranties: Standard warranties specified in this Section.

## 1.6 QUALITY ASSURANCE

- A. **Installer Qualifications:** An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- B. **Source Limitations for Glass:** Obtain glass in fabricated units through one source from a single manufacturer for each product and installation method indicated.
- C. **Source Limitations for Glazing Accessories:** Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.
- D. **Glass Product Testing:** Obtain glass test results for product test reports in "Submittals" Article from a qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- E. **Glazing Publications:** Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. **FGIA Publication for Insulating Glass:** SFGIA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."
  - 2. **NGA Publications:** "Laminated Glazing Reference Manual"; "Glazing Manual."
- F. **Insulating-Glass Certification Program:** Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:
  - 1. **Insulating Glass Certification Council.**
  - 2. **Associated Laboratories, Inc.**
  - 3. **Fenestration and Glazing Industry Alliance.**
- G. **Fire Protective Rated Glass:** Permanently marked with nonremovable label of UL certifying it for use in tested and rated fire protective assemblies.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

## 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
  - 1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or expected to fall below 40 deg F. during curing period

## 1.9 WARRANTY

- A. Manufacturer's Standard Warranty for Coated-Glass Products: Manufacturer's standard form, made out to the glass fabricator in which the coated glass manufacturer agrees to replace coated glass units that deteriorates during normal use within the specified warranty period. Deterioration of the coated glass is defined as peeling and/or cracking, or discoloration that is not attributed to glass breakage, seal failure, improper installation, or cleaning and maintenance that is contrary to the manufacturer's written instructions.
- B. Manufacturer's Standard Warranty on Insulating Glass: Manufacturer's standard form in which the insulating glass unit manufacturer agrees to replace insulating-glass units that deteriorate during normal use within the specified warranty period. Deterioration of insulating glass units is defined as an obstruction of vision by dust, moisture, or a film on the interior surfaces of the glass caused by a failure of the hermetic seal that is not attributed to glass breakage, improper installation, or cleaning and maintenance that is contrary to the manufacturer's written instructions.
- C. Manufacturer's Standard Warranty on Laminated Glass: Manufacturer's standard form in which the laminated glass manufacturer agrees to replace laminated glass units that deteriorate during normal use within the specified warranty period. Deterioration of laminated glass is defined as defects, such as discoloration, edge separation, or blemishes exceeding those allowed by

ASTM C 1172 that are not attributed to glass breakage, improper installation, or cleaning and maintenance that is contrary to the manufacturer's written instructions.

## PART 2 PRODUCTS

### 1.10 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to the following:
  - 1. Pilkington North America.
  - 2. Vitro Architectural Glass.
  - 3. Guardian Industries Corp.

### 1.11 GLASS PRODUCTS

- A. Annealed Float Glass: ASTM C 1036, Type I, Class I (clear), Quality-Q3.
  - 1. Ultra-Clear (Low-Iron) Float Glass: Class I (clear); with a minimum 91 percent visible light transmission and a minimum solar heat gain coefficient of 0.87.
- B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
- C. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.
  - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
  - 2. Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
  - 3. For uncoated glass, comply with requirements for Condition A.
  - 4. For coated vision glass, comply with requirements for Condition C (other uncoated glass).

- D. Laminated Glass: ASTM C 1172, and complying with other requirements specified and with the following:
1. Interlayer: Polyvinyl butyral of thickness indicated with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.
    - a. Laminate lites in autoclave with heat plus pressure.
  2. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air or glass pockets.
- E. Insulating-Glass Units, (IGU): Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, complying with ASTM E 2188/2189 and other requirements specified.
1. Sealing System: Provide IGUs with dual seal silicone foam warm-edge spacer system with high-performance acrylic adhesive structural seal, backed with moisture vapor seal, and designed to maintain hermetic seal; edge seal as selected by Architect, where not indicated.
- F. Spacer Specifications: Manufacturer's standard spacer material and construction complying with the following requirements:
1. Spacer Material: Aluminum with mill or clear anodic finish.
  2. Desiccant: Molecular sieve or silica gel, or blend of both.
  3. Corner Construction: Manufacturer's standard corner construction.
- G. Fire Rated Glass units: Tested in accordance to NFPA 252 or UL 10B or UL 10C. Provide units marked as D-H-90.
1. 100 square inches maximum exposed area.
  2. Passes positive pressure test standards UL 10C.
  3. Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat. I and II).

#### 1.12 GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:
1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass

products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by architect from manufacturer's full range.

B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Single-Component Neutral-Curing Silicone Glazing Sealants:
  - a. Available Products: Provide one of the following or approved equal.
    - 1) GE Silicones; SilPruf SCS2000
    - 2) Pecora Corporation; 890
    - 3) Tremco; Spectrem 3
  - b. Type and Grade: S (single component) and NS (nonsag)
  - c. Class: 50
  - d. Use Related to Exposure: NT (nontraffic)
  - e. Uses Related to Glazing Substrates: M, G, A, and, as applicable to glazing substrates indicated, O
    - 1) Use O Glazing Substrates: Coated glass and aluminum coated with a high-performance coating.

#### 1.13 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

1. EPDM complying with ASTM C 864.

2. Silicone complying with ASTM C 1115.
  3. Thermoplastic polyolefin rubber complying with ASTM C 1115.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned EPDM silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

#### 1.14 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Glazing Tape: Polyisobutylene/Butyl, complying with ASTM C 1281:
1. Dap, Inc., Butyl Rubber Tape.
  2. Pecora Corporation, G-66 or BB-50.
  3. Tremco, Tremco 400 Tape

#### 1.15 Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

- A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- B. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- C. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- D. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

## 1.16 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
  - 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
    - a. Temperature Change: 120 deg F, ambient; 180 deg F.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with outdoor and indoor faces.
- C. Grind smooth and polish exposed glass edges and corners.
- D. Fabricate fire rated glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

## PART 3 EXECUTION

### 1.17 EXAMINATION

- A. Examine framing glazing, with Installer present, for compliance with the following:
  - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  - 2. Presence and functioning of weep system.
  - 3. Minimum required face or edge clearances.
  - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 1.18 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

#### 1.19 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

#### 1.20 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

#### 1.21 GASKET GLAZING (DRY)

- A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Install gaskets so they protrude past face of glazing stops.

#### 1.22 FIRE RATED GLAZING

- A. Comply with referenced FGMA standards and instructions of manufacturers of glass, glazing sealants, and glazing compounds.
- B. Protect glass from edge damage during handling and installation. Inspect glass during installation and discard pieces with edge damage that could affect glass performance.
- C. Cut glazing tape to length and set against permanent stops, flush with sight lines to fit openings exactly, with stretch allowance during installation.
- D. Place setting blocks located at quarter points of glass with edge block no more than 6 inches from corners.
- E. Glaze vertically into labeled fire-rated metal frames same fire rating as glass and push against tape for full contact at perimeter of pane or unit.

- F. Place glazing tape on free perimeter of glazing in same manner described above.
- G. Install removable stop and secure without displacement of tape.
- H. Install in vision panels in fire-rated doors to requirements of NFPA 80.

#### 1.23 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

#### 1.24 GLAZING SCHEDULE

- A. Glass Type GT-1, Insulating Glass Units Clear Glass:
  - 1. Solar-control Low-E tinted insulating glass, cool light-gray, low-reflective exterior appearance at all exterior windows, and other locations indicated.
  - 2. Overall Unit Thickness: One Inch.
  - 3. Outdoor Lite: 6 mm (1/4-Inch) thick clear glass. Low-E coating on surface No.2
  - 4. Interspace Content: Argon filled. 13 mm (1/2-Inch) thick.
  - 5. Indoor Lite: 6 mm (1/4-Inch) thick clear glass.

6. Low-E Coating: Sputtered on surface No. 2, unless otherwise indicated on the approved sample.
7. Visible Light Transmittance: 35 percent
8. Winter Nighttime U-Factor: 0.29
9. Summer Daytime U-Factor: 0.27
10. Solar Heat Gain Coefficient: 0.25
11. Shading Coefficient: 0.29
12. Outdoor Visible Reflectance: 6 percent

B. Glass Type GT-2 Laminated Glass Units:

1. Solar-control Low-E tinted insulating laminated glass, cool light-gray, low-reflective exterior appearance at locations indicated.
2. Clear Laminated Glass Type: Two plies of fully tempered float glass.
  - a. Minimum Thickness of Each Glass Ply: 6 mm.
  - b. Interlayer Thickness: 0.060 inch.
3. Overall Unit Thickness: One Inch.
4. Outdoor Lite: 6 mm (1/4-Inch) thick clear glass. Low-E coating on surface No.2
5. Interspace Content: Argon filled. 13 mm (1/2-Inch) thick.
6. Indoor Lite: 6 mm (1/4-Inch) thick clear glass.
7. Low-E Coating: Sputtered on surface No. 2, unless otherwise indicated on the approved sample.
8. Visible Light Transmittance: 35 percent
9. Winter Nighttime U-Factor: 0.29
10. Summer Daytime U-Factor: 0.27
11. Solar Heat Gain Coefficient: 0.25
12. Shading Coefficient: 0.29

13. Outdoor Visible Reflectance: 6 percent
  14. Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat II).
- C. Glass Type GT-3, Fire rated Units:
1. Thickness: 5/16-inch min overall.
  2. Approximate Visible Transmission: 85 percent.
  3. Approximate Visible Reflection: 9 percent.
  4. Fire-rating: 90 minutes.
  5. Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat. I).

END OF SECTION

SECTION 08 80 13  
FIRE RATED GLAZING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Fire rated glazing for interior applications.

B. RELATED SPECIFICATIONS

1. Section 08 11 13 – Steel Doors and Frames
2. Section 08 88 00 – Glass and Glazing

1.2 SYSTEM DESCRIPTION

A. Performance Requirements: Provide a fire rating glazing manufactured, fabricated and installed to maintain performance criteria stated by manufacturer without defects, damage or failure.

1. Fire Rating: 45/60/90 minutes with hose stream.
2. Fire protective, safety rated clear glazing tested in accordance with NFPA 80, NFPA 252, UL 10B and UL 10C.
3. Testing Laboratory: Fire test shall be conducted by a nationally recognized independent testing laboratory.

B. Listings and Labels:

1. Fire rated glazing shall be under current follow-up service by a nationally recognized independent testing laboratory approved by OSHA and maintain a current listing or certification. Assemblies shall be labeled in accordance with limits of listings.

1.3 SUBMITTALS

A. General: Provide all submittals, including the following, as specified in Division 1.

1. Product Data: For each glass product and glazing material indicated.

2. Shop Drawings: Submit shop drawings showing layout, profiles and product components.
3. Samples: Submit 6 x 6 glass samples.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations for Glass: Obtain glass in fabricated units through one source from a single manufacturer for each product and installation method indicated.
- B. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.
- C. Field Measurements: Verify actual measurements for openings by field measurements before fabrication. Show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.6 Delivery: Deliver materials to specified destinations in manufacturer's or distributor's packaging undamaged, complete with installation instructions.

1.7 Storage and Protection: Store off ground, under cover, protected from weather and construction activities and at temperature conditions recommended by manufacturer.

#### 1.8 WARRANTY

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document. Manufacturer's warranty is not intended to limit other rights that the Owner may have under the Contract Documents.

B. Warranty Period:

1. Lifetime limited warranty from date of shipping for monolithic versions.
2. 5-year limited warranty for insulated versions.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide glass products by the following:
  - 1. SaftiFirst

### 2.2 FIRE RATED GLAZING

- A. Material: SuperLite X-45/60/90 minute fire and safety rated glazing.
- B. Manufacturer: SuperLite X-45/60/90 as manufactured and distributed by SAFTI FIRST.
- C. Design Requirements:
  - 1. Thickness: 3/4-inch.
  - 2. Weight: 9 lbs./sq. ft.
  - 3. Sound Transmission Rating: 38 STC.
  - 4. Appearance: clear, wireless and tint-free.
  - 5. Visible Light Transmittance: 0.81.
  - 6. Fire Rating: 45/60/90 minutes with hose stream.
  - 7. Impact Safety Resistance: CPSC 16 CFR Cat. II.
- D. Label Each piece of fire-rated glazing material with a permanent logo including name of product, manufacturer, testing laboratory, fire rating period and safety glazing standards.
- E. Glazing material installed in Hazardous Locations, subject to human impact, shall be certified and permanently labeled as meeting applicable requirements referenced in NFPA 80:
  - 1. CPSC 16 CFR 1201, Cat. I or II

### 2.3 GLAZING ACCESSORIES

- A. Manufacturer recommended fire rated glazing accessory as follows:
  - 1. Listed and labeled vision lite kits.

## PART 3 EXECUTION

### 3.1 GENERAL

- A. Comply with manufacturer's written installation instructions.

### 3.2 EXAMINATION

- A. Verification of Conditions: Verify substrate conditions, are acceptable for product installation in accordance with manufacturer's instructions. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

### 3.4 INSTALLATION

- A. Install glass in strict accordance with the fire glazing material manufacturer's specifications.
- B. Field cutting or tampering is strictly prohibited.

### 3.5 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.
- C. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- D. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION

## SECTION 08 91 00

### METAL LOUVERS

#### PART 1 GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Fixed, extruded-aluminum louvers.
2. Bird or insect screening and frames
3. Blank-off panels for louvers.

###### B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:

1. Section 07 92 00 - Joint Sealants

##### 1.2 REFERENCES

###### A. Codes and standards referred to in this Section are:

1. AMCA 500 - Test Method for Louvers, Dampers, and Shutters
2. ASTM B 221 - Specification for Aluminum-Alloy Extruded Bars, Rods, Wire Shapes and Tubes

##### 1.3 SYSTEM PERFORMANCE

###### A. Provide louvers bearing the AMCA rating seal for air performance and water penetration ratings and meeting the following criteria:

###### B. Structural Performance: Provide exterior metal louvers capable of withstanding the effects of loads and stresses from wind and normal thermal movement without evidencing permanent deformation of louver components including blades, frames, and supports; noise or metal fatigue caused by louver blade rattle or flutter; or permanent damage to fasteners and anchors.

1. Wind Load: Uniform pressure (velocity pressure) of 30 lbf/sq. ft acting inward or outward.
2. Thermal Movements: Provide louvers that allow for thermal movements resulting from the following maximum change (range) in ambient and

surface temperatures by preventing buckling, opening of joints, overstressing of components, and other detrimental effects:

- a. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- C. Air-Performance, Water-Penetration, and Air-Leakage Ratings: Provide louvers complying with performance requirements indicated, as demonstrated by testing manufacturer's stock units 48 inches wide by 48 inches high. Test units according to AMCA 500.
1. Minimum free area: 50 percent.
  2. Free outside air intake velocity pressure drop at 1,250 feet per minute not exceeding 0.18-inch wg.
  3. Water penetration not exceeding 0.01 ounces of water per square foot of free area at an air flow of 1,250 FPM when tested for 15 minutes in accordance with AMCA Standard 500.

#### 1.4 SUBMITTALS

- A. Provide all submittals, including the following, and as specified in Division 1.
- B. Product Data: For each type of product specified.
- C. Shop Drawings: For louver units and accessories. Include plans; elevations; sections; and details showing profiles, angles, and spacing of louver blades. Show unit dimensions related to wall openings and construction; free area for each size indicated; profiles of frames at jambs, heads, and sills; and anchorage details and locations.
- D. Samples: For each type of metal finish required, prepared on Samples of same thickness and material indicated for final Work. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected.
- E. Product Certificates: Signed by manufacturers of louvers certifying that the products furnished comply with requirements and are licensed to bear the AMCA seal based on tests made according to AMCA 500 and complying with AMCA's Certified Ratings Program.
- F. Product Test Reports: Indicate compliance of products with requirements based on comprehensive testing of current products.
- G. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects

with project names and addresses, names and addresses of architects and owners, and other information specified.

## 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain louvers and vents through one source from a single manufacturer where alike in one or more respects regarding type, design, or factory-applied color finish.
- B. Welding Standards: As follows:
  - 1. Comply with AWS D1.2, "Structural Welding Code--Aluminum."
  - 2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- C. SMACNA Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" recommendations for fabrication, construction details, and installation procedures.

## 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify louver openings by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating louvers without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to established dimensions.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Airolite Co. - use as basis of design and quality.
  - 2. Construction Specialties, Inc.
  - 3. Industrial Louvers, Inc.
  - 4. The Greenheck Company

B. Products: Subject to compliance with requirements, provide the following as a basis of design and quality:

1. Airolite Co.; Horizontal Louver K 6776
2. Louver frame width: 6-inch

## 2.2 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, alloy 6063-T5 or T-52.
- B. Aluminum Sheet: ASTM B 209, alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Of same basic metal and alloy as fastened metal or 300 series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.
1. Use types and sizes to suit unit installation conditions.
  2. Use Phillips flat-head screws for exposed fasteners, unless otherwise indicated.
- D. Anchors and Inserts: Of type, size, and material required for loading and installation indicated. Use nonferrous metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as needed for corrosion resistance. Use toothed steel or expansion bolt devices for drilled-in-place anchors.
- E. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12 but containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

## 2.3 FABRICATION, GENERAL

- A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
1. Continuous Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates and without interrupting blade spacing pattern.
- B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

- C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining materials' tolerances, and perimeter sealant joints.
  - 1. Frame Type: Channel type, unless otherwise indicated.
- D. Include supports, anchorages, and accessories required for complete assembly.
- E. Provide sill extensions and loose sills made of same material as louvers where indicated or required for drainage to exterior and to prevent water penetrating to interior.
- F. Join frame members to one another and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer, concealed from view; unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

#### 2.4 LOUVER SCREENS

- A. General: Provide each exterior louver with louver screens complying with the following requirements:
  - 1. Bird Screens: Provide bird screens of interwoven wire mesh of 0.063 inch diameter wire, 1/2-inch, square design, in a rewirable extruded aluminum frame.
    - a. Provide bird screens at intake-air louvers of filtered HVAC systems and at all exhaust louvers.
    - b. Provide manufacturer's recommended accessories and mounting to facilitate removal of screens without any tools. Refer to HVAC drawings and specifications for filtration requirements and additional information.
  - 2. Insect Screens: Provide insect screens of 18 x 16 (count) x 0.011" (wire diameter) aluminum mesh, set in rewirable extruded aluminum frame.
    - a. Provide insect screens at intake air louvers of non-filtered HVAC systems.
    - b. Provide manufacturer's recommended accessories and mounting to facilitate removal of screens without any tools. Refer to HVAC drawings and specifications for filtration requirements and additional information.
- B. Secure screens to louver frames with stainless-steel machine screws.

- C. Louver Screen Frames: Fabricate screen frames with mitered corners to louver sizes indicated
- D. Miter louver blades at corners by welding mitered joint.
- E. Reinforce extruded-aluminum screen frames at corners with clips.
- F. Finish: integral color to match louvers.
- G. Separate dissimilar material to avoid galvanic corrosion.

## 2.5 BLANK-OFF PANELS

- A. Blank-off unused portions of louvers with insulated sheet aluminum laminated panels, consisting of an exterior facing of 0.040-inch thick sheet aluminum with a core of 1-inch thick expanded polyurethane and an interior face of 0.032-inch thick sheet aluminum laminated with an adhesive resistant to moisture and mildew. .
  - 1. Use panels in largest widths and lengths available.
  - 2. Finish exterior and interior sheet aluminum for blank-off panels in Kynar 500 National Association of Architectural Metal Manufacturers (NAAMM) Class 1 AA-A42 finish.
  - 3. Color: Exterior face to be black. Interior face to match adjacent walls.
  - 4. Capture panel edges with aluminum channels. Avoid exposure of insulation. Finish aluminum channels in same color as the louver.

## 2.6 ALUMINUM FINISHES

- A. Finish windows, frames, and mullions with an anodic finish equal to the National Association of Architectural Metal Manufacturers (NAAMM).
- B. Anodized Finish: Class I finish, 0.7 mils thick.
  - 1. AA-M10C12C22A41, Class I, 0.7 mils thick.
    - a. Color: As selected by Architect from manufacturers full color palette.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install the louver assembly in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.

- B. Locate and place louver units level, plumb, and at indicated alignment with adjacent work.
- C. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- D. Form closely fitted joints with exposed connections accurately located and secured.
- E. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- F. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- G. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- H. Install concealed gaskets, flashings, joint fillers, and insulation, as louver installation progresses, where weathertight louver joints are required. Comply with Division 7 Section "Joint Sealants" for sealants applied during louver installation.

### 3.2 CLEANING, AND PROTECTING

- A. Protect louvers and vents from damage during construction. Use temporary protective coverings where needed and approved by louver manufacturer. Remove protective covering at the time of Substantial Completion.
- B. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
  - 1. Clean and touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

(NO TEXT ON THIS PAGE)

## SECTION 09 22 10

### NON-STRUCTURAL METAL FRAMING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Grid suspension systems for gypsum board ceilings.

###### B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:

1. Section 09 25 00 - Gypsum Board.

##### 1.2 ACTION SUBMITTALS

###### A. Product Data: For each type of product.

##### 1.3 INFORMATIONAL SUBMITTALS

###### A. Product Certificates: For each type of code-compliance certification for studs and tracks.

###### B. Manufacturer's Certification: Submit manufacturer's certification of product compliance with codes and standards along with product literature and data sheets for specified products.

##### 1.4 QUALITY ASSURANCE

###### A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified in accordance with the product-certification program of the Steel Framing Industry Association (SFIA) or similar organization providing a verifiable code-compliance program.

###### B. Contractor to provide effective, full-time quality control over fabrication and erection complying with pertinent codes and regulations of government agencies having jurisdiction. Conduct preinstallation meeting to verify Project requirements, substrate conditions, and manufacturer's written installation instructions.

##### 1.5 DELIVERY, STORAGE, AND HANDLING

###### A. Notify manufacturer of damaged materials received prior to installation.

###### B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

- C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, in accordance with ASTM E119 and displaying a classification label from an independent testing agency acceptable to authorities having jurisdiction.
  - 1. Construct fire-resistance-rated partitions in compliance with tested assembly requirements.
  - 2. Rated assemblies to be substantiated from applicable testing using proposed products, by Contractor.
- B. Horizontal Deflection: For composite and non-composite wall assemblies, limited to 1/360 of the wall height based on horizontal loading of 5 lbf/sq. ft.
- C. Design framing systems in accordance with AISI S220, unless otherwise indicated.
- D. Design Loads: As indicated on architectural Drawings or 5 lbf/sq. ft. minimum as required by the IBC.
- E. Design framing systems to accommodate deflection of primary building structure and construction tolerances and to withstand design loads with a maximum deflection of 1-inch.

### 2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with AISI S220 for conditions indicated.
  - 1. Steel Sheet Components: Comply with AISI S220 requirements for metal unless otherwise indicated.
  - 2. Protective Coating: Comply with AISI S220; ASTM A653/A653M, G40; or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.
    - a. Coating to demonstrate equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.
- B. Studs and Track: AISI S220.
  - 1. Subject to compliance with requirements, provide products by one of the following current members of the SFIA:

- a. Clark Dietrich
  - b. CEMCO; California Expanded Metal Products Co.
  - c. Telling Industries.
2. Minimum Base-Steel Thickness: 0.0181.
  3. Flange Size: 1-1/4.
- C. Steel Framing Stud and Track Wall System: Self-locking steel studs, and telescoping stud extensions and tracks.
1. Subject to compliance with requirements, provide products by one of the following current members of the SFIA:
    - a. Clark Dietrich
    - b. CEMCO; California Expanded Metal Products Co.
    - c. Telling Industries.
  2. Minimum Base-Steel Thickness: 0.0296 inch
  3. Web Depth: As indicated on Drawings.
- D. Slip-Type Head Joints: Provide one of the following:
1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing 1-1/2-inch minimum vertical movement.
    - a. Subject to compliance with requirements, provide products by one of the following current members of the SFIA:
      - 1) Clark Dietrich
      - 2) CEMCO; California Expanded Metal Products Co.
      - 3) Steel Network, Inc. (The).
  2. Single Long-Leg Track System: Top track with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging and spacer bar located within 12 inches of the top of studs to provide lateral bracing.
    - a. Subject to compliance with requirements, provide products by one of the following current members of the SFIA:
      - 1) Clark Dietrich

- 2) CEMCO; California Expanded Metal Products Co.
  - 3) Telling Industries.
- E. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- 1. Subject to compliance with requirements, provide products by one of the following current members of the SFIA:
    - a. Clark Dietrich
    - b. CEMCO; California Expanded Metal Products Co.
    - c. Steel Network, Inc. (The).
- F. Resilient Furring Channels: 1/2-inch- deep, steel sheet members.
- 1. Subject to compliance with requirements, provide products by one of the following current members of the SFIA:
    - a. Clark Dietrich
    - b. CEMCO; California Expanded Metal Products Co.
    - c. Telling Industries.
  - 2. Configuration: Asymmetrical.
- G. Carrying Channels: 0.053-inch base-steel thickness, with minimum 1/2-inch- wide flanges.
- 1. Depth: 3/4 inch.
  - 2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum base-steel thickness of 0.0296 inch.
  - 3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch diameter wire, or double strand of 0.048-inch-diameter wire.
- H. Partial Wall Framing Connection: 1/2-inch ASTM A36/A36M steel-plate ST50H stud connector designed to support out-of-plane loading of cantilevered partial wall systems that are unsupported at the top track.

## 2.3 SUSPENSION SYSTEMS

- A. Furring Channels (Furring Members):

1. Cold-Formed Channels: 0.0538-inch base-steel thickness, with minimum 1/2-inch- wide flanges, 3/4 inch deep or as required to meet UL system installed.
2. Steel Studs and Tracks: AISI S220.
  - a. Subject to compliance with requirements, provide products by one of the following current members of the SFIA:
    - 1) Clark Dietrich
    - 2) CEMCO; California Expanded Metal Products Co.
    - 3) Telling Industries.
  - b. Minimum Base-Steel Thickness: 0.0181 inch
  - c. Flange Size: 1-1/4 inches).
  - d. Web Depth: As indicated on Drawings.
3. Hat-Shaped, Rigid Furring Channels: AISI S220, 7/8 inch deep.
  - a. Minimum Base-Steel Thickness: As indicated on Drawings.

#### 2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
  1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
  1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

### 3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.
  - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

### 3.4 INSTALLATION OF FRAMED ASSEMBLIES

- A. Install framing system components in accordance with spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Single-Layer Application: As required by horizontal deflection performance requirements unless otherwise indicated.
  - 2. Multilayer Application: As required by horizontal deflection performance requirements unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
  - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  - 2. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
    - a. Install fire-resistant partitions using manufacturer's proprietary equivalent-gauge studs in compliance with requirements of UL V438.

- b. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

### 3.5 INSTALLATION OF CEILING SUSPENSION SYSTEMS

- A. Install suspension system components in accordance with spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Furring Channels (Furring Members): 16 inches o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Fire-Resistance-Rated Assemblies: Tie furring channels to supports as required to meet UL system design.
- D. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- E. Grid Suspension Systems: Attach perimeter wall track grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 ft. measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

(NO TEXT FOR THI PAGE)

## SECTION 09 25 00

### GYPSUM BOARD

#### PART 1 GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

##### 1.2 SUMMARY

- A. Section includes:
  - 1. Interior gypsum board for walls and ceilings.
  - 2. Shaft wall systems for vertical shaft enclosures, horizontal enclosures.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 07 21 13 - Building Insulation.
  - 2. Section 09 22 10 - Nonstructural Metal Framing
  - 3. Section 09 96 00 - High performance Coatings.

##### 1.3 DEFINITIONS

- A. Shaft Wall: An assembly of steel framing, gypsum boards and other materials used to enclose elevator shafts, stairways, air shafts and mechanical components.

##### 1.4 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.

##### 1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Gypsum board, Type X.
  - 2. Gypsum board, Type C.
  - 3. Shaftwall system.
  - 4. Interior trim.

5. Aluminum trim.
  6. Joint treatment materials.
- B. Samples: For the following products:
1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.
  2. Textured Finishes: Manufacturer's standard size for each textured finish indicated and on same backing indicated for Work.

#### 1.6 QUALITY ASSURANCE

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

#### 1.7 STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

#### 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
1. Indications that panels are wet, or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

### PART 2 PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated in accordance with ASTM E119 or UL 263 by an independent testing agency.

## 2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

## 2.3 INTERIOR GYPSUM BOARD

### A. Gypsum Wallboard: ASTM C1396

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CertainTeed Gypsum.
  - b. Georgia-Pacific Gypsum LLC.
  - c. National Gypsum Company.
  - d. USG Corporation
- 2. Thickness: 5/8 inch.
- 3. Long Edges: Tapered.

### B. Gypsum Wallboard Type X ASTM C1396:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CertainTeed Gypsum.
  - b. Georgia-Pacific Gypsum LLC.
  - c. National Gypsum Company.
  - d. USG Corporation
- 2. Thickness: 5/8 inch.
- 3. Long Edges: Tapered.

### C. Gypsum Ceiling board ASTM C1396:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CertainTeed Gypsum.
  - b. Georgia-Pacific Gypsum LLC.

- c. National Gypsum Company.
  - d. USG Corporation
- 2. Thickness: 5/8 inch.
  - 3. Long Edges: Tapered.
  - 4. ASTM D3274.

## 2.4 EXTERIOR SHEATHING BOARD

- A. Sizes to minimize joints in place; ends square cut.
- B. Application: Exterior sheathing, unless otherwise indicated.
- C. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
- D. Core Type: Type X, as indicated.
- E. Type X Thickness: 5/8 inch.
- F. Edges: Square.
- G. Glass Mat Faced Products:
  - 1. American Gypsum Company; M-Glass Exterior Sheathing Type X.
  - 2. Continental Building Products; Weather Defense Platinum Sheathing Type X.
  - 3. Georgia-Pacific Gypsum; DensGlass Fireguard Sheathing.
  - 4. National Gypsum Company; Gold Bond eXP Sheathing.

## 2.5 SHAFTWALL SYSTEMS

- A. Basis of Design—USG Shaft Wall System. Other manufacturers of similar products may be submitted for approval.
  - 1. Gypsum Liner Panels: ASTM C1396, 1inch USG Sheetrock Brand Gypsum Liner Panels, 100% recycled green face and back paper, beveled edge, 24 inches wide, lengths as required. Stamped with UL Classification label documenting UL Classifications for fire resistance, surface burning characteristics and non-combustibility.
  - 2. Gypsum Wallboard—ASTM C1396, 5/8 inch 4 feet wide, tapered edge, USG Sheetrock Brand Gypsum Panels, Firecode X, ASTM C1287.

3. Fasteners: ASTM C1002, Screws as required for application.
4. Metal Trim: ASTM C1047, as required for application.
5. Steel furring channels.
6. USG steel C-H studs, hot-dipped galvanized, lengths as required.

## 2.6 TRIM ACCESSORIES

### A. Interior Trim: ASTM C 1047.

1. Material: Plastic.
2. Shapes:
  - a. Cornerbead.
  - b. Bullnose bead.
  - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
  - d. L-Bead: L-shaped; exposed long flange receives joint compound.
  - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
  - f. Expansion (control) joint.
  - g. Curved-Edge Cornerbead: With notched or flexible flanges.
  - h. Base-of-Wall Galvanized Moisture Barrier Trim: Galvanized-steel sheet, 2 inches high.
    - (1) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - (a) VersaDry, LLC. Or approved equal.

## 2.7 JOINT TREATMENT MATERIALS

### A. General: Comply with ASTM C 475

### B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.

### C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
  - a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound. At contractor's option use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

## 2.8 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
  1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
  1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
  2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance of the work.

- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.
  - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch-wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

### 3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
1. Wallboard Type: Vertical surfaces, unless otherwise indicated.
  2. Type X: Where required for fire-resistance-rated assembly.
  3. Ceiling Type: Ceiling surfaces.
- B. Single-Layer Application:
1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
  2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
  3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
  4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
  5. On ceilings, apply gypsum board indicated for base layers before applying face layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
  6. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated. Stagger joints on opposite sides of partitions.
  7. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
  8. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations, and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 INSTALLATION OF TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings, according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
  1. Cornerbead: Use at outside corners.
  2. U-Bead: Use at exposed panel edges.

D. Exterior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use at exposed panel edges.

### 3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
1. Level 5: At panel surfaces that will be exposed to view unless otherwise indicated.
    - a. Primer and its application to surfaces are specified in other Division 9 Sections.

### 3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

## SECTION 09 67 50

### RESINOUS FLOORING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Epoxy-Based seamless troweled or screened flooring system.

##### 1.2 SUBMITTALS

- A. Provide all submittals, including the following, as specified in Division 1.
- B. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- C. Samples for Verification: For each resinous flooring system required, 5 inches square, applied to a rigid backing.
- D. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- E. Maintenance Data: For resinous flooring to include in maintenance manuals.

##### 1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.
  - 1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
- A. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, through one source from a single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.
- B. Manufacturer Field Technical Service Representatives: Resinous flooring manufacture shall retain the services of Field Technical Service Representatives who are trained specifically on installing the system to be used on the project.

1. Field Technical Services Representatives shall be employed by the system manufacturer to assist in the quality assurance and quality control process of the installation and shall be available to perform field problem solving issues with the installer.
- C. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Apply full-thickness mockups on 48-inch- square floor area selected by Engineer.
    - a. Include 48-inch length of integral cove base if applicable.
  2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.
- B. Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.
- C. Factory pre-weight and pre-pack all materials used in single, easy to manage batches to eliminate on-site mixing errors. No on-site weighing or volumetric measurements allowed.

#### 1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application unless manufacturer recommends a longer period.
- D. Concrete substrate shall be properly cured. If no vapor barrier is present for concrete subfloors on or below grade; install an osmotic pressure resistant grout prior to the resinous flooring application.

#### 1.6 WARRANTY

- A. Provide a single, written warranty covering both material and workmanship for a period of (1) full year from date of installation or provide a joint and several

warranties signed on a single document by material manufacturer and applicator jointly and severally warranting the materials and workmanship for a period of (1) full year from date of installation.

## PART 2 PRODUCTS

### 2.1 FLOORING MATERIALS, GENERAL

- A. Provide Epoxy-Based flooring system meeting the requirements of ASTM C722.
- B. Provide flooring materials with a slip resistance coefficient of friction not less than 0.60 tested in accordance with ASTM D 2047.

### 2.2 RESINOUS FLOORING

- A. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Stoneclad GS with topcoat Stonkote GS4 by Stonhard Inc. (Basis of Design)
  - 2. Dur-A-Crete by DUR-A-FLEX
  - 3. Other approved equivalent by Engineer.
- B. System Characteristics:
  - 1. Colors and Patterns: To be selected by OWNER from manufacturer's standard colors.
  - 2. Wearing Surface: Manufacturer's standard orange-peel texture.
  - 3. Integral Cove Base: 4 inches high.
  - 4. Overall System Thickness: 1/4 inch.
- C. System Components: Manufacturer's standard components that are compatible with each other and as follows:
  - 1. Primer:
    - a. Material Basis: Manufacturer's Standard Primer.
    - b. Resin: Epoxy.
    - c. Formulation Description: (2) two component, 100 percent solids.
    - d. Application Method: Squeegee and roller.
    - e. Number of Coats: (1) one.

2. Mortar Base:
  - a. Material design basis: Manufacturer's standard.
  - b. Resin: Epoxy.
  - c. Formulation Description: (3) three component, 100 percent solids.
  - d. Application Method: Metal Trowel.
  - e. Thickness of Coats: nominal 1/4 inch.
  - f. Number of Coats: One.
  - g. Aggregates: Pigmented Blended aggregate
3. Topcoat: Chemical-resistant UV-resistant sealing or finish coat.
  - a. Material design basis: Manufacturer's standard topcoat for use and application.
  - b. Resin: Epoxy.
  - c. Formulation Description: (2) two component 100 percent solids.
  - d. Type: pigmented.
  - e. Finish: standard.
  - f. Number of Coats: one.

## 2.3 ACCESSORY MATERIALS

- a. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.
- b. Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous flooring application.

- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
  - 1. Roughen concrete substrates as follows:
    - a. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.
  - 2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.
  - 3. Verify that concrete substrates are dry.
    - a. Perform in situ probe test, ASTM F 2170. Proceed with application only after substrates do not exceed a maximum potential equilibrium relative humidity of 85 percent.
    - b. Perform additional moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.
  - 4. Verify that concrete substrates have neutral Ph and that resinous flooring will adhere to them. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations.

### 3.2 APPLICATION

- A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
  - 1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
  - 2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

- C. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and top coating of cove base. Round internal and external corners.
- D. Apply troweled or screeded body coat in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, sand to remove trowel marks and roughness.
- E. Apply grout coat, of type recommended by resinous flooring manufacturer to fill voids in surface of final body coat and to produce wearing surface indicated.
- F. Apply topcoat in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.

### 3.3 TERMINATIONS

- A. Chase edges to “lock” the flooring system into the concrete substrate along lines of termination.
- B. Penetration Treatment: Lap and seal resinous system onto the perimeter of the penetrating item by bridging over compatible elastomer at the interface to compensate for possible movement.
- C. Trenches: Continue flooring system into trenches to maintain monolithic protection. Treat cold joints to assure bridging of potential cracks.
- D. Treat floor drains by chasing the flooring system to lock in place at point of termination.

### 3.4 JOINTS AND CRACKS

- A. Treat control joints to bridge potential cracks and to maintain monolithic protection.
- B. Treat cold joints and construction joints to maintain monolithic protection on horizontal and vertical surfaces as well as horizontal and vertical interfaces.
- C. Vertical and horizontal contraction and expansion joints are treated by installing backer rod and compatible sealant after coating installation is completed. Provide sealant type recommended by manufacturer for traffic conditions and chemical exposures to be encountered.

### 3.5 CLEANING AND PROTECTING

- A. Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 24 hours.

- B. Protect resinous flooring materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and method of application. General Contractor is responsible for protection.
- C. Cleaning: Remove temporary covering and clean resinous flooring just prior to final inspection. Use cleaning materials and procedures recommended by resinous flooring manufacturer. General contractor responsible for cleaning prior to inspection.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 09 96 00

### HIGH PERFORMANCE COATINGS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Preparation of surfaces, shop painting of items furnished, field painting of new, structures, piping, conduit, ductwork and equipment, masonry waterproofing and parking lot marking.

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
1. SSPC - The Society for Protective Coatings
    - SSPC-SP 1 - Hand Tool Cleaning
    - SSPC-SP 3 - Power Tool Cleaning
    - SSPC-SP 5 - White Metal Blast Cleaning
    - SSPC-SP 6 - Commercial Blast Cleaning
    - SSPC-SP 10 - Near-White Blast Cleaning
    - SSPC-SP 11 - Power Tool Cleaning to Bare Metal
    - SSPC-SP 13 - Surface Preparation of Concrete
    - SSPC-SP 16 - Brush-off Blast Cleaning of Non-Ferrous Metals
  2. FS-TT-V-51F - Asphalt Varnish
  3. NSF/ANSI Standard 61 - Drinking Water System Components
  35. ASME A13.1 - Scheme for the Identification of Piping Systems
  6. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method

- 7. ASTM E-1795 - Standard Specification for Non-Reinforced Liquid Coating Encapsulation Products for Leaded Paint in Buildings
- 8. NACE SP0178 - Standard Practice for Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to Be Lined for Immersion Service
- 9. NAFB 500-03 - Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings

### 1.3 SUBMITTALS

- A. Provide all submittals, including the following, as specified in Division 1.
  - 1. Submit manufacturer's standard color chart for color selection.
  - 2. Where equipment is customarily shipped with a standard finish, submit samples of the proposed color and finish for approval prior to shipping.
  - 3. Furnish affidavits from the manufacturer certifying that materials furnished conform to the requirements specified and that paint products have been checked for compatibility.
  - 4. Submit a supplementary schedule of paint products with mil thickness and solids by volume, including all paint applied in the shop and in the field. Provide a schedule that is in accordance with the recommendations of the paint manufacturer.
  - 5. Furnish affidavits from the manufacturer certifying that coatings in immersion service contain no water soluble solvents or corrosion inhibitive (active) pigments with slight water solubility.

### 1.4 PAINTING REQUIREMENTS

- A. Shop Primed and Finished Items: Furnish the following items with the manufacturer's standard prime and finish coats applied in the shop: motors, gears, gear housings, air compressors, wall fans, temperature control and instrument panels, process air blowers, filters, strainers, air dryers, meters, gas boosters, gas turbines, generators, switchgears, switchboards, motor control centers, panelboards, transformers, industrial control panels (except stainless steel or fiberglass), condensing units, water chillers, cooling towers, condensers, heat exchangers, humidifiers, air handling units, sound attenuators, air conditioning and dehumidification units, convector cabinets, unit heaters, enclosures for finned tube radiators, cabinet heaters, hoisting equipment. Coat steel reinforcing bars for concrete in accordance with Section 03 20 00.

Shop Primed and Field Painted Items: Furnish the following items shop primed and field painted: structural steel and wrought metals, composite metal floor deck, pipelines, hangers and supports, sluice gates, valves, valve and sluice gate operators and stands, guard housings, air filter equipment, effluent strainers, heat exchangers, air receivers, tanks, air silencing equipment, steel stair framing, steel lintels, hollow metal doors and frames.

- B. Field Primed and Finished Items: Field prime and finish, where exposed to view, all items not shop primed or shop finished. This Work generally includes, but is not limited to, the following: gypsum wallboard, interior concrete block, interior concrete walls, columns, beams and ceilings, covering over insulation on piping, galvanized steel electrical conduit systems, cast iron electrical boxes, small piping and copper tubing, ducts, covering over ducts, exterior PVC piping valves, and fittings, drain piping.
- C. Unpainted Items: Do not paint the following items, unless otherwise specified: interior structural steel not exposed to view, registers, grilles, dampers and linkage, fire sprinklers, name and identification plates and tags, floor gratings, brass pipe and fittings, brass valves, stainless steel, fiberglass and fiber reinforced polymer enclosures, wood, cast-iron piping installed underground, stop log panels, spray-on fireproofing steel to receive spray-on fireproofing, surfaces to receive field welding, faying surfaces of high strength bolted connections, steel to be embedded or in contact with cast-in-place concrete, fiberglass doors and railings.

## 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 1 and as follows:
- B. Delivery and Storage: Deliver and store paint at the site from the approved manufacturer only.
- C. Packaging and Labeling: Prepare, pack and label paints, stains, varnish or ingredients of paints to be used on the job. Deliver all material to the site in original, unbroken containers.
- D. Storage: Store the painting materials at the site in accordance with applicable codes and regulations and in accordance with manufacturer's instructions. Keep the storage space clean at all times. Take every precaution to eliminate fire hazards.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.

1. Paint - General:
  - a. AkzoNobel (Ceilcote, Devoe, Enviroline, International)
  - b. TNEMEC Incorporated.
  - c. PPG Industries, Inc.
2. Floor Marking:
  - a. Aexcel Inc.; Mentor, OH Alkyd Traffic Paint 12Y-D272

2.2 MATERIALS

- A. General: Furnish paint and other materials of the type and quality of the manufacturer on which the painting schedule specified herein is based.
  1. Provide compatible shop and field coats.
  2. Provide all coats of paint for any particular surface from the same manufacturer.
  3. Provide coatings, including paints, primers and materials in contact with potable water listed by NSF International under Standard 61 for materials and products in contact with potable water.
  4. Provide paint of approved color as selected from the manufacturer's standard range of colors.
- B. Paint Schedule: Provide all painting in accordance with the following schedule with the number of coats not less than the number shown on the schedule. Final thickness of coatings shall be per manufacturer requirements

Class of Work	Surface Preparation	Total			DFT
		1st	2nd	3rd	
Steel-Structural, Pipe, and Equipment:					
Interior	SSPC-SP 6	F	F		8.0-16.0
Exterior	SSPC-SP 6	E	F	C	8.5-15.0
Below Grade Immersion	SSPC-SP 10	B	B	B	12.0-18.0

Class of Work	Surface Preparation	Total			DFT
		1st	2nd	3rd	
		<b>Nonferrous Metal and Galvanized Steel:</b>			
Interior	SSPC-SP 16	G	F		6.0-11.0
Exterior	SSPC-SP 16	G	C		4.0-6.0
Immersion	SSPC-SP 1 & SSPC-SP 10	B	B		8.0-12.0
<b>Ductile or Cast Iron,-Pipes, Pumps, and Valves:</b>					
Interior & Exterior Exposed	NAFP 500-03	G	F	C*	8.0-14.0
Below Ground	NAFP 500-03	H	H		32.0-40.0
Immersion	NAFP 500-03	B	B		8.0-12.0
*Optional					
<b>PVC:</b>					
Exterior Exposed	Scarify	G	C		4.0-6.0
Interior Exposed	Scarify	G	F		6.0-11.0
<b>Insulated Piping:</b>					
Interior/Exterior Exposed	SSPC-SP 10	I	I		8.0-12.0
<b>Concrete Walls (Cast and Precast):</b>					
Below Grade	SSPC-SP 13	H			16.0-20.0
Interior Exposed	SSPC-SP 13	M	F	F	8.0-16.0
Exterior Exposed	SSPC-SP 13	M	L	L	7.0-10.0
<b>CMU Walls:</b>					
Interior Exposed (General Service)	SSPC-SP 13	J	K	K	4.0-8.0
Interior Exposed (High Humidity & Moisture)	SSPC-SP 13	J	F	F	8.0-16.0

Class of Work	Surface Preparation	Total			DFT
		1st	2nd	3rd	
		Exterior Exposed	SSPC-SP 13	J	
Concrete Floors:					
Light Traffic/Low Impact (Urethane Finish)**	SSPC-SP 13	D	F	C	7.0-12.5
Light Traffic/Low Impact (Epoxy Finish)	SSPC-SP 13	D	F	F	9.0-17.5

\* Optional

\*\* For applications exposed to UV

C. Schedule of Paints: Alphabetical designations in the following list are given solely for the purpose of indicating the type and quality of materials desired. Equivalent material from other approved manufacturers may be submitted for approval.

<u>Symbol</u>	<u>Product Name and Number</u>	<u>Volume Solids %</u>	<u>Dry Film Thickness Mils Per Coat</u>	<u>VOCs (g/L)</u>
A	International Paint-Devoe Coatings Bar-Rust 231	71	4.0-8.0	247
B	International Paint-Devoe Coatings Bar-Rust 233H	80	4.0-6.0	170
C	International Paint-Devoe Coatings Devthane 379	63	2.0-3.0	311
D	International Paint-Devoe Coatings Pre-Prime 167	100	1.0-1.5	95
E	International Paint-Devoe Coatings Cathacoat 302H	78	2.5-4.0	282
F	International Paint-Devoe Coatings Devran 224V	77	4.0-8.0	28
G	International Paint-Devoe Coatings Devran 201H	58	2.0-3.0	327
H	International Paint-Devoe Coatings Devtar 5A-HS	79	16.0-20.0	98
I	International Paint-Devoe Coatings Intertherm 228HS	70	4.0-6.0	265
J	International Paint-Devoe Coatings Tru-Glaze 4015	53	9.0-11.0	99

K	International Paint-Devoe Coatings Tru-Glaze-WB 4428	36	2.0-4.0	43
L	International Paint-Devoe Coatings Devcryl 1448 – Semi-gloss	38	1.5-4.0	98
M	International Paint-Devoe Coatings Devran 203	45	3.0-4.0	91
N	International Paint-Devoe Coatings Devcryl 1440	44	2.0-3.0	77
O	Euclid Chemical-Tammscoat Smooth	PMR*	PMR*	TBD
P	Euclid Chemical-Tammscoat Fine (Sanded) Pre-Mixed	PMR*	PMR*	TBD
Q	Euclid Chemical-Tammoseal	PMR*	PMR*	TBD
R	Euclid Chemical-Akkro-7T	PMR*	PMR*	TBD

\* Per manufacturers requirements.

### 2.3 BITUMINOUS PAINT

- A. Cold-applied asphalt mastic complying with SSPC-Paint 12 but containing no asbestos fibers, or cold-applied asphalt emulsion complying with ASTM D 1187.

## PART 3 EXECUTION

### 3.1 REPAIR

- A. Fill all pits in concrete having a depth in excess of 1/8 of an inch with a 100 percent solids epoxy repair compound. Provide fill material in compliance with NSF Standard 61 for materials and products in contact with potable water and from the same manufacturer.
- B. Notify the ENGINEER of all pits with a depth greater than 1/4 inch to determine whether structural repairs are necessary. Repair such pits in a manner approved by ENGINEER.

### 3.2 PREPARATION

- A. Inspection: Prior to surface preparation perform the following:
  1. Verify that surface substrate conditions are ready to receive Work as instructed by the product manufacturer.
  2. Examine specifications for all Work and become thoroughly familiar with all provisions regarding painting.

3. Document conditions of substrate prior to beginning work. Indicate any damaged or deficient substrates requiring repair and report findings to the ENGINEER.
- B. Surface Preparation: After inspection and prior to painting, perform the following:
1. Inspect all Work prior to application of any paint or finishing material.
  2. Prepare the surface to be painted in accordance with the instructions of the manufacturer, the latest edition of AWWA D102 and as approved.
  3. Brush and wash concrete and masonry surfaces. Remove all loose dirt, free lime, form oil, curing compounds and other foreign matter by approved methods such as SSPC-SP 13. Patch concrete surfaces requiring repair and spackle and repair surfaces to receive paint. Acid etch concrete surfaces to be painted as recommended by the manufacturer of the coating to be applied, to produce a slightly granular surface required for adherence of the paint to the concrete unless otherwise indicated. Determine that concrete and concrete masonry is thoroughly dry prior to painting per ASTM D4263.
  4. Thoroughly clean surfaces to be given protective coatings.
  5. Refinish shop-coated equipment that has scratches and abrasions.
  6. Do not begin field painting prior to approval of the surface preparation.
  7. Thoroughly clean wood surfaces to remove all foreign matter. Properly fill and smooth cracks and nail holes. Finish exposed wood with sandpaper to a fine finish and wipe clean of dust.
  8. Prepare and clean all surfaces prior to painting, as specified and required. Verify that surfaces are dry before any paint is applied. Perform special surface preparation work as directed by the manufacturer of the paint specified to be applied to the surface.
  9. Clean the surface of structural steel, exterior and interior dry surfaces of water storage tanks and steel encased in concrete, masonry or spray-on fireproofing by removing all rust, mill scale, oil, grease or dirt in accordance with SSPC-SP 6.
  10. Prior to painting steel and interior wet surfaces of water storage tanks, grind smooth all welds, beads, blisters or protuberances per NACE SP0178, other than identification markings and remove other imperfections. Remove all rust, mill scale, oil, grease and dirt by abrasive blasting in accordance with SSPC-SP 10 unless otherwise indicated.
  11. Prior to painting metals other than steel, grind smooth all welds, beads, blisters of protuberances, other than identification markings, and remove

other imperfections. Solvent clean all nonferrous metals, galvanized steel and stainless steel whether shop primed or field primed, in accordance with SSPC-SP 1 prior to the application of the primer.

12. Prime cleaned metal the same day immediately after sandblasting to prevent rusting.
13. Remove all adhering debris on pipe and duct covering and smooth out indentations or unsightly spots and brush clean.
14. Remove all bituminous or asphaltic coating from cast iron drain and soil pipe prior to painting.
15. Remove all adhering debris on PVC, roughen surface with sandpaper and brush clean.

### 3.3 INSTALLATION

- A. General: Install all painting and coatings in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.
  1. Refer to manufacturer's guidelines as it relates to minimum/maximum allowable temperatures for application.
  2. Do not apply coatings to steel surfaces when the temperature of the steel is at or below 5 degrees F above the dew point.
  3. Paint surfaces in accordance with the material painting schedule included in this Section.
  4. Completely cover all surfaces to be painted. Cover by additional coats when color on undercoats shows through the final coat of paint, until paint is of uniform color and appearance and coverage is complete.
  5. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
  6. Provide sufficient temporary ventilation during painting operations in enclosed areas to remove moisture and solvents, and to keep the atmosphere safe from harmful or dangerous fumes and dust levels for personnel.
- B. Touch-Up Shop-Primed and Finished Items: Touch-up all damaged portions and imperfections in shop-primed and finished items. Use the same paint as used for the shop prime and finish. Prepare the surface prior to touch-up by wire brushing and sanding to remove rust, scale and loose paint per SSPC-SP 2, 3, or 11, as determined by each situation.

- C. Aluminum and Incompatible Surfaces: Where aluminum surfaces come in contact with incompatible metals, lime, mortar, concrete or other masonry materials, apply one field coat of International Paint-Devoe Coatings Bar-Rust 231 Epoxy or two coats of asphalt varnish conforming to FS-TT-V-51F. The aluminum surface should be abraded to a 1.5-2.0 mil profile before coatings application is done to ensure maximum adhesion to the surface.
- D. Castings: Castings, such as manhole covers, frames, curb and area inlets and valve boxes.
- E. Steel Pipe: Applicable to insulated and uninsulated steel pipe. Immediately after installation, prime pipe not furnished with a shop coat.
- F. Field Painting: Perform field painting at the job site as follows:
  - 1. Mix all paints and similar materials in approved containers of adequate capacity.
  - 2. Mix all paint thoroughly before being taken from the containers. Keep mixed while painting. Apply all ready-mixed paint exactly as received from the manufacturer without addition of any kind of drier or thinner, except as specified, to mix colors to conform to approved color schedule. Tint successive coats of paint to make various coats easily distinguishable. Tint undercoats of paint to the approximate shade of the final coat of paint.
  - 3. Use only skilled painters on the Work, and employ specialists where required. Apply paint by brush, roller or sprayer in accordance with the manufacturer's recommendation.
  - 4. Paint top and bottom edges of doors. Thoroughly and uniformly sand undercoats on hollow metal Work with No. 240 grit sandpaper or equal abrasive to remove all surface defects and provide a smooth, even surface. Do not allow brush marks or other irregularities on finished surfaces.
  - 5. Perform painting as a continuous and orderly operation to facilitate adequate inspection. Prime coat and paint materials subject to weathering or corrosion before erection. Perform all paint application methods in accordance with the instructions of the paint manufacturer and as approved.
  - 6. Do not field paint equipment, such as electrical control cabinets, motors, unit heaters and similar items which are shipped with a final baked enamel finish and having received prior approval unless the finish is damaged in transit or installation.
  - 7. Paint access panels, pipe, pipe covering, ducts and other building appurtenances built into adjoining walls the same color as adjacent walls, unless color coding applies. Remove or protect hardware and accessories,

fixtures and similar items placed prior to painting during painting and replace them upon completion of painting.

8. Paint piping up to and including the flanges attached to mechanical equipment. Paint electrical conduit up to and including the flexible conduit connected to equipment.
9. Paint all wall surfaces which will be concealed by equipment before equipment installation.
10. Paint all existing wall surfaces newly exposed to view due to removal of existing equipment or other demolition work. Paint to match adjacent surfaces.
11. Fully protect areas under and adjacent to painted work at all times and promptly remove dripped or spattered paint.
12. Repair, refinish and repaint any adjacent surfaces that have been damaged or discolored by overspray.
13. Do not paint when the air or surface temperature is below that recommended by the manufacturer, or in dust-laden air, or until moisture on the surface has completely disappeared. If necessary, provide sufficient heating and ventilation to keep the atmosphere and all surfaces to be painted dry and warm until each coat of paint has hardened.
14. Remove any painting found defective. Touch-up and provide remedial painting as directed and as required until completion and acceptance of final work.

G. Color Coding: For colors to be used for identification of mechanical and electrical piping, tubing and conduit see the following:

<b>TBL 099600-1</b>	
<b>Pipe Service</b>	<b>Pipe Color</b>
Potable Water	Dark Blue
Chlorine	Yellow
Natural Gas	Orange
Sanitary	Dark Grey
Fire Protection	Red

1. For items not covered by table 09 96 00-1, see the following:
  - a. Section 26 05 53- Electrical identification
  - b. Section 40 05 03 - Mechanical Identification

- H. Equipment Colors: Furnish the following equipment in their respective groups to be shop or field painted in the colors herein specified.

Equipment Description (Groups)	Color
Hoisting Equipment	Medium Yellow 339
Instrumentation and Control	White 311

1. Provide chart of standard colors offered by each equipment manufacturer. Coordinate color selection.
2. Furnish all electrical equipment shop painted in a color selected from the manufacturer's standard colors.

- I. Floor Marking: Stripe and mark surfaces that is clean and dry and by method recommended by the manufacturer.

- J. Masonry Waterproofing: Coat all exterior concrete masonry units and brick with clear sealer. Prepare the masonry surfaces and apply the waterproof coating in accordance with the manufacturer's recommendations.

### 3.4 HEALTH AND SAFETY

A. Introduction

1. Products listed in this specification and used in high-performance coatings situations contain high volume solids; the aerosol droplets/particulates produced during airless spray of some of these materials may form an explosive mixture with air and additionally may contain materials which may necessitate personal protection against potential health hazards. A summary of the main precautions to be taken includes:
  - a. Danger of explosion or fire
  - b. Provision of a suitable breathing environment for workers.
  - c. Prevention of skin irritation problems.
  - d. Use of paints which have been specially formulated for use in tanks.

- B. Consult with manufacturer prior to commencing work to review recommended Health and Safety procedures.

### 3.5 QUALITY CONTROL

#### A. General Coatings:

1. At least daily, check temperature, humidity, and Dew Point as to time and readings obtained. Submit "Paint Inspection: Daily Coating Inspection Report" to ENGINEER on a daily basis. See Supplement below.
2. Perform daily wet film thickness readings or spreading rate checks to make certain that proper film thickness is being achieved. If proper film thickness is not being achieved more frequent checks may be required by the ENGINEER at their discretion. Provide daily written report to ENGINEER. Correct any deficiencies in film thickness by application of additional paint. See Supplement below.

### 3.6 CLEANING AND FINAL TOUCH UP PAINTING

- #### A.
- Touch up and restore any damaged finish. Remove paint or other finishes spilled, splashed or splattered from all surfaces taking care not to mar any surface or item being cleaned.

### 3.7 SUPPLEMENT

- #### A.
- The supplement listed below is a part of this Specification:

1. Paint Inspection: Daily Coating Inspection Report



SECTION 10 15 16  
BUILDING PLAQUE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Cast bronze plaque and all accessories and appurtenances required for installation.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 04 20 00 - Masonry

1.2 SUBMITTALS

- A. General: Provide all submittals, including the following as specified in Division 1.
- B. Product Data: Submit manufacturer's product data, including installation instructions.
- C. Warranty: Submit manufacturer's standard lifetime warranty against defects in craftsmanship and materials.
- D. Submit four copies of a full size rubbing directly to Owner for approval prior to casting.
- E. Owner will return two copies of the approved rubbing to the Contractor.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum of five years documented experience.
- B. Installer Qualifications: Minimum two years documented experience in installing products like the one specified in this Section.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to site in manufacturer's original, unopened packaging, with labels clearly identifying product name, manufacturer, and location of installation. Upon delivery, materials shall be inspected for damage. Deficient materials shall not be used.
- B. Storage: Store materials in a clean, dry area indoors in accordance with manufacturer's instructions. Keep temporary protective coverings in place.

- C. Handling: Protect materials and finish from damage during handling and installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
  - 1. The Southwell Company, San Antonio, TX
  - 2. Matthews International Corporation, Pittsburgh, PA
  - 3. Gemini Incorporates, Cannon, MN

2.2 CAST BRONZE PLAQUES

- A. Cast of virgin ingots (85-5-5-5 Standard U. S. bronze alloy). Free of pits and gas holes.
  - 1. Letters shall be sharp and hand tooled.
  - 2. Border and faces of raised letters shall be satin/brushed finish and background shall be leatherette finish.
  - 3. Plaque shall be chemically cleaned and etched and treated with Alodine and sprayed with two coats of Clear Acrylic Lacquer.
  - 4. Size: 20 inches wide x 24 inches high.
  - 5. Border Design: Raised, satin/brushed finish.
  - 6. Letter style: "Arial Black," satin/brushed finish.
  - 7. Background: Leatherette finish, Oxidized-Dark Bronze.
- B. Text: Include, in 1/2 -inch font, the items listed below in order of placement on the plaque:

City of Evanston

Water Protection Bureau

Water Plant

Date of construction to be provided by Owner.

- C. Additional Text: Include, in 3/8-inch font, the items listed below in order of placement on the plaque:

4160V Electrical System Reliability Project

- D. Additional text: Include, in 1/2-inch font the items listed below in order of placement on the plaque:

Board of Trustees:

- E. Additional text: Include, in 3/8-inch font the items listed below in order of placement on the plaque:

Mayor Daniel Biss

Clare Kelly

Krissie Harris

Melissa A. Wynne

Jonathan Nieuwsma

Bobby Burns

Thomas M. Suffredin

Eleanor Revelle

Devon Reid

Juan Geracaris

City Clerk: Stephanie Mendoza

City Manager: Luke Stowe

Public Works Director: Edgar Cano

Water Production Bureau Chief: Darrell King

Senior Project Manager: Paul Moyano, P.E., PMP

- F. Additional text: Include, in 1/2-inch font the items listed below in order of placement on the plaque:

Engineer of Record: TYLin Greeley and Hansen Water Solutions

- G. Additional text: Include, in 3/8-inch font the items listed below in order of placement on the plaque:

Catharine M. Richardson, P.E., ENV SP

Michael T. Monte, P.E., ENV SP

Jonathan Walters, AIA, ENV SP

- H. Additional text: Include, in 1/2-inch font the items listed below in order of placement on the plaque:

General Contractor

- I. Additional text: Include, in 3/8-inch font the items listed below in order of placement on the plaque:

Prime Contractor to be provided by Owner.

### PART 3 EXECUTION

#### 3.1 PREPARATION

- A. Examine the area and conditions where plaque will be installed notify Engineer in writing of conditions detrimental to proper and timely completion of Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

#### 3.2 INSTALLATION

- A. General: Install plaques in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.
- B. Install plaque plumb level and square, in proper planes with related surfaces, with concealed type fastening devices at heights and location indicated.

#### 3.3 CLEAN UP

- A. Repair scratches and other damage which might have occurred during installation.
- B. Clean the installed product in accordance with manufacturer's instructions.
- C. Clean up all debris caused by the work of this section.

END OF SECTION

## SECTION 10 40 00

### SIGNAGE

#### PART 1 GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Panel signs.
2. Signage accessories.
3. Warning Signs and Hazardous Materials signs.
4. Room identification signs.
5. Restrictive signs.

##### 1.2 RELATED SECTIONS

###### A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1. Section 03 30 00 - Cast-In-Place Concrete
2. Section 04 20 00 - Masonry
3. Section 07 90 00 - Joint Sealants

##### 1.3 SUBMITTALS

###### A. General: Provide all submittals, including the following, as specified in Division 1.

###### B. Product Data

1. For each type of sign specified, include details of construction, materials description, dimensions of individual components and profiles, and finishes.

###### C. Shop Drawings

1. Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.
2. Sign Schedule: Show location of each sign on plan. Provide message list for each sign, including large-scale details of wording, lettering, and Braille layout.

- D. Samples for Initial Selection: For each type of sign material that involves color selection from manufacturer's complete color range and type styles.
- E. Samples for Verification: For each type of sign, include following samples:
  - 1. Panel Signs: Full size Sample of each type of sign required.
  - 2. Approved samples will not be returned for installation into Project.
- F. Submit in accordance with Division 1.

#### 1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with code provisions as adopted by authorities having jurisdiction.
- B. Single Source Responsibility: Obtain sign from single manufacturer.

#### 1.5 PROJECT CONDITIONS

- A. Field Measurements: Where sizes of signs are determined by dimensions of surfaces on which they are installed, verify dimensions by field measurement before fabrication and indicated measurements on Shop Drawings.

### PART 2 PRODUCTS

#### 2.1 PANEL SIGNS

- A. Manufacturers
  - 1. ASE Manufacturing, Inc.
  - 2. Brady Signs Corporation.
  - 3. Best Manufacturing Company.
  - 4. Or Approved Equal.
- B. Locate signage and accessories at Building Entrances, Room Entrances and where required by OSHA using mounting methods of type described and in compliance with manufacturer's instructions.
- C. Follow Americans with Disabilities Act (ADA) standards for sign location, characteristics, height above floors, dimensions, etc.
- D. Panel Signs: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.

1. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within tolerance of plus or minus 1/16 in. measured diagonally.
- E. Cast Acrylic Sheet: Manufacturers standard as follows:
  1. Color: As selected by ENGINEER from manufacturer's full range.
- F. Plastic Laminate: Provide high-pressure plastic laminate engraving stock with face and core plies as selected from manufacturer's standards.
- G. Unframed Panel Signs: Fabricate signs with edges mechanically and smoothly finished to conform to the following requirements:
  1. Edge Condition: Beveled.
  2. Corner Condition: Rounded to radius indicated.
- H. Graphic Content and Style: Provide sign copy that complies with ENGINEER's requirements or as indicated on Drawings for size, style, spacing, content, position, material, finishes, and colors of letters, numbers, and other graphic devices.
- I. Colored Coating for Acrylic Sheet
  1. Colored Coating for Acrylic Sheet: For copy and background and frame colors, provide Pantone Matching System (PMS) colored coatings, including inks and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are nonfading for application intended.

## 2.2 PANEL SIGN TYPES

- A. Room Signs
  1. Material: Fiberglass: Molded, seamless, thermosetting, glass-fiber-reinforced polyester panels with face and core plies in contrasting colors, 1/8 inch thick, with a minimum tensile strength of 9,000 psi when tested according to ASTM D638 and with a minimum flexural modulus strength of 20,000 psi when tested according to ASTM D790.
  2. Perimeter: Framed.
  3. Copy: Tactile and braille.
  4. Character Style: Helvetica.
  5. Text: As required by ENGINEER.
  6. Message: Fixed.

7. Sizes:
  - a. Sign: Match ENGINEER's standards or 8 inches by 8 inches
  - b. Character: Minimum 1 in. uppercase high characters.

B. Wayfinding Signs

1. Material: Fiberglass: Molded, seamless, thermosetting, glass-fiber-reinforced polyester panels with face and core pules in contrasting colors, 1/8 inch thick, with a minimum tensile strength of 14,000 psi when tested according to ASTM D638 and with a minimum flexural strength of 22,000 psi when tested according to ASTM D790.
2. Perimeter: Framed.
3. Copy: Raised.
4. Character Style: Helvetica.
5. Graphics/Text: As required by ENGINEER.
6. Message: Fixed.
7. Sizes:
  - a. Sign: Match ENGINEER's standards or 8 inches by 8 inches
  - b. Character: Minimum 1 in. uppercase high characters.

C. Warning Signs and Hazardous Materials Signs

1. Material: Fiberglass: Molded, seamless, thermosetting, glass-fiber-reinforced polyester panels with face and core pules in contrasting colors, 1/8 inch thick, with a minimum tensile strength of 14,000 psi when tested according to ASTM D638 and with a minimum flexural strength of 22,000 psi when tested according to ASTM D790.
2. Perimeter: Framed.
3. Copy: Raised.
4. Character Style: Helvetica.
5. Graphics/Text: As required by ENGINEER.
6. Message: Fixed.

7. Sizes:
  - a. Sign: Match ENGINEER's standards or 8 inches by 8 inches
  - b. Character: Minimum 1 in. uppercase high characters.

## 2.3 ACCESSORIES

- A. Vinyl Film: Provide opaque nonreflective vinyl film, 0.0035 in. minimum thickness, with pressure sensitive adhesive backing suitable for both exterior and interior applications.
- B. Mounting Methods: Use concealed fasteners fabricated from materials that are not corrosive to sign material and mounting surface.
- C. Anchors and Inserts: Provide nonferrous metal or hot dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled in place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

## PART 3 EXECUTIONS

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- B. Verify that items, including anchor inserts, provided under other sections of Work are sized and located to accommodate signs.
- C. Examine supporting members to ensure that surfaces are at elevations indicated or required to comply with authorities having jurisdiction and are free from dirt and other deleterious matter.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Locate signs and accessories at Building Entrances, Room Entrances and where required by OSHA using mounting methods of type described and in compliance with manufacturer's instructions.
  1. Install signs level, plumb, and at height indicated or as required by the ADA, with sign surfaces free from distortion or other defects in appearance.

2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 in. of sign without encountering protruding objects or standing within swing of door.
  3. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
  4. Where panel signs are scheduled or indicated to be mounted on glass, provide matching plate on opposite side of glass to conceal mounting materials.
- B. Bracket Mounted Units: Provide manufacturer's standard brackets, fittings, and hardware as appropriate for mounting signs that project at right angles from walls and ceilings. Attach brackets and fittings securely to walls or ceilings with concealed fasteners and anchoring devices to comply with manufacturer's directions.

### 3.3 CLEANING AND PROTECTION

- A. After installation, clean soiled sign surfaces according to manufacturer's instructions. Protect signs from damage until acceptance by ENGINEER.

END OF SECTION

## SECTION 10 44 16

### FIRE EXTINGUISHERS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

##### 1.2 QUALITY ASSURANCE

- A. Provide portable fire extinguishers and accessories by one manufacturer.
- B. UL-Listed Products: Provide fire extinguishers that are UL-listed and bear UL "Listing Mark" for type, rating, and classification of extinguisher.

##### 1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of standard warranty.

##### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

##### 1.7 WARRANTY

- A. Standard Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
  - a. Failure of hydrostatic test according to NFPA 10.
  - b. Faulty operation of valves or release levers.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
  1. Provide fire extinguishers approved, listed, and labeled by FM Global.

### 2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Amerex Corporation.
    - b. Ansul Incorporated.
    - c. JL Industries, Inc.; a division of the Activar Construction Products Group.
    - d. Larsens Manufacturing Company.
    - e. Potter Roemer LLC.
  2. Valves: Manufacturer's standard.
  3. Handles and Levers: Manufacturer's standard.
  4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type: Dry-Chemical Type UL-rated 20-A:120-B:C, 20-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-aluminum container.

## 2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Amerex Corporation.
    - b. Ansul Incorporated.
    - c. JL Industries, Inc.; a division of the Activar Construction Products Group.
    - d. Larsens Manufacturing Company.
    - e. Potter Roemer LLC.
- B. Identification: Lettering complying with authorities having jurisdiction and as required by NFPA 10 Standard for Portable Fire Extinguishers for letter style, size, spacing, and location.
  - 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
  - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
  - 1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

3.3 SERVICE

- A. Determine the approximate completion date of the work and then inspect, charge, and tag the fire extinguishers at a date not more than 10 days before or not less than one day before actual completion date of the work.

END OF SECTION

## SECTION 22 05 48

### VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section includes the following:
  - 1. Isolation mounts.
  - 2. Spring isolators.
  - 3. Pipe riser resilient supports.
  - 4. Resilient pipe guides.

##### 1.2 SUBMITTALS

- A. Product Data: For the following:
  - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
- B. Coordination Drawings: Show coordination of seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
- C. Welding certificates.

##### 1.3 WARRANTY

- A. Provide manufacturer's standard 1-year warranty for materials and labor, commencing on date of substantial completion.

#### PART 2 PRODUCTS

##### 2.1 MANUFACTURERS

- A. Vibration Isolators
  - 1. Ace Mountings Co., Inc.
  - 2. Isolation Technology, Inc.
  - 3. Kinetics Noise Control.
  - 4. Mason Industries.
  - 5. Vibration Eliminator Co., Inc.
  - 6. Vibration Isolation.
  - 7. Vibration Mountings & Controls, Inc.

## 2.2 VIBRATION ISOLATORS

- A. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
  - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
  - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- B. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
  - 1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  - 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  - 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  - 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  - 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
  - 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- C. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
  - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
  - 2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
  - 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- D. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
  2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
  3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
  4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
  5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
  6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
  7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- E. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig (3.45 MPa) and for equal resistance in all directions.
- F. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

## 2.3 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

### 3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
  2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days' advance notice.
  3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.

4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
  5. Test to 90 percent of rated proof load of device.
  6. Measure isolator restraint clearance.
  7. Measure isolator deflection.
  8. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- C. Remove and replace malfunctioning units and retest as specified above.
- D. Prepare test and inspection reports.
- 3.4 CLEANING AND ADJUSTING
- A. Adjust isolators after piping system is at operating weight.
  - B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
  - C. Adjust active height of sprint isolators.
  - D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 22 05 53

### IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

#### PART 1 **GENERAL**

##### 1.1 SUMMARY

###### A. Section Includes:

1. Pipe labels.
2. Valve tags.

##### 1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

##### 1.3 DELIVERY, STORAGE AND HANDLING

- A. Store materials in a dry and secure area on-site and protect against dirt and moisture damage.
- B. Do not apply or install damaged materials.

#### PART 2 **PRODUCTS**

##### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following manufacturers:
  1. Brady Corporation.
  2. emedco.
  3. Kolbi Pipe Marker Co.
  4. LEM Products Inc.
  5. Marking Services Inc.
  6. Seton Identification Products.

## 2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

## 2.3 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  - 1. Tag Material: Brass, 0.032 inch thick, or stainless steel, 0.025 inch thick, with predrilled holes for attachment hardware.
  - 2. Fasteners: Brass beaded chain.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  - 1. Valve-tag schedule shall be included in operation and maintenance data.
  - 2. See sample valve-tag schedule at the end of Part 3.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

### 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

### 3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Painting"
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 25 feet along each run. Reduce intervals to 15 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

#### C. Pipe Label Color Schedule:

	<u>Background</u>	<u>Lettering</u>
1. Domestic Cold Water Piping:	Green	White
2. Domestic Hot Water and Hot Water Recirculation Piping:	Green	White
3. Sanitary Waste and Storm Drainage Piping:	Black	White
4. Non-Potable Water / Makeup Water Piping	Black	White
5. Rainwater Harvesting Piping	Gray	White
6. Storm water Piping	Gray	White

### 3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-

watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule. See sample valve-tag schedule at the end of Part 3.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

- a. Cold Water: 2 inches, round.
- b. Hot Water: 2 inches, round.

2. Valve-Tag Color:

- a. Cold Water: Natural.
- b. Hot Water: Natural.

3. Letter Color:

- a. Cold Water: Black.
- b. Hot Water: Black.

### 3.5 SAMPLE SCHEDULES

A. The following tables are examples of schedules required to be submitted by the Contractor. Example information has been included in the first row of the tables for reference only.

<b>VALVE-TAG SCHEDULE – DOMESTIC COLD WATER</b>					
<b>VALVE NUMBER</b>	<b>VALVE TYPE</b>	<b>VALVE SIZE</b>	<b>VALVE LOCATION</b>	<b>NORMAL OPERATING POSITION</b>	<b>REMARKS</b>
CWS-1	GATE	NPS 2	MECHANICAL ROOM M-1	OPEN	

END OF SECTION

## SECTION 22 07 00

### PLUMBING INSULATION

#### PART 1 GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Insulation Materials:
  - a. Flexible elastomeric.
  - b. Mineral fiber.
2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Factory-applied jackets.
6. Field-applied jackets.
7. Tapes.
8. Securements.

##### 1.2 DEFINITIONS

- A. Hot Surfaces: Normal operating temperatures of 100 deg F or higher.
- B. Dual-Temperature Surfaces: Normal operating temperatures that vary from hot to cold.
- C. Cold Surfaces: Normal operating temperatures less than 75 deg F.
- D. Thermal Resistivity: "r-values" represent the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogeneous material exactly 1 inch thick. Thermal resistivity's are expressed by the temperature difference in degrees F between two exposed faces required to cause one Btu to flow through one square foot of material, in one hour, at a given mean temperature.
- E. Density: Is expressed in lb/cu.ft.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, Thermal resistance (R Value), thickness, and jackets (both factory and field applied, if any).

- B. Shop Drawings:
1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  2. Detail attachment and covering of heat tracing inside insulation.
  3. Detail insulation application at pipe expansion joints for each type of insulation.
  4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  5. Detail removable insulation at piping specialties, equipment connections, and access panels.
  6. Detail application of field-applied jackets.
  7. Detail application at linkages of control devices.
  8. Detail field application for each equipment type.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
1. Sample Sizes:
    - a. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
    - b. Sheet Form Insulation Materials: 12 inches square.
    - c. Jacket Materials for Pipe: 12 inches long by NPS 2.
    - d. Sheet Jacket Materials: 12 inches square.
    - e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.
- D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes,

and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

#### 1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

#### 1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

#### 1.8 WARRANTY

- A. Provide warranty on materials and labor for 18 months starting from date of delivery, or one year from date of substantial completion, whichever is longer.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following manufacturers:
  1. Flexible Elastomeric Insulation:
    - a. Aeroflex USA Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180

2. Mineral Fiber Blanket Insulation:
  - a. CertainTeed Corp.; Duct Wrap.
  - b. Johns Manville; Microlite.
  - c. Knauf Insulation; Duct Wrap.
  - d. Owens Corning; All-Service Duct Wrap
  
3. Mineral-Fiber, Preformed Pipe Insulation:
  - a. Johns Manville; Micro-Lok.
  - b. Knauf Insulation; 1000(Pipe Insulation.
  - c. Owens Corning; Fiberglas Pipe Insulation.
  
4. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
  - a. Insulco, Division of MFS, Inc.; Triple I.
  - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
  
5. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
  - a. P. K. Insulation Mfg. Co., Inc.; Thermal-V-Kote.
  
6. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement:
  - a. Insulco, Division of MFS, Inc.; SmoothKote.
  - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
  - c. Rock Wool Manufacturing Company; Delta One Shot.
  
7. Flexible Elastomeric and Polyolefin Adhesive:
  - a. Aeroflex USA Inc.; Aero seal.
  - b. Armacell LCC; 520 Adhesive.
  - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
  - d. RBX Corporation; Rubatex Contact Adhesive.
  
8. Mineral-Fiber Adhesive:
  - a. Childers Products, Division of ITW; CP-82.
  - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
  - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
  
9. Mineral-Fiber, Pipe and Tank Insulation:
  - a. CertainTeed Corp.; CrimpWrap.
  - b. Johns Manville; MicroFlex.
  - c. Knauf Insulation; Pipe and Tank Insulation.
  - d. Owens Corning; Fiberglas Pipe and Tank Insulation.

10. Mineral-Fiber Insulating Cement:
  - a. Insulco, Division of MFS, Inc.; Triple I.
  - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
11. Expanded or Exfoliated Vermiculite Insulating Cement:
  - a. P. K. Insulation Mfg. Co., Inc.; Thermal-V-Kote.
12. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement:
  - a. Insulco, Division of MFS, Inc.; SmoothKote.
  - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
  - c. Rock Wool Manufacturing Company; Delta One Shot.
13. Flexible Elastomeric and Polyolefin Adhesive:
  - a. Aeroflex USA Inc.; Aero seal.
  - b. Armacell LCC; 520 Adhesive.
  - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
  - d. RBX Corporation; Rubatex Contact Adhesive.
14. Mineral-Fiber Adhesive:
  - a. Childers Products, Division of ITW; CP-82.
  - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
  - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
  - d. Marathon Industries, Inc.; 225.
15. PVC Jacket Adhesive:
  - a. Dow Chemical Company (The); 739, Dow Silicone.
  - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
  - c. P.I.C. Plastics, Inc.; Welding Adhesive.
  - d. Red Devil, Inc.; Celulon Ultra Clear.
16. Vapor-Barrier Mastic:
  - a. Childers Products, Division of ITW; CP-35.
  - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
  - c. Marathon Industries, Inc.; 590.
  - d. Vimasco Corporation; 749.
17. Breather Mastic:
  - a. Childers Products, Division of ITW; CP-10.
  - b. Foster Products Corporation, H. B. Fuller Company; 35-00.

- c. Marathon Industries, Inc.; 550.
  - d. Vimasco Corporation; WC-1/WC-5.
18. PVDC Jacket for Indoor Applications:
- a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
19. PVDC-SSL Jacket:
- a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
20. PVC Jacket:
- a. Johns Manville; Zeston.
  - b. P.I.C. Plastics, Inc.; FG Series.
  - c. Proto PVC Corporation; LoSmoke.
  - d. Speedline Corporation; SmokeSafe.
21. Metal Jacket:
- a. Childers Products, Division of ITW; Metal Jacketing Systems.
  - b. PABCO Metals Corporation; Surefit.
  - c. RPR Products, Inc.; Insul-Mate.
22. ASJ Tape:
- a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
  - b. Compac Corp.; 104 and 105.
  - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
  - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
23. PVC Tape:
- a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
  - b. Compac Corp.; 130.
  - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
  - d. Venture Tape; 1506 CW NS.
24. Bands:
- a. Childers Products; Bands.
  - b. PABCO Metals Corporation; Bands.
  - c. RPR Products, Inc.; Bands.
25. Capacitor-Discharge-Weld Pins:
- a. AGM Industries, Inc.; CWP-1.
  - b. GEMCO; CD.

- c. Midwest Fasteners, Inc.; CD.
  - d. Nelson Stud Welding; TPA, TPC, and TPS.
26. Cupped-Head, Capacitor-Discharge-Weld Pins:
- a. AGM Industries, Inc.; CWP-1.
  - b. GEMCO; Cupped Head Weld Pin.
  - c. Midwest Fasteners, Inc.; Cupped Head.
  - d. Nelson Stud Welding; CHP.
27. Metal, Adhesively Attached, Perforated-Base Insulation Hangers:
- a. AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
  - b. GEMCO; Perforated Base.
  - c. Midwest Fasteners, Inc.; Spindle.
28. Insulation-Retaining Washers:
- a. AGM Industries, Inc.; RC-150.
  - b. GEMCO; R-150.
  - c. Midwest Fasteners, Inc.; WA-150.
  - d. Nelson Stud Welding; Speed Clips.
29. Wire:
- a. C & F Wire.
  - b. Childers Products.
  - c. PABCO Metals Corporation.
  - d. RPR Products, Inc.

## 2.2 INSULATION MATERIALS

- A. Comply with requirements in PART 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- H. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

### 2.3 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

### 2.4 ADHESIVES

- A. All Adhesives & Sealants (LEED EQ 4): All adhesive and sealants installed in the building interior shall meet the testing and product requirements of the California Department of Health Services Standard for the Testing of Volatile Organic Emissions From Various Sources Using Small Scale Environmental Chambers, including 2004 addenda.
- B. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
- F. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

### 2.5 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
  2. Service Temperature Range: Minus 20 to plus 180 deg F.
  3. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
  4. Color: White.
  5. All Adhesives & Sealants (LEED EQ 4): All adhesive and sealants installed in the building interior shall meet the testing and product requirements of the California Department of Health Services Standard for the Testing of Volatile Organic Emissions From Various Sources Using Small Scale Environmental Chambers, including 2004 addenda.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
  2. Service Temperature Range: Minus 20 to plus 200 deg F.
  3. Solids Content: 63 percent by volume and 73 percent by weight.
  4. Color: White.
  5. All Adhesives & Sealants (LEED EQ 4): All adhesive and sealants installed in the building interior shall meet the testing and product requirements of of the California Department of Health Services Standard for the Testing of Volatile Organic Emissions From Various Sources Using Small Scale Environmental Chambers, including 2004 addenda.

## 2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

4. PVDC Jacket for Indoor Applications: 4-mil thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
5. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

## 2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  1. Adhesive: As recommended by jacket material manufacturer.
  2. All Adhesives & Sealants (LEED EQ 4): All adhesive and sealants installed in the building interior shall meet the testing and product requirements of the California Department of Health Services Standard for the Testing of Volatile Organic Emissions From Various Sources Using Small Scale Environmental Chambers, including 2004 addenda.
  3. Color: Color-code jackets based on system.
  4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
  5. Factory-fabricated tank heads and tank side panels.
- C. Metal Jacket:
  1. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
    - a. Sheet and roll stock ready for shop or field sizing.
    - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
    - c. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      - 3) Tee covers.

- 4) Flange and union covers.
- 5) End caps.
- 6) Beveled collars.
- 7) Valve covers.
- 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

## 2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  1. Width: 3 inches.
  2. Thickness: 11.5 mils.
  3. Adhesion: 90 ounces force/inch in width. All Adhesives & Sealants (LEED EQ 4): All adhesive and sealants installed in the building interior shall meet the testing and product requirements of of the California Department of Health Services Standard for the Testing of Volatile Organic Emissions From Various Sources Using Small Scale Environmental Chambers, including 2004 addenda.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
  
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
  1. Width: 2 inches.
  2. Thickness: 6 mils.
  3. Adhesion: 64 ounces force/inch in width. All Adhesives & Sealants (LEED EQ 4): All adhesive and sealants installed in the building interior shall meet the testing and product requirements of of the California Department of Health Services Standard for the Testing of Volatile Organic Emissions From Various Sources Using Small Scale Environmental Chambers, including 2004 addenda.
  4. Elongation: 500 percent.
  5. Tensile Strength: 18 lbf/inch in width.

## 2.9 SECUREMENTS

### A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch thick, 3/4 inch wide with wing seal.
2. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch wide with wing seal.

### B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch diameter shank, length to suit depth of insulation indicated.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - b. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch diameter shank, length to suit depth of insulation indicated.
4. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates. All Adhesives & Sealants (LEED EQ 4): All adhesive and sealants installed in the building interior shall meet the testing and product requirements of of the California Department of Health Services Standard for the Testing of Volatile Organic Emissions From Various Sources Using Small Scale Environmental Chambers, including 2004 addenda.
5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
  - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

- ### C. Wire: 0.080-inch nickel-copper alloy 0.062-inch soft-annealed, stainless steel 0.062-inch soft-annealed, galvanized steel.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
  - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
  - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.

- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- O. For above ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Manholes.
  - 5. Handholes.
  - 6. Cleanouts.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

### 3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
  2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
  3. Protect exposed corners with secured corner angles.
  4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
    - a. Do not weld anchor pins to ASME-labeled pressure vessels.
    - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    - d. Do not overcompress insulation during installation.
    - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    - f. Impale insulation over anchor pins and attach speed washers.
    - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
  6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
  7. Stagger joints between insulation layers at least 3 inches.

8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from galvanized steel, at least 0.050 inch thick.
3. For below ambient services and or not conditioned spaces, use stainless steel and install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

### 3.6 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made
3. from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
4. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

5. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  6. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
  7. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  8. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  9. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  10. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness

over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.7 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
  1. Install mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
  2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
  3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  4. Install insulation to flanges as specified for flange insulation application.

### 3.9 FIELD-APPLIED JACKET INSTALLATION

- A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
2. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.10 FINISHES

- A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 Section "Painting".
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

- D. Do not field paint aluminum or stainless-steel jackets.
- E. Domestic water storage tank insulation shall be the following:
  - 1. Mineral-Fiber Pipe and Tank: 1 inch thick.

3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawl spaces.
  - 2. Underground piping.

3.12 PIPING INSULATION SCHEDULE

- A. General: Abbreviations used in the following schedules include:
  - 1. Field-Applied Jackets: P - PVC, K - Foil and Paper, A - Aluminum, SS - Stainless Steel.
- B. Interior Domestic Hot Water and Recirculated Hot Water:

PIPE SIZES (NPS)	MATERIALS	THERMAL CONDUCTIVITY, K FOR LISTED K	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD-APPLIED JACKET
ALL SIZES	GLASS FIBER	.28	1	NO	(P)
	FLEXIBLE ELASTOMERIC	.26	1	NO	NONE, (P in exposed locations)

NOTE: Increase insulation thickness 1/2" for pipes > 1-1/2" in systems operating between 140 deg F and 169 deg F. Increase insulation thickness 1/2" for 1-1/2" and 2" pipes operating between 170 deg F and 180 deg F. Increase insulation thickness 1" for pipes > 2" operating between 170 deg F and 180 deg F.

- C. Interior Domestic Cold Water, condensate drains and Storm Drainage:

PIPE SIZES (NPS)	MATERIALS	THERMAL CONDUCTIVITY, K FOR LISTED K	THICKNESS IN INCHES	VAPOR BARRIER REQ'D	FIELD-APPLIED JACKET
1/2 TO <1-1/2	GLASS FIBER	.28	1/2	Yes Factory Installed	(P)
	FLEXIBLE ELASTOMERIC	.26	1/2	NO	NONE, (P in exposed locations)

<b>PIPE SIZES (NPS)</b>	<b>MATERIALS</b>	<b>THERMAL CONDUCTIVITY, K FOR LISTED K</b>	<b>THICKNESS IN INCHES</b>	<b>VAPOR BARRIER REQ'D</b>	<b>FIELD-APPLIED JACKET</b>
1-1/2 TO <4	GLASS FIBER	.28	1	Yes Factory Installed	(P)
	FLEXIBLE ELASTOMERIC	.26	1	NO	NONE, (P in exposed locations)

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material for all pipes located below 8 feet from the floor. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is owner/architect's option.
- C. Piping, Exposed:
  - 1. PVC, Color-Coded by System: 30 mils thick.

END OF SECTION

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## SECTION 22 11 16

### DOMESTIC WATER PIPING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section includes domestic water piping inside the building.

##### 1.2 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Water Samples: Specified in PART 3 "Cleaning" Article.
- C. Field quality-control test reports.

##### 1.3 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

##### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt..

##### 1.5 WARRANTY

- A. Provide manufacturer's standard 1-year warranty for materials and labor, commencing on date of substantial completion.

##### 1.6 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing domestic water piping systems with 125 psig (860 kPa), unless otherwise indicated.

## PART 2 PRODUCTS

### 2.1 PIPING MATERIALS

- A. Refer to PART 3 "Pipe and Fitting Applications" Article for applications of pipe, tube, fitting, and joining materials.
- B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

### 2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A, Schedule 40, galvanized. Include ends matching joining method.
  - 1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
  - 2. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body, with ball-and-socket, metal-to-metal, bronze seating surface and female threaded ends.
  - 3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
  - 4. Cast-Iron Flanges: ASME B16.1, Class 125.
  - 5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.
  - 6. Steel-Piping, Expansion Joints: Compound, galvanized steel fitting with telescoping body and slip-pipe section. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.

### 2.3 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Types K and L (ASTM B 88M, Types A and B), water tube, annealed temper.
  - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
  - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

- B. Hard Copper Tube: ASTM B 88, Types K and L (ASTM B 88M), water tube, drawn temper.
  - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought- copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
  - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- C. Ductile-Iron Pipe: AWWA C151, 250-psig minimum pressure rating with mechanical-joint bell, plain spigot end, and AWWA C104 cement-mortar lining.
  - 1. Include AWWA C111 ductile-iron gland, rubber gasket, and steel bolts with mechanical-joint pipe.
  - 2. Ductile-Iron, Flexible Expansion Joints: Compound fitting with combination of flanged and mechanical-joint ends conforming to AWWA C110 or AWWA C153. Include 2 gasketed ball-joint sections, 1 or more gasketed sleeve sections, 250-psig minimum working-pressure rating, and AWWA C550 epoxy interior coating. Assemble components for offset and expansion indicated. Include AWWA C111 ductile-iron glands, rubber gaskets, and steel bolts.

## 2.4 VALVES

- A. Bronze and cast-iron, general-duty valves are specified in Division 23 Section "Valves."
- B. Balancing and drain valves are specified in Division 23 Section "Domestic Water Piping Specialties."

## PART 3 EXECUTION

### 3.1 PIPE AND FITTING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, unless otherwise indicated.
- C. Domestic Water Piping on Service Side of Water Meter inside the Building: Use the following piping materials for each size range:
  - 1. NPS 4 and smaller (DN 100 to DN 150): Hard copper tube, Type K; copper pressure fittings; and soldered joints.

2. NPS 4 and larger (DN 100 to DN 150): Steel pipe; gray-iron, threaded fittings; and threaded joints.
- D. Aboveground Domestic Water Piping: Use the following piping materials for each size range:
1. NPS 4 and smaller (DN 75 and smaller): Hard copper tube, Type L, copper pressure fittings; and soldered joints.
  2. NPS 4 to NPS 6 (DN 100 to DN 150): Galvanize pipe; flagged joints and flagged fittings.
  3. NPS 8 (DN 200): Ductile iron pipe, mechanical joints.
- E. Non-Potable-Water Piping: Use the following piping materials for each size range:
1. NPS 3 and smaller (DN 75 and smaller): Steel pipe; gray-iron, threaded fittings; and threaded joints.
- 3.2 VALVE APPLICATIONS
- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use bronze ball valves for piping NPS 2-1/2 (DN 65) and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 3 (DN 75) and larger.
  2. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
  3. Hot-Water-Piping, Balancing Duty: Calibrated balancing valves.
  4. Drain Duty: Hose-end drain valves.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping NPS 2-1/2 (DN 65) and smaller. Use butterfly or gate valves for piping NPS 3 (DN 75) and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
1. Install hose-end drain valves at low points in water mains, risers, and branches.
  2. Install stop-and-waste drain valves where indicated.

- D. Install calibrated balancing valves in each hot-water circulation return branch, in the hot water return main where branches join together and on discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Calibrated balancing valves are specified in Division 23 Section "Domestic Water Piping Specialties."
- 3.3 PIPING INSTALLATION
- A. Basic piping installation requirements are specified in Division 23 Section "Basic HVAC Materials and Methods."
  - B. Install under-building-slab copper tubing according to CDA's "Copper Tube Handbook."
  - C. Install domestic water piping level without pitch and plumb.
  - D. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- 3.4 JOINT CONSTRUCTION
- A. Basic piping joint construction requirements are specified in Division 23 Section "Basic HVAC Materials and Methods."
  - B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
  - C. Grooved Joints: NOT ALLOWED
- 3.5 HANGER AND SUPPORT INSTALLATION
- A. Pipe hanger and support devices are specified in Division 23 Section "Hangers and Supports for Piping and Equipment." Install the following:
    - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
    - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
      - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
      - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
      - c. Longer Than 100 Feet (30 m): MSS Type 49, spring cushion rolls, if indicated.
    - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
    - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
  - B. Install supports according to Division 23 Section "Hangers and Supports for Piping and Equipment."

- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch (10 mm).
- E. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
  1. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
  2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
  3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
  4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
  5. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
  6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
- F. Install supports for vertical steel piping every 15 feet (4.5 m).
- G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
  2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
  3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
  4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
  5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
- H. Install supports for vertical copper tubing every 10 feet (3 m).

### 3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.

- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve, and extend and connect to the following:
  - 1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 23 Section "Plumbing Fixtures."
  - 2. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

### 3.7 FIELD QUALITY CONTROL

- A. Inspect domestic water piping as follows:
  - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
  - 2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
    - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
  - 3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
  - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test domestic water piping as follows:
  - 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
  - 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

### 3.8 CLEANING AND ADJUSTING

- A. Clean and disinfect potable and non-potable domestic water piping as follows:
  1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
  2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
      - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
    - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
- D. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
  - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
  - b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.9 CONTRACTOR STARTUP AND REPORTING

- A. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
- B. Perform the following steps before putting into operation:
  1. Close drain valves, hydrants, and hose bibbs.
  2. Open shutoff valves to fully open position.
  3. Open throttling valves to proper setting.
  4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
  5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
  6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and that cartridges are clean and ready for use

- C. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.
- D. Check plumbing specialties and verify proper settings, adjustments, and operation.

END OF SECTION

## SECTION 22 13 16

### SANITARY WASTE AND VENT PIPING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section includes the following for soil, waste, and vent piping inside the building:
  - 1. Pipe, tube, and fittings.
  - 2. Special pipe fittings.
  - 3. Encasement for underground metal piping.

##### 1.2 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

##### 1.3 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Shop Drawings:
- C. Field quality-control inspection and test reports.

##### 1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

#### PART 2 PRODUCTS

##### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
  - 1. Flexible, Nonpressure Pipe Couplings:
    - a. Fernco, Inc.
    - b. Logan Clay Products Company (The).
    - c. Mission Rubber Co.
    - d. NDS, Inc.

2. Shielded Nonpressure Pipe Couplings:
  - a. Cascade Waterworks Mfg. Co.
  - b. Mission Rubber Co.
3. Rigid, Unshielded, Nonpressure Pipe Couplings:
  - a. ANACO.
4. Pressure Pipe Couplings:
  - a. Cascade Waterworks Mfg. Co.
  - b. Dresser, Inc.; DMD Div.
  - c. EBAA Iron Sales, Inc.
  - d. JCM Industries, Inc.
  - e. Romac Industries, Inc.
5. Expansion Joints:
  - a. EBAA Iron Sales, Inc.
  - b. Romac Industries, Inc.
  - c. Star Pipe Products; Star Fittings Div.
6. Wall-Penetration Fittings:
  - a. SIGMA Corp.

## 2.2 PIPING MATERIALS

- A. Refer to PART 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

## 2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy class(es).
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

## 2.4 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.
- B. Drainage Fittings: ASME B16.12, galvanized, threaded, cast-iron drainage pattern.

C. Pressure Fittings:

1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
4. Cast-Iron Flanges: ASME B16.1, Class 125.
5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.

2.5 DUCTILE-IRON PIPE AND FITTINGS

A. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

B. Flanges: ASME 16.1, Class 125, cast iron.

2.6 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
2. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
3. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
4. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

- B. Soft Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, annealed temper.
  - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

## 2.7 SPECIAL PIPE FITTINGS

- A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - 1. Sleeve Materials:
    - a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
    - b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
    - c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
  - 1. Center-Sleeve Material: Stainless steel.
  - 2. Gasket Material: Natural or synthetic rubber.
  - 3. Metal Component Finish: Corrosion-resistant coating or material.
- D. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
- E. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

## 2.8 ENCASUREMENT FOR UNDERGROUND METAL PIPING

- A. Description: ASTM A 674 or AWWA C105, high-density, crosslaminated PE film of 0.004-inch (0.10-mm) minimum thickness.
- B. Form: Sheet or tube.
- C. Color: Black or natural.

## PART 3 EXECUTION

### 3.1 EXCAVATION

- A. Refer to Division 31 Section "Earthwork" for excavating, trenching, and backfilling.

### 3.2 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 3 (DN 75) and smaller shall be any of the following:
  - 1. Service class, cast-iron soil pipe and fittings; lead and oakum joints.
  - 2. Steel pipe, drainage fittings, and threaded joints.
  - 3. Stainless-steel pipe and fittings, gaskets, and gasketed joints.
  - 4. Copper tube, copper drainage fittings, and soldered joints.
  - 5. Dissimilar Pipe-Material Couplings: Rigid, unshielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- C. Aboveground, soil and waste piping NPS 4 (DN 100) and larger shall be the following:
  - 1. Service class, cast-iron soil pipe and fittings; lead and oakum joints.
- D. Aboveground, vent piping NPS 3 (DN 75) and smaller shall be any of the following:
  - 1. Service class, cast-iron soil pipe and fittings; lead and oakum joints.
  - 2. Stainless-steel pipe and fittings gaskets, and gasketed joints.
  - 3. Copper tube, copper drainage fittings, and soldered joints.
  - 4. Dissimilar Pipe-Material Couplings: Rigid, unshielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

- E. Aboveground, vent piping NPS 4 (DN 100) and larger shall be the following:
  - 1. Service class, cast-iron soil pipe and fittings; lead and oakum joints.
- F. Underground, soil, waste, and vent piping NPS 4 (DN 100) and larger shall be the following:
  - 1. Service Class Extra-Heavy (where required to connect to existing), cast-iron soil piping; gaskets; and gasketed joints.
- G. Aboveground sanitary-sewage force mains NPS 1-1/2 to NPS 3 (DN 40 and DN 75) shall be any of the following:
  - 1. Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.
  - 2. Steel pipe, pressure fittings, and threaded joints.
- H. Underground sanitary-sewage force mains NPS 4 (DN 100) and smaller shall be any of the following:
  - 1. Soft copper tube, Type L (Type B); wrought-copper pressure fittings; and soldered joints.
  - 2. Steel pipe, pressure fittings, and threaded joints.
  - 3. Push-on-joint, ductile-iron pipe; push-on-joint ductile-iron fittings; gaskets; and gasketed joints.
  - 4. Pressure pipe couplings, if dissimilar pipe materials or piping with small difference in OD must be joined.

### 3.3 PIPING INSTALLATION

- A. Sanitary sewer piping outside the building is specified in Division 22 Section "Facility Storm Drains."
- B. Basic piping installation requirements are specified in Division 23 Section "Basic HVAC Materials and Methods."
- C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- D. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

- E. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside the building between wall and floor penetrations and connection to sanitary sewer piping outside the building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
  - 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- F. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
  - 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- G. Install underground, ductile-iron, special pipe fittings according to AWWA C600.
  - 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- H. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 23 Section "Basic HVAC Materials and Methods."
- I. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
  - 2. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
  - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.

- 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- M. Install engineered soil and waste drainage and vent piping systems as follows:
- 3. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
- N. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- 3.4 JOINT CONSTRUCTION
- A. Basic piping joint construction requirements are specified in Division 23 Section "Basic HVAC Materials and Methods."
  - B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
  - C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
  - D. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- 3.5 VALVE INSTALLATION
- A. General valve installation requirements are specified in Division 23 Section "Valves."
  - B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
    - 1. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
    - 2. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.
  - C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
  - D. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
    - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.

2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Backwater valve are specified in Division 23 Section "Domestic Water Piping Specialties."

### 3.6 HANGER AND SUPPORT INSTALLATION

1. Pipe hangers and supports are specified in Division 23 Section "Hangers and Supports for Piping and Equipment." Install the following:
    - a. Vertical Piping: MSS Type 8 or Type 42, clamps.
  2. Install individual, straight, horizontal piping runs according to the following:
    - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.
  3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 23 Section "Hangers and Supports for Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
  2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
  3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
  4. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
  5. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.

- F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
  - 2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
  - 3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
  - 4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
  - 5. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
  - 6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
  - 7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
  - 8. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
- H. Install supports for vertical steel piping every 15 feet (4.5 m).
- I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 2 (DN 50): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
  - 2. NPS 3 (DN 80): 96 inches (2400 mm) with 1/2-inch (13-mm) rod.
  - 3. NPS 4 (DN 100): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
  - 4. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
- J. Install supports for vertical stainless-steel piping every 10 feet (3 m).
- K. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
  - 2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
  - 3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
  - 4. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.

- 5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
  - 6. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
  - L. Install supports for vertical copper tubing every 10 feet (3 m).
- 3.7 CONNECTIONS
- A. Drawings indicate general arrangement of piping, fittings, and specialties.
  - B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
  - C. Connect drainage and vent piping to the following:
    - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
    - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
    - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
    - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.
  - D. Connect force-main piping to the following:
    - 1. Sanitary Sewer: To exterior force main or sanitary manhole.

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
  - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
  - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 6. Prepare reports for tests and required corrective action.

### 3.9 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
  - 1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).
  - 2. Sanitary Sewer, Force-Main Piping: 100 psig (690 kPa).

### 3.10 CLEANING AND ADJUSTING

- A. Clean interior of piping. Remove dirt and debris as work progresses.

- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

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## SECTION 22 14 13

### STORM DRAINAGE PIPING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section includes the following storm drainage piping inside the building:
  - 1. Pipe, tube, and fittings for drainage and drain tile.
  - 2. Special pipe fittings.
  - 3. Encasement for underground metal piping.

##### 1.2 DEFINITIONS

- A. PVC: Polyvinyl chloride plastic.
- B. TPE: Thermoplastic elastomer.

##### 1.3 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Shop Drawings:
- C. Field quality-control inspection and test reports.

##### 1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

#### PART 2 PRODUCTS

##### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
  - 1. Flexible, Nonpressure Pipe Couplings:
    - a. Fernco, Inc.
    - b. Logan Clay Products Company (The).

- c. Mission Rubber Co.
  - d. NDS, Inc.
- 2. Shielded Nonpressure Pipe Couplings:
  - a. Cascade Waterworks Mfg. Co.
  - b. Mission Rubber Co.
- 3. Rigid, Unshielded, Nonpressure Pipe Couplings:
  - a. ANACO.
- 4. Pressure Pipe Couplings:
  - a. Cascade Waterworks Mfg. Co.
  - b. Dresser, Inc.; DMD Div.
  - c. EBAA Iron Sales, Inc.
  - d. JCM Industries, Inc.
  - e. Romac Industries, Inc.
- 5. Expansion Joints:
  - a. EBAA Iron Sales, Inc.
  - b. Romac Industries, Inc.
  - c. Star Pipe Products; Star Fittings Div.
- 6. Wall-Penetration Fittings:
  - a. SIGMA Corp.

## 2.2 PIPING MATERIALS

- A. Refer to PART 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

## 2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy class(es).
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

## 2.4 DUCTILE-IRON PIPE AND FITTINGS

- A. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
  2. Gaskets: AWWA C111, rubber.
- B. Flanges: ASME 16.1, Class 125, cast iron.
- 2.5 COPPER TUBE AND FITTINGS
- A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, drawn temper.
1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
  2. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  3. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
  4. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- B. Soft Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, annealed temper.
1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
- 2.6 SPECIAL PIPE FITTINGS
- A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
1. Sleeve Materials:
    - a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
    - b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
    - c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

- C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
- D. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
  - 1. Center-Sleeve Material: Stainless steel.
  - 2. Gasket Material: Natural or synthetic rubber.
  - 3. Metal Component Finish: Corrosion-resistant coating or material.
- E. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
- F. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

## PART 3 EXECUTION

### 3.1 EXCAVATION

- A. Refer to Division 31 Section "Earthwork" for excavating, trenching, and backfilling.

### 3.2 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground storm drainage piping NPS 6 (DN 150) and smaller shall be any of the following:
  - 1. Service class, cast-iron soil pipe and fittings; and lead and oakum joints.
  - 2. Steel pipe, drainage fittings, and threaded joints.
  - 3. Copper tube, copper drainage fittings, and soldered joints.
  - 4. Dissimilar Pipe-Material Couplings: Rigid, unshielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

- C. Aboveground, storm drainage piping NPS 8 (DN 200) and larger shall be the following:
  - 1. Service class, cast-iron soil pipe and fittings; and lead and oakum joints.
- D. Underground storm drainage piping NPS 6 (DN 150) and smaller shall be the following:
  - 1. Extra-heavy (where require to match existing) Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
- E. Underground, storm drainage piping NPS 8 (DN 200) and larger shall be any of the following:
  - 1. Extra-Heavy (where require to match existing) Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

### 3.3 PIPING INSTALLATION

- A. Storm sewer and drainage piping outside the building are specified in Division 23 Section "Facility Storm Drainage Piping."
- B. Basic piping installation requirements are specified in Division 23 Section "Basic HVAC Materials and Methods."
- C. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 23 Section "Drainage Piping Specialties."
- D. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.
- E. Install underground, steel, force-main piping. Install encasement on piping according to ASTM A 674 or AWWA C105.
- F. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to storm sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
  - 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- G. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
  - 1. Install encasement on piping according to ASTM A 674 or AWWA C105.

- H. Install underground, ductile-iron, special pipe fittings according to AWWA C600.
    - 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
  - I. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 23 Section "Basic HVAC Materials and Methods."
  - J. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
    - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105 where indicated on drawings.
  - K. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
  - L. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
  - M. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
    - 1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
    - 2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.
  - N. Install engineered controlled-flow storm drainage piping in locations indicated.
  - O. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
  - P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- 3.4 JOINT CONSTRUCTION
- A. Basic piping joint construction requirements are specified in Division 23 Section "Basic HVAC Materials and Methods."

- B. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Hub-and-Spigot, Cast-Iron Soil Piping Calked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- D. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

### 3.5 DRAINTILE INSTALLATION

- A. General installation procedure as follows:
  1. Excavation.
  2. Placement of fabric.
  3. Placement of filtering fill/gravel.
  4. Placement of piping.
  5. Placement of filtering fill/gravel.
  6. Complete fabric installation and overlap.
  7. Integration of foundation wall drainage mats to foundation drainage system as instructed by manufacturers.
  8. Complete backfill procedure.
- B. Impervious Fill at Footings: Place impervious fill material on subgrade adjacent to bottom of footing after concrete footings have been cured and forms removed. Place and compact impervious fill to dimensions indicated but not less than 6 inches deep and 12 inches wide.
- C. Filtering Material: Place supporting layer of filtering material over compacted subgrade where drainage pipes is to be laid to depth indicated or, if not indicated, to compacted depth of not less than 6 inches.
- D. Drainage Fill: Place fill over drain piping after satisfactory testing and covering with filtering material. Cover piping to width of at least 6 inches on each side and above top of pipe to within 12 inches of finish grade. Place fill material in layers not exceeding 3 inches in loose depth, and compact each layer placed.
- E. Fill to Grade: Place impervious fill material over compacted drainage fill. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Fill to finish elevations and slope away from building.

### 3.6 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 23 Section "Valves."
- B. Shutoff Valves: Install shutoff valve on each sump pump discharge.
  - 1. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
  - 2. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sump pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
  - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
  - 2. Install backwater valves in accessible locations.
  - 3. Backwater valve are specified in Division 23 Section "Drainage Piping Specialties."

### 3.7 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 23 Section "Hangers and Supports for Piping and Equipment." Install the following:
  - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
    - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.
  - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 23 Section "Hangers and Supports for Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
    - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
    - 2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
    - 3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
    - 4. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
    - 5. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
    - 6. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).
  - F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
  - G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
    - 1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
    - 2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
    - 3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
    - 4. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
    - 5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
    - 6. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.
  - H. Install supports for vertical copper tubing every 10 feet (3 m).
  - I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.
- 3.8 CONNECTIONS
- A. Drawings indicate general arrangement of piping, fittings, and specialties.
  - B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

- C. Connect storm drainage piping to roof drains and storm drainage specialties.
- D. Connect force-main piping to the following:

- 1. Storm Sewer: To exterior force main or storm manhole.

### 3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - 3. Test Procedure: Test storm drainage piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
  - 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  - 5. Prepare reports for tests and required corrective action.

### 3.10 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water (30 kPa).
2. Storm Drainage, Force-Main Piping: 100 psig (690 kPa).

### 3.11 CLEANING AND ADJUSTING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

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## SECTION 22 14 23

### DRAINAGE PIPING SPECIALTIES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section includes the following drainage piping specialties:
  - 1. Backwater valves.
  - 2. Cleanouts.
  - 3. Floor drains.
  - 4. Roof flashing assemblies.
  - 5. Through-penetration firestop assemblies.
  - 6. Roof drains.
  - 7. Miscellaneous drainage piping specialties.
  - 8. Flashing materials.
  - 9. Oil interceptors.

##### 1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FOG: Fats, oils, and greases.
- C. FRP: Fiberglass-reinforced plastic.
- D. HDPE: High-density polyethylene plastic.
- E. PE: Polyethylene plastic.
- F. PP: Polypropylene plastic.
- G. PUR: Polyurethane plastic.
- H. PVC: Polyvinyl chloride plastic.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
  - 1. Oil interceptors.

- B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary and storm piping specialty components.

#### 1.5 DELIVERY, STORAGE AND HANDLING.

- A. Deliver specialties in factory-provided packaging. Maintain packaging through shipping, storage, and handling to prevent damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored specialties from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

#### 1.6 WARRANTY

- A. Provide manufacturer's standard 1-year warranty for materials and labor, commencing on date of substantial completion.

#### 1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.
- B. Coordinate size and location of roof penetrations.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
1. Exposed Metal Cleanouts
    - a. Josam Company; Josam Div.
    - b. MIFAB, Inc.
    - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - d. Tyler Pipe; Wade Div.
    - e. Zurn Plumbing Products Group; Specification Drainage Operation.
  2. Cast Iron Cleanouts
    - a. Josam Company; Josam Div.
    - b. MIFAB, Inc.
    - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - d. Tyler Pipe; Wade Div.
    - e. Zurn Plumbing Products Group; Specification Drainage Operation.
  3. Cast-Iron Wall Cleanouts
    - a. Josam Company; Josam Div.
    - b. MIFAB, Inc.
    - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - d. Tyler Pipe; Wade Div.
    - e. Zurn Plumbing Products Group; Specification Drainage Operation.
  4. Cast-Iron Floor Drains
    - a. Josam Company; Josam Div.
    - b. MIFAB, Inc.
    - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - d. Tyler Pipe; Wade Div.
    - e. Zurn Plumbing Products Group; Specification Drainage Operation.
  5. Through-Penetration Firestop Assemblies
    - a. ProSet Systems Inc.
    - b. B-Line.
  6. Roof Drains
    - a. Cast-Iron
      - 1) Josam Company; Josam Div.

- 2) MIFAB, Inc.
- 3) Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
- 4) Tyler Pipe; Wade Div.
- 5) Zurn Plumbing Products Group; Specification Drainage Operation.

7. Oil Interceptors

- a. Josam Company; Josam Div.
- b. Rockford Sanitary Systems, Inc.
- c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
- d. Tyler Pipe; Wade Div.
- e. Zurn Plumbing Products Group; Specification Drainage Operation.

## 2.2 STANDARD CLEANOUTS

### A. Exposed Metal Cleanouts CO:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed in paragraph 2.1.
2. Standard: ASME A112.36.2M for cast iron cleanout test tee.
3. Size: Same as connected drainage piping up to 4 inch diameter, 4 inch for larger piping.
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
5. Closure: Countersunk or raised-head, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

### B. Metal Floor Cleanouts FCO:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed in paragraph 2.1.
2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
3. Size: Same as connected branch up to 4 inch diameter, 4 inch for larger piping.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Spigot.
8. Closure: Brass plug with straight threads and gasket.

9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Polished bronze.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Extra Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts WCO:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed in paragraph 2.1.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping up to 4 inch diameter, 4 inch for larger piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
5. Closure: Countersunk or raised-head, drilled-and-threaded brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: (frame and cover to be installed in drywall ) Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.
8. (stainless-steel wall-installation frame and cover to be used in other areas) Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

## 2.3 STANDARD FLOOR DRAINS AND CLEANOUTS

A. Floor Drain FD-1: Where plumbing specialties of this designation are indicated, provide products complying with the following:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed in paragraph 2.1.
2. Applicable Standard: ASME A112.21.1M
3. Body Material: Cast iron.
4. Seepage Flange: Required.
5. Clamping Device: Required.
6. Outlet: Bottom.

7. Sediment Bucket: Not required.
8. Top or Strainer Material: Cast iron.
9. Top of Body and Strainer Finish: Polished brass.
10. Top Shape: Round.
11. Dimensions of Top or Strainer: 6"
12. Top Loading Classification: Light Duty.
13. Funnel: Not required.
14. Funnel Dimensions: Not required.
15. Inlet Fitting: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.
16. Trap Material: Cast iron.
17. Trap Pattern: Standard P-trap.
18. Trap Features: Cleanout and trap seal primer valve drain connection.

B. Floor Drain FD-2: Where plumbing specialties of this designation are indicated, provide products complying with the following:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed in paragraph 2.1.
2. Applicable Standard: ASME A112.21.1M.
3. Body Material: Cast iron.
4. Seepage Flange: Required.
5. Clamping Device: Required.
6. Outlet: Bottom.
7. Sediment Bucket: Required.
8. Top or Strainer Material: Cast iron.
9. Top of Body and Strainer Finish: Rough brass.
10. Top Shape: Round.

11. Dimensions of Top or Strainer: 8"
  12. Depth of Drain Body: 3inches
  13. Top Loading Classification: Medium Duty.
  14. Funnel: Not required.
  15. Funnel Dimensions: Not required.
  16. Inlet Fitting: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.
  17. Trap Material: Cast iron.
  18. Trap Pattern: Deep-seal P-trap.
  19. Trap Features: Cleanout and trap seal primer valve drain connection.
- C. Floor Drain FD-3: Where plumbing specialties of this designation are indicated, provide products complying with the following:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed in paragraph 2.1.
  2. Applicable Standard: ASME A112.21.1M.
  3. Body Material: Cast iron.
  4. Seepage Flange: Required.
  5. Clamping Device: Required.
  6. Outlet: Bottom.
  7. Sediment Bucket: Required.
  8. Top or Strainer Material: Cast iron.
  9. Top of Body and Strainer Finish: Iron, heavy duty.
  10. Top Shape: Round.
  11. Dimensions of Top or Strainer: 12-18"
  12. Depth of Drain Body: 8 inches
  13. Top Loading Classification: Heavy-Duty.

14. Funnel: Not required.
15. Funnel Dimensions: Not required.
16. Inlet Fitting: Cast iron, with threaded inlet and threaded or spigot outlet, and trap seal primer valve connection.
17. Trap Material: Cast iron.
18. Trap Pattern: Deep-seal P-trap.
19. Trap Features: Cleanout and trap seal primer valve drain connection.

## 2.4 STANDARD ROOF DRAINS

- A. Roof Drain RD-1: Where plumbing specialties of this designation are indicated, provide products complying with the following:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed in paragraph 2.1.
  2. Applicable Standard: ASME A112.21.2M.
  3. Body Material: Cast iron.
  4. Combination Flashing Ring and Gravel Stop: Required.
  5. Outlet: Bottom.
  6. Dome Material: Cast iron.
  7. Extension Collars: Required.
  8. Underdeck Clamp: Required.
  9. Sump Receiver: Required.
  10. Diameter of Body: 16 inch.

## 2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

- A. Through-Penetration Firestop Assemblies:
  1. Coordinate firestopping of penetrations with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."
  2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
  3. Size: Same as connected soil, waste, or vent stack.

4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.

## 2.6 MISCELLANEOUS DRAINAGE PIPING SPECIALTIES

### A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
  - a. NPS 2 (DN 50): 4-inch- (100-mm-) minimum water seal.
  - b. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.

### B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

### C. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches (51 mm) above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

### D. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

### E. Expansion Joints:

1. Standard: ASME A112.21.2M.

2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

F. Downspout Boots:

1. Description: ASTM A 74, Service class, hub-and-spigot, cast-iron soil pipe.
2. Size: Same as or larger than connected downspout.

G. Conductor Nozzles:

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

## 2.7 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness, unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

## 2.8 OIL INTERCEPTORS

### A. Oil Interceptors:

1. Type: Factory-fabricated interceptor for separating and removing light oil from wastewater.
2. Body Material: Cast iron or steel..
3. Interior Lining: Corrosion-resistant enamel .
4. Exterior Coating: Corrosion-resistant enamel .
5. Body Dimensions: See Plumbing Fixture Schedule.
6. Flow Rate: See Plumbing Fixture Schedule.
7. Inlet and Outlet Size: See Floor Plans
8. End Connections: Flanged or Hub
9. Cleanout: Integral or field installed on outlet.
10. Mounting: Recessed, flush with floor.
11. Flow-Control Fitting: Required.

## PART 3 EXECUTION

### 3.1 CONCRETE BASES

- #### A. Anchor grease interceptors grease removal devices and solids interceptors to concrete bases.
1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 19-inch (480-mm) centers around full perimeter of base.
  2. For installed equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be imbedded.
  4. Install anchor bolts to elevations required for proper attachment to supported equipment.
  5. Concrete base construction requirements are specified in Division 23 Section "Basic HVAC Materials and Methods."
  6. Cast-in-place concrete materials and placement requirements are specified in Division 03.

### 3.2 INSTALLATION

- A. Refer to Division 23 Section "Basic HVAC Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backwater valves in building drain piping where indicated. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  - 1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
  - 2. Locate at each change in direction of piping greater than 45 degrees.
  - 3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
  - 4. Locate at base of each vertical soil and waste stack.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
  - 1. Position floor drains for easy access and maintenance.
  - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
    - a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
    - b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
    - c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
  - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
  - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

- G. Assemble non-ASME A112.3.1, stainless-steel channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- H. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- I. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
- J. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 7.
  - 1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
  - 2. Position roof drains for easy access and maintenance.
- K. Install deep-seal traps on floor drains and other waste outlets, unless otherwise indicated.
- L. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
  - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
  - 2. Size: Same as floor drain inlet.
- M. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- N. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- O. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- P. Install cast-iron soil pipe downspout boots at grade with top of hub 12 inches (305 mm) above grade.
- Q. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- R. Install oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing. Coordinate oil-interceptor storage tank and gravity drain.
- S. Install wood-blocking reinforcement for wall-mounting-type specialties.
- T. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

- U. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow-control fitting and vent to unit inlet piping; and gravity drawoff and suction piping to oil storage tank.

### 3.4 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
  - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
  - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
  - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
  - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

### 3.5 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Oil interceptors.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 23 Section "Identification for HVAC."

### 3.6 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

### 3.7 CONTRACTOR STARTUP AND REPORTING

- A. Perform the following final checks before startup:
  - 1. Verify that specified tests of piping systems are complete.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 22 14 26

### FACILITY STORM SEWER DRAINAGE

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section includes furnishing all labor, materials, tools, and equipment required to install the storm sewer systems as established by the Contractor in continuity to the plans and specification for the complete system. The work shall include but is not limited to excavation for sewer pipes and structures, sewer pipe and structure installation, backfilling trenches, and testing of the complete systems as required.
- B. Definitions:
  - 1. Drainage Piping: System of sewer pipe, fittings, and appurtenances for gravity flow of storm drainage.
  - 2. Sewerage Piping: System of sewer pipe, fittings, and appurtenances for gravity flow of sanitary sewage.

##### 1.2 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Section "Submittal Procedures."
- B. Shop drawings for precast concrete manholes and other structures. Include frames, covers, and grates.
- C. Inspection and test reports specified in the "Field Quality Control" Article.

##### 1.3 QUALITY ASSURANCE

- A. Environmental Agency Compliance: Comply with regulations pertaining to sanitary sewerage and storm drainage systems.
- B. Utility Compliance: Comply with regulations pertaining to sanitary sewerage and storm drainage systems. Include standards of water and other utilities where appropriate.
- C. Product Options: Drawings indicate sizes, profiles, connections, and dimensional requirements of system components and are based on specific manufacturer types indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Division 01 Section "Product Substitutions."

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect pipe, pipe fittings, and seals from dirt and damage.
- B. Handle precast concrete manholes and other structures according to manufacturer's rigging instructions.

#### 1.6 PROJECT CONDITIONS

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.
- B. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted under the following conditions and then only after arranging to provide acceptable temporary utility services.
  - 1. Notify Architect not less than 48 hours in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without receiving Architect's written permission.

#### 1.7 SEQUENCING AND SCHEDULING

- A. Coordinate with interior building drainage systems.
- B. Coordinate with other utility work.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements of Division 01 Sections.

#### 2.2 PIPES AND FITTINGS

- A. Vitrified Clay Pipe (VCP) and Fittings: Extra strength and fittings ASTM C700-88, Compression - Type Gasket and Gasketed Joints ASTM C425-86.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end, unless grooved or flanged ends are indicated.
  - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
  - 2. Gaskets: AWWA C111, rubber.

## 2.3 MANHOLES

- A. Precast Concrete Manholes: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for rubber gasket joints.
1. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent floatation.
  2. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (100-mm) minimum thickness for walls and base riser section, and having a separate base slab or base section with integral floor.
  3. Riser Sections: 4-inch (100-mm) minimum thickness, 48-inch (1220-mm) diameter, and lengths to provide depth indicated.
  4. Top Section: Eccentric cone type, unless concentric cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
  5. Gaskets: ASTM C 443 (ASTM C 443M), rubber.
  6. Grade Rings: Include 2 or 3 reinforced-concrete rings, of 6- to 9-inch (152- to 229-mm) total thickness, that match a 24-inch- (610-mm-) diameter frame and cover.
  7. Steps: ASTM C 478 (ASTM C 478M) individual steps or ladder. Omit steps for manholes less than 60 inches (1500 mm) deep.
  8. Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section.
- B. Manhole Frames and Covers: ASTM A-48, Class 35B, cast gray iron and per current city code. Include indented top design with lettering cast into cover:
1. Sanitary Sewerage Piping Systems: Raised flush letters per current city code.
  2. Storm Drainage Piping Systems: Raised flush letters per current city code.

## 2.4 CATCH BASINS

- A. Precast Concrete Catch Basins: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for rubber gasket joints.
1. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (100-mm) minimum thickness for walls and base riser section, and having a separate base slab or base section with integral floor.
  2. Riser Sections: 4-inch (100-mm) minimum thickness; 48-inch (1220-mm) diameter, and lengths to provide depth indicated.

3. Top Section: Eccentric cone type, unless concentric cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
  4. Gaskets: ASTM C 443 (ASTM C 443M), rubber.
  5. Grade Rings: Include 2 or 3 reinforced-concrete rings, of 6- to 9-inch (152- to 229-mm) total thickness, that match a 24-inch- (610-mm-) diameter frame and grate.
  6. Steps: ASTM C 478 (ASTM C 478M) individual steps or ladder. Omit steps for catch basins less than 60 inches (1500 mm) deep.
  7. Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section.
- B. Frames and Grates: ASTM A-48, cast gray iron per current city code. Include indented top design with lettering cast into cover:
1. Sanitary Sewerage Piping Systems: Raised flush letters per current city code.
  2. Storm Drainage Piping Systems: Raised flush letters per current city code.

## 2.5 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:
1. Cement: ASTM C 150, Type II.
  2. Fine Aggregate: ASTM C 33, sand.
  3. Coarse Aggregate: ASTM C 33, crushed gravel.
  4. Water: Potable.
- B. Structures: Portland-cement design mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water-cement ratio.
1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
  2. Reinforcement Bars: ASTM A 615, Grade 60 (ASTM A 615M, Grade 400), deformed steel.

## 2.6 PROTECTIVE COATINGS

- A. General: Include factory- or field-applied protective coatings to structures and appurtenances according to the following:

- B. Coating: 1- or 2-coat, coal-tar epoxy, 15-mil (0.381-mm) minimum thickness, except where otherwise indicated.
  - 1. Manholes: On exterior and interior surfaces.
  - 2. Manhole Frames and Covers: On interior surfaces.
  - 3. Catch Basins: On exterior and interior surfaces.
  - 4. Catch Basin Frames and Grates: On interior surfaces.

### PART 3 EXECUTION

#### 3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Excavating, Backfilling, and Compacting for Utilities."

#### 3.2 IDENTIFICATION

- A. Install green warning tapes directly over piping and at outside edges of underground structures.
  - 1. Use warning tapes or detectable warning tape over ferrous piping.
  - 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

#### 3.3 SEWERAGE PIPING APPLICATIONS

- A. General: Include watertight joints.
- B. Refer to Part 2 of this Section for detailed specifications for pipe and fitting products listed below. Use pipe, fittings, and joining methods according to the following applications.
  - 1. Pipe Size 6 and 10 Inches (150 and 250 mm): Hub-and spigot, extra strength vitrified clay pipe, and fittings; compression type gaskets; and gasketed joints for pipe outside of buildings or structures
  - 2. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end for pipe below buildings or structures.

#### 3.4 INSTALLATION, GENERAL

- A. General Locations and Arrangements: Drawings (plans and details) indicate the general location and arrangement of underground sewerage and drainage systems piping. Location and arrangement of piping layout take into account many design considerations. Install piping as indicated, to extent practical.

- B. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- C. Install gravity-flow-systems piping at constant slope between points and elevations indicated. Install straight piping runs at constant slope, not less than that specified, where slope is not indicated.
- D. Extend piping and connect to building's drains, of sizes and in locations indicated. Terminate piping as indicated.
- E. Install piping pitched down in direction of flow, at minimum slope of 1 percent (1:100) and 36-inch (1000-mm) minimum cover, except where otherwise indicated.

### 3.5 PIPE JOINT CONSTRUCTION AND INSTALLATION

- A. General: Join and install pipe and fittings according to the following.
  - 1. Hub-and-Spigot, Vitrified Clay Pipe and Fittings: With rubber compression gaskets according to ASTM C12-86. Use gaskets that match class of pipe and fittings.

### 3.6 MANHOLE INSTALLATION

- A. General: Install manholes, complete with accessories, as indicated.
- B. Set tops of frames and covers flush with finished surface where manholes occur in pavements. Set tops 3 inches (76 mm) above finished surface elsewhere, except where otherwise indicated.
- C. Place precast concrete manhole sections as indicated, and install according to ASTM C 891.
  - 1. Provide rubber joint gasket complying with ASTM C 443 (ASTM C 443M), at joints of sections.
  - 2. Apply bituminous mastic coating at joints of sections.

### 3.7 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

### 3.8 TAP CONNECTIONS

- A. Make connections to existing piping and underground structures so finished work conforms as nearly as practical to requirements specified for new work.

- B. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch (150-mm) overlap, with not less than 6 inches (150 mm) of 3000-psi (20.7-MPa), 28-day, compressive-strength concrete.
- C. Make branch connections from side into existing piping, sizes 4 to 20 inches (100 to 500 mm) by removing a section of existing pipe and installing a wye fitting into existing piping. Encase entire wye with not less than 6 inches (150 mm) of 3000-psi (20.7-MPa), 28-day, compressive-strength concrete.
  - 1. Use concrete that shall attain a minimum 28-day compressive strength of 3000 psi (20.7 MPa), unless otherwise indicated.
  - 2. Use epoxy bonding compound as an interface between new and existing concrete and piping materials.
- D. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

### 3.9 FIELD QUALITY CONTROL

- A. Clear interior of piping and structures of dirt and superfluous material as the work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
  - 1. In large, accessible piping, brushes and brooms may be used for cleaning.
  - 2. Place plug in end of incomplete piping at end of day and whenever work stops.
  - 3. Flush piping between manholes and other structures, if required by authorities having jurisdiction, to remove collected debris.
- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of the Project.
  - 1. Submit separate reports for each system inspection.
  - 2. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visual between structures.
    - b. Deflection: Flexible piping with deflection that prevents passage of a ball or cylinder of a size not less than 92.5 percent of piping diameter.
    - c. Crushed, broken, cracked, or otherwise damaged piping.
    - d. Infiltration: Water leakage into piping.
    - e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials and repeat inspections until defects are within allowances specified.
  4. Reinspect and repeat procedure until results are satisfactory.
- C. Test new piping systems and parts of existing systems that have been altered, extended, or repaired for leaks and defects.
1. Do not enclose, cover, or put into service before inspection and approval.
  2. Test completed piping systems according to authorities having jurisdiction.
  3. Schedule tests, and their inspections by authorities having jurisdiction, with at least 24 hours' advance notice.
  4. Submit separate reports for each test.
  5. Where authorities having jurisdiction do not have published procedures, perform tests as follows:
    - a. Sanitary Sewerage: Perform hydrostatic test.
      - 1) Allowable leakage is a maximum of 50 gallons per inch nominal pipe size, for every mile of pipe, during a 24-hour period.
      - 2) Allowable leakage is a maximum of 4.6 L per mm dimension nominal pipe size, for every km of pipe, during a 24-hour period.
      - 3) Close openings in system and fill with water.
      - 4) Purge air and refill with water.
      - 5) Disconnect water supply.
      - 6) Test and inspect joints for leaks.
      - 7) Option: Test ductile-iron piping according to AWWA C600, Section 4 "Hydrostatic Testing." Use test pressure of at least 10 psig (69.0 kPa).
    - b. Sanitary Sewerage: Perform air test according to UNI-B-6.
      - 1) Option: Test Poly Vinyl Chloride (PVC) according to ASTM-D1785-86.
    - c. Storm Drainage: Perform hydrostatic test.
      - 1) Allowable leakage is a maximum of 200 gallons per inch nominal pipe size, for every mile of pipe, during a 24-hour period.
      - 2) Allowable leakage is a maximum of 18.4 L per mm dimension nominal pipe size, for every km of pipe, during a 24-hour period.
      - 3) Close openings in system and fill with water.
      - 4) Purge air and refill with water.
      - 5) Disconnect water supply.
      - 6) Test and inspect joints for leaks.

- 7) Storm Drainage: Perform hydrostatic test. Close openings in system and fill with water to not less than 10-foot (3-m) head of water. Disconnect water supply. Water level must not drop for 15 minutes. Inspect joints for leaks.
- d. Storm Drainage: Perform air test according to UNI-B-6.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 23 05 13

### COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. General construction and requirements.
- B. Applications.
- C. Single phase electric motors.
- D. Three phase electric motors.
- E. Electronically Commutated Motors (ECM).

##### 1.2 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015.
- B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; 2004.
- C. NEMA MG 1 - Motors and Generators; 2017.
- D. NFPA 70 - National Electrical Code; 2017.

##### 1.3 SUBMITTALS

- A. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements. Provide nameplate data and ratings; shipping, installed, and operating weights; enclosure type and mounting arrangements; size, type, and location of winding terminations; conduit entry and ground lug locations; and information on coatings or finishes.
- B. Shop Drawings for Field-Installed Motors: Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Include the following:
  - 1. Each installed unit's type and details.
  - 2. Nameplate legends.

3. Diagrams of power, signal, and control wiring. Provide schematic wiring diagram for each type of motor and for each control scheme.
- C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around field-installed motors. Show motor layout, mechanical power transfer link, driven load, and relationship between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- D. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.
- E. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
- F. Operation Data: Include instructions for safe operating procedures.
- G. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

#### 1.4 QUALITY ASSURANCE

- A. Conform to NFPA 70.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- C. Product Options for Field-Installed Motors: Drawings indicate size, profiles, and dimensional requirements of motors and are based on the specific system indicated.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

#### 1.6 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices and features that comply with the following:

1. Compatible with the following:
    - a. Magnetic controllers.
    - b. Multispeed controllers.
    - c. Reduced-voltage controllers.
  2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
  3. Matched to torque and horsepower requirements of the load.
  4. Matched to ratings and characteristics of supply circuit and required control sequence.
- B. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.
- C. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

#### 1.7 WARRANTY

- A. Written manufacturer's warranty covering parts and labor for a period of one year from substantial completion, or eighteen months from shipment, whichever is longer.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Baldor Electric Company/ABB Group
- B. General Electric
- C. Lincoln Motors
- D. Marathon
- E. Reliance
- F. U.S. Motors

## 2.2 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Electrical Service:
  - 1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.
  - 2. Motors Larger than 1/2 Horsepower: \_\_\_ volts, three phase, 60 Hz.
- B. Construction:
  - 1. Open drip-proof type except where specifically noted otherwise.
  - 2. Design for continuous operation in 104 degrees F environment.
  - 3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
- C. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- D. Wiring Terminations:
  - 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
  - 2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

## 2.3 APPLICATIONS

- A. Motors located in exterior locations, wet air streams downstream of sprayed coil dehumidifiers, draw through cooling towers, air cooled condensers, humidifiers, direct drive axial fans, roll filters, explosion proof environments, and dust collection systems: Totally enclosed type.
- B. Motors located outdoors and in draw through cooling towers: Totally enclosed weatherproof epoxy-sealed type.

## 2.4 SINGLE PHASE POWER - SPLIT PHASE MOTORS

- A. Starting Torque: Less than 150 percent of full load torque.
- B. Starting Current: Up to seven times full load current.
- C. Breakdown Torque: Approximately 200 percent of full load torque.

- D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
- E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

## 2.5 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

- A. Starting Torque: Exceeding one fourth of full load torque.
- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.
- D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

## 2.6 SINGLE PHASE POWER - CAPACITOR START MOTORS

- A. Starting Torque: Three times full load torque.
- B. Starting Current: Less than five times full load current.
- C. Pull-up Torque: Up to 350 percent of full load torque.
- D. Breakdown Torque: Approximately 250 percent of full load torque.
- E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.
- G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

## 2.7 THREE PHASE POWER - SQUIRREL CAGE MOTORS

- A. Starting Torque: Between 1 and 1-1/2 times full load torque.
- B. Starting Current: Six times full load current.
- C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.

- D. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
- E. Insulation System: NEMA Class B or better.
- F. All three phase motors shall be rated for VFD applications.
- G. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
- H. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- I. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- J. Sound Power Levels: To NEMA MG 1.
- K. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
- L. Nominal Efficiency: As indicated at full load and rated voltage when tested in accordance with IEEE 112.
- M. Nominal Power Factor: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

## 2.8 ELECTRONICALLY COMMUTATED MOTORS (ECM)

### A. Applications:

#### 1. Commercial:

##### a. Through-the-Wall Unit:

- (1) Operating Mode: Constant cfm.
- (2) Input: Motor manufacturer to coordinate control requirements with the control board of the through-the-wall unit and/or specified sequence of operation.
- (3) Shaft Extension: Single.
- (4) RPM: 300 through 1250.

- b. Hydronic Fan Coil Unit:
  - (1) Operating Mode: Constant cfm.
  - (2) Input: Motor manufacturer to coordinate control requirements with the control board of the fan coil unit and/or specified sequence of operation.
  - (3) Shaft Extension: Single.
  - (4) Options: User-interface.
  - (5) RPM: 300 through 1250.
  
- c. Package Terminal Air Conditioner (PTAC):
  - (1) Operating Mode: Constant speed.
  - (2) Input: Motor manufacturer to coordinate control requirements with the control board of the PTAC and/or specified sequence of operation.
  - (3) Shaft Extension: Single.
  - (4) Options: Resilient mounting.
  - (5) RPM: 600 through 1800.
  
- d. Power Roof Ventilator and Inline Centrifugal Fans (PRV):
  - (1) Operating Mode: Constant cfm.
  - (2) Input: Motor manufacturer to coordinate control requirements with the control board of the PRV and/or specified sequence of operation.
  - (3) Shaft Extension: Single.
  - (4) Options: Remote mount control.
  
- e. Fan Powered Boxes (FPB):
  - (1) Operating Mode: Constant cfm.
  - (2) Input: Motor manufacturer to coordinate control requirements with the control board of the PRV and/or specified sequence of operation.
  - (3) Shaft Extension: Single.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine areas to receive field-installed motors for compliance with requirements, installation tolerances, and other conditions affecting performance.

- B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before motor installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Check line voltage and phase and ensure agreement with nameplate.

### 3.3 FIELD QUALITY CONTROL FOR FIELD-INSTALLED MOTORS

- A. Prepare for acceptance tests.
  - 1. Align motors, bases, shafts, pulleys, and belts. Tension belts according to manufacturer's written instructions.
  - 2. Verify bearing lubrication.
  - 3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
  - 4. Test interlocks and control and safety features for proper operation.
  - 5. Verify that current and voltage for each phase comply with nameplate rating and NEMA MG 1 tolerances.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- C. Perform the following field tests and inspections and prepare test reports:
  - 1. Perform electrical tests and visual and mechanical inspections including optional tests and inspections stated in NETA ATS on factory- and field-installed motors. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

### 3.4 CLEANING

- A. Comply with applicable requirements in Division 23 Section "HVAC Equipment Cleaning."

### 3.5 CONTRACTOR STARTUP AND REPORTING

- A. Prepare for acceptance tests.
  - 1. Align motors, bases, shafts, pulleys, and belts. Tension belts according to manufacturer's written instructions.
  - 2. Verify bearing lubrication.
  - 3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
  - 4. Test interlocks and control and safety features for proper operation.
  - 5. Verify that current and voltage for each phase comply with nameplate rating and NEMA MG 1 tolerances.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- C. Perform the following field tests and inspections and prepare test reports:
  - 1. Perform electrical tests and visual and mechanical inspections including optional tests and inspections stated in NETA ATS on factory- and field-installed motors. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

### 3.6 DEMONSTRATION AND COMMISSIONING

- A. Engage a factory-authorized service representative to train maintenance personnel to adjust, operate, and maintain field-installed motors. Refer to Division 01 Section "Demonstration and Training."
  - 1. Train maintenance personnel on procedures and schedules for starting up and shutting down, troubleshooting, servicing, and maintaining chillers. The training will occur after the startup report has been provided to the Owner and the trainer will provide two (2) Installation and Operations manuals for the use of the Owner's personnel during training.

2. Review data in maintenance manuals. Refer to Division 01. All required and recommended maintenance will be reviewed as well as operational trouble shooting. If the IOM does not include a written trouble shooting guide one will be provided.
  3. Schedule training with Owner, through Architect/Engineer of Record, with at least seven days' advance notice.
- B. Demonstrate proper operation of equipment to commissioning agent or designated Owner's personnel. The scope of the demonstration will include functional performance requirements under both local and building automation control as well as any commissioning requirements in Division 01 or 23.

END OF SECTION

## SECTION 23 05 23

### GENERAL-DUTY VALVES FOR HVAC PIPING

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Applications.
- B. General requirements.
- C. Globe valves.
- D. Ball valves.
- E. Butterfly valves.
- F. Check valves.
- G. Plug valves.
- H. Chainwheels.

##### 1.2 ABBREVIATIONS AND ACRONYMS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene.
- G. RS: Rising stem.
- H. SWP: Steam working pressure.
- I. TFE: Tetrafluoroethylene.

### 1.3 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose (Inch); 2013.
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2015.
- C. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2017.
- D. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2017.
- E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.
- F. ASME B16.34 - Valves - Flanged, Threaded and Welding End; 2017.
- G. ASME B31.9 - Building Services Piping; 2014.
- H. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators; 2017.
- I. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2003 (Reapproved 2016).
- J. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2014).
- K. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
- L. MSS SP-67 - Butterfly Valves; 2017.
- M. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010a.
- N. MSS SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends; 2011.
- O. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; 2013.
- P. MSS SP-85 - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends; 2011.
- Q. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.
- R. MSS SP-125 - Gray Iron and Ductile Iron In-Line, Spring-Loaded, Center-Guided Check Valves; 2010.

- S. NSF 61 - Drinking Water System Components - Health Effects; 2017.

#### 1.4 SUBMITTALS

- A. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- B. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.
- C. Maintenance Materials: Furnish Board with one wrench for every five plug valves, in each size of square plug valve head.
  - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer:
  - 1. Obtain valves for each valve type from single manufacturer.
- B. Welding Materials and Procedures: Conform to ASME BPVC-IX.
- C. ASME Compliance: ASME B31.9 for building services piping valves.
- D. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- E. NSF Compliance: NSF 61 for valve materials for potable-water service.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
  - 2. Protect valve parts exposed to piped medium against rust and corrosion.
  - 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
  - 4. Adjust globe and angle valves to the closed position to avoid clattering.

5. Secure check valves in either the closed position or open position.
  6. Adjust butterfly valves to closed or partially closed position.
- B. Use the following precautions during storage:
1. Maintain valve end protection and protect flanges and specialties from dirt.
    - a. Provide temporary inlet and outlet caps.
    - b. Maintain caps in place until installation.
  2. Store valves in shipping containers and maintain in place until installation.
    - a. Store valves indoors in dry environment.
    - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.
- C. Exercise the following precautions for handling:
1. Handle large valves with sling, modified to avoid damage to exposed parts.
  2. Avoid the use of operating handles or stems as rigging or lifting points.

## PART 2 PRODUCTS

### 2.1 APPLICATIONS

- A. See drawings for specific valve locations.
- B. Provide the following valves for the applications if not indicated on drawings:
1. Throttling (Hydronic): Butterfly, Ball, and Globe.
  2. Throttling (Steam): Butterfly.
  3. Isolation (Shutoff): Butterfly, Ball, and Plug.
  4. Swing Check (Pump Outlet):
    - a. 2 NPS and Smaller: Bronze with bronze disc.
    - b. 2-1/2 NPS and Larger: Iron with lever and spring.
- C. Substitutions of valves with higher CWP classes or SWP ratings for same valve types are permitted when specified CWP ratings or SWP classes are not available.

D. Chilled Water and Condenser Water Valves:

1. 2 NPS and Smaller, Bronze Valves:
  - a. Ball: Full port, two piece, bronze trim.
  - b. Swing Check: Bronze disc, Class 125 .
  - c. Globe: Bronze disc, Class 150.
2. 2-1/2 NPS and Larger, Iron Valves:
  - a. Single-Flange Butterfly: 2-1/2 NPS to 12 NPS, aluminum-bronze disc, EPDM seat, 150 CWP.
  - b. Swing Check: Metal seats, Class 125.
  - c. Center-Guided Check: Compact-wafer, metal seat, Class 125.
  - d. Globe: Class 125.

E. Heating Hot Water Valves:

1. 2 NPS and Smaller, Bronze Valves:
  - a. Threaded ends.
  - b. Ball: Full port, two piece, bronze trim.
  - c. Swing Check: Bronze disc, Class 125.
  - d. Globe: Bronze disc, Class 125.
2. 2-1/2 NPS and Larger, Iron Valves:
  - a. Ball: 2-1/2 NPS to 10 NPS, Class 150.
  - b. Single-Flange Butterfly: 2-1/2 NPS to 12 NPS, aluminum-bronze disc, EPDM seat, 200 CWP.
  - c. Single-Flange Butterfly: 14 NPS to 24 NPS, aluminum-bronze disc, EPDM seat, 150 CWP.
  - d. Swing Check: 2-1/2 NPS to 12 NPS, lever and spring closure control, Class 125.
  - e. Center-Guided Check: Compact-wafer, metal seat, Class 125.
  - f. Globe: 2-1/2 NPS to 12 NPS, Class 125.

F. Low Pressure Steam Valves (15 PSIG or Less):

1. 2 NPS and Smaller, Bronze Valves:
  - a. Ball: Full port, twopiece, bronze trim.
  - b. Swing Check: Bronze disc, Class 125.
  - c. Globe: Bronze disc, Class 125.

2. 2-1/2 NPS and Larger, Iron Valves:
  - a. 2-1/2 NPS to 4 NPS: Flanged ends.
  - b. Ball: 2-1/2 NPS to 10 NPS, Class 150.
  - c. Swing Check: 2-1/2 NPS to 12 NPS, lever and spring closure. control, Class 125.
  - d. Globe: 2-1/2 NPS to 12 NPS: Class 125.

G. Steam-Condensate Valves:

1. 2 NPS and Smaller, Bronze Valves:
  - a. Gate: NRS, Class 125.
  - b. Ball: Full port, two piece, bronze trim.
  - c. Globe: Bronze disc, Class 125.
2. 2-1/2 NPS and Larger, Iron Valves:
  - a. Ball: 2-1/2 NPS to 10 NPS, Class 150.
  - b. Swing Check: Lever and spring closure control, Class 125.
  - c. Gate: OSY, Class 125.
  - d. Globe: 2-1/2 NPS to 12 NPS, Class 125.
  - e. Lubricated Plug: Threaded, cylindrical, threaded, Class 125.

## 2.2 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
  1. Gear Actuator: Quarter-turn valves 8 NPS and larger.
  2. Handwheel: Valves other than quarter-turn types.
  3. Hand Lever: Quarter-turn valves 6 NPS and smaller.
  4. Wrench: Plug valves with square heads.
  5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator, of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

- D. Valves in Insulated Piping: Provide 2 NPS stem extensions and the following features:
  - 1. Gate Valves: Rising stem.
  - 2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
  - 3. Butterfly Valves: Extended neck.
  - 4. Memory Stops: Fully adjustable after insulation is installed.
- E. Valve-End Connections:
  - 1. Threaded End Valves: ASME B1.20.1.
  - 2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
  - 3. Pipe Flanges and Flanged Fittings 2 1/2 NPS through 24 NPS: ASME B16.5.
  - 4. Solder Joint Connections: ASME B16.18.
- F. General ASME Compliance:
  - 1. Building Services Piping Valves: ASME B31.9.
- G. Source Limitations: Obtain each valve type from a single manufacturer.

## 2.3 BRONZE GLOBE VALVES

- A. Class 125: CWP Rating: 200 psig., and Class 150: CWP Rating: 300 psig.:
  - 1. Comply with MSS SP-80, Type 1.
  - 2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
  - 3. Ends: Threaded or solder joint.
  - 4. Stem: Silicon Bronze-alloy
  - 5. Disc: Bronze or PTFE.
  - 6. Packing: Asbestos free.
    - a. Handwheel: Malleable iron.
    - b. Manufacturers:

- (1) Crane Co.
- (2) Milwaukee Valve Company
- (3) NIBCO, Inc.
- (4) Apollo Valve

## 2.4 IRON GLOBE VALVES

- A. Class 125: CWP Rating: 200 psig:.
1. Comply with MSS SP-85, Type I.
  2. Body: Gray iron; ASTM A126, with bolted bonnet.
  3. Ends: Flanged.
  4. Trim: Bronze.
  5. Packing and Gasket: Asbestos free, teflon-impregnated packing with bronze nut.
  6. Operator: Aluminum or malleable-iron handwheel or chainwheel.
  7. Manufacturers:
    - a. Crane Co.
    - b. Milwaukee Valve Company
    - c. NIBCO, Inc.
    - d. Apollo Valve

## 2.5 BRONZE BALL VALVES

- A. Two Piece, Full Port with Bronze or Brass Trim:
1. Comply with MSS SP-110.
  2. SWP Rating: 150 psig.
  3. CWP Rating: 600 psig.
  4. Body: Bronze.
  5. Ends: Threaded or soldered.
  6. Seats: PTFE .
  7. Stem: Bronze or brass.

8. Ball: Chrome plated brass.
9. Manufacturers:
  - a. Conbraco Industries
  - b. Crane Co.
  - c. NIBCO, Inc.
  - d. Watts Industries
  - e. Apollo Valve

## 2.6 IRON BALL VALVES

### A. Split Body, Full Port:

1. Comply with MSS SP-72.
2. CWP Rating: 200 psig.
3. Body: ASTM A126, gray iron.
4. Ends: Flanged.
5. Seats: PTFE.
6. Stem: Stainless steel.
7. Ball: Stainless steel.

## 2.7 IRON, SINGLE FLANGE BUTTERFLY VALVES

### A. Lug type: Bi-directional dead end service without downstream flange.

1. Comply with MSS SP-67, Type I.
2. CWP Rating: 200 psig.
3. Body Material: ASTM A126 cast iron.
4. Stem: One or two-piece stainless steel.
5. Seat: NBR.
6. Disc: Coated ductile iron.

7. Operator:
  - a. Sizes 2 Inches to 6 Inches: Standard lever handle with memory stop.
  - b. Sizes 8 Inches to 24 Inches: Gear operator with position indicator.
  - c. Sizes 8 Inches and Larger, 96 Inches or Higher above Floor: Chain-wheel operator.
  
8. Manufacturers:
  - a. Crane Co.
  - b. Milwaukee Valve Company
  - c. NIBCO, Inc.
  - d. Watts Industries
  - e. Apollo Valve

## 2.8 BRONZE SWING CHECK VALVES

- A. Class 125: CWP Rating: 200 psig (1380 kPa) and Class 150: CWP Rating: 300 psig (2070 kPa).
  1. Comply with MSS SP-80, Type 3.
  2. Body Design: Horizontal flow.
  3. Body Material: Bronze, ASTM B62.
  4. Ends: Threaded.
  5. Disc: Bronze.
  6. Manufacturers:
    - a. Crane Co.
    - b. Milwaukee Valve Company
    - c. NIBCO, Inc.
    - d. Watts Industries
    - e. Apollo Valve

## 2.9 IRON, CENTER-GUIDED CHECK VALVES

- A. Class 125, Compact-Wafer:
  1. 1 Comply with MSS SP-125.
  2. 2-1/2 NPS to 12 NPS, CWP Rating: 200 psig.
  3. Body Material: ASTM A126, gray iron.

4. Metal Seat: Bronze.
5. Resilient Seat: Buna N.
6. Manufacturers:
  - a. Crane Co.
  - b. NIBCO, Inc.
  - c. Watts Industries
  - d. Apollo Valve

## 2.10 LUBRICATED PLUG VALVES

### A. Regular Gland and Cylindrical with Threaded Ends:

1. Comply with MSS SP-78, Type II.
2. Class 125: 2-1/2 NPS to 12 NPS, CWP Rating: 200 psig.
3. Body Material: Cast iron with lubrication sealing system.
4. Pattern: Regular or short.
5. Plug: Cast iron or bronze with sealant groove.
6. Operator:
  - a. Lever for valves 5" and smaller
  - b. Worm and gear with handwheel for valves 6" and larger
  - c. Worm and gear with chain wheel, sizes 6 inches and larger, 96 inches or higher above floor.
7. Manufacturers:
  - a. General Signal; DeZurik Unit.
  - b. Grinnell Corporation.
  - c. Tyco International, Ltd.; Tyco Valves & Controls.

## 2.11 CHAINWHEELS

### A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to ball, butterfly, and plug valve stems.

3. Sprocket Rim with Chain Guides: Ductile iron include zinc coating.
4. Chain: Hot-dip galvanized steel. Sized to fit sprocket rim.

B. Manufacturers:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries, Inc.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.
- B. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- D. Verify valve parts to be fully operational in all positions from closed to fully open.
- E. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- F. Should valve is determined to be defective, replace with new valve.
- G. Examine threads on valve and mating pipe for form and cleanliness.
- H. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- I. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- J. Confirm valve component material is appropriate for hydronic systems using propylene or ethylene glycol.

### 3.2 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.
- F. Install chainwheel operators on valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor elevation.
- G. Install check valves for proper direction of flow and as follows:
  - 1. Swing Check Valves: In horizontal position with hinge pin level.
- H. Provide chainwheels on operators for valves 4 NPS and larger where located 96 NPS or more above finished floor, terminating 60 NPS above finished floor.

END OF SECTION

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## SECTION 23 05 48

### VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Vibration isolators.
- B. Equipment support bases
- C. Flexible piping connections.
- D. Roof curbs.

##### 1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping

##### 1.3 SUBMITTALS

- A. Product Data:
  - 1. Provide manufacturer's product literature documenting compliance with PRODUCTS.
- B. Shop Drawings:
  - 1. Provide schedule of vibration isolator type with location and load on each.
  - 2. Fully dimensioned fabrication drawings and installation details for vibration isolation bases, member sizes, attachments to isolators, and supported equipment.
  - 3. Include auxiliary motor slide bases and rails, base weights, inertia bases, concrete weights, equipment static loads, support points, vibration isolators, and detailed layout of isolator location and orientation with static and dynamic load on each isolator.
  - 4. Clearly indicate the load and capacity assumptions selected. Include copies of any calculations.

- C. Manufacturer's Instructions: Indicate installation instructions with special procedures and setting dimensions.

#### 1.4 QUALITY ASSURANCE

- A. Perform design and installation in accordance with applicable codes.
- B. The isolation materials manufacturer shall be responsible for the proper selection of spring rates to accomplish the specified minimum static deflections for all spring and pay type isolators based on the weight distribution of equipment to be isolated.
- C. The isolation materials manufacturer shall be responsible for the structural design of steel beam bases and concrete inertia bases to support mechanical equipment scheduled or specified to receive a supplementary base.
- D. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and registered and licensed in Illinois.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Store equipment in accordance with manufacturer's instructions.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Kinetics Noise Control, Inc
- B. Mason Industries
- C. Vibration Eliminator Company, Inc

#### 2.2 PERFORMANCE REQUIREMENTS

- A. General:
  - 1. All vibration isolators, base frames and inertia bases to conform to all uniform deflection and stability requirements under all operating loads.
  - 2. Steel springs to function without undue stress or overloading.

## 2.3 EQUIPMENT SUPPORT BASES

### A. Structural Bases:

1. Construction: Engineered, structural steel frames with welded brackets for side mounting of the isolators.
2. Frames: Square, rectangular or T-shaped.
3. Design: Sufficiently rigid to prevent misalignment or undue stress on machine, and to transmit design loads to isolators and snubbers.

## 2.4 VIBRATION ISOLATORS

### A. Non-Seismic Type:

1. Elastomeric Mounts:
  - a. Material: Oil, ozone, and oxidant resistant compounds.
  - b. Assembly: Encapsulated load transfer plate bolted to equipment and base plate with anchor hole bolted to supporting structure.
2. Steel Springs:
  - a. Assembly: Freestanding, laterally stable without housing.
  - b. Leveling Device: Rigidly connected to equipment or frame.
  - c. Isolator shall be complete with a molded neoprene cup or 1/4"(6mm) neoprene acoustical friction pad between the baseplate and the support.
  - d. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8.
  - e. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection.
3. Restrained Steel Springs:
  - a. Housing: Rigid blocking during rigging prevents equipment installed and operating height from changing during temporary weight reduction. Housing and spring shall be powder coated and hardware electro-galvanized.
  - b. Equipment Wind Loading: Adequate means for fastening isolator top to equipment and isolator base plate to supporting structure.
  - c. Restraining bolts shall have large rubber grommets to provide cushioning in the vertical as well as horizontal modes.
  - d. The hole through the bushing shall be a minimum of 0.75" larger in diameter than the restraining bolt.

- e. Horizontal clearance on the sides between the spring assembly and the housing shall be a minimum of 0.5" to avoid bumping and interfering with the spring action.

4. Elastomeric Hangers:

- a. Housing: Steel construction containing elastomeric isolation element to prevent rod contact with housing and short-circuiting of isolating function.
- b. Incorporate steel load distribution plate sandwiching elastomeric element to housing.

5. Spring Hanger:

- a. Housing: Steel construction containing stable steel spring and integral elastomeric element preventing metal to metal contact.
- b. Bottom Opening: Sized to allow plus/minus 15 degrees rod misalignment.

6. Combination Elastomeric-Spring Hanger:

- a. Housing: Steel construction containing stable steel spring with elastomeric element in series isolating upper connection of hanger box to building structure.
- b. Bottom Opening: Sized to allow plus/minus 15 degrees rod misalignment.

7. Thrust Restraints:

- a. Housing: Steel construction containing stable steel spring and integral elastomeric element installed in pairs to resist air pressure thrusts.
- b. Bottom Openings: Sized to allow plus/minus 15 degrees rod misalignment.

2.5 FLEXIBLE STAINLESS STEEL HOSE

- A. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3" and larger shall be flanged. Smaller sizes may have male nipples. Minimum lengths shall be as tabulated:

Flanged

3" x 14" (75 x 350mm)	6" x 20" (150 x 500mm)	12" x 28" (300 x 700mm)
4" x 15" (100 x 375mm)	8" x 22" (200 x 550mm)	14" x 30" (350 x 750mm)
5" x 19" (125 x 475mm)	10" x 26" (250 x 650mm)	16" x 32" (400 x 800mm)

### Male Nipples

1/2" x 9" (12 x 225mm)	1-1/4" x 12" (32 x 300mm)	2" x 14" (50 x 350mm)
3/4" x 10" (19 x 250mm)	1-1/2" x 13" (38 x 325mm)	2-1/2" x 18" (64 x 450mm)
1" x 11" (25 x 275mm)		

- B. At equipment, hoses shall be installed on the equipment side of the shut off valves horizontal and parallel to the equipment shafts wherever possible. Hoses shall be type BSS as manufactured by Mason Industries, Inc.

## 2.6 ROOF CURBS

### A. Vibration Isolation Curbs:

#### 1. Non-Seismic Curb Rail:

- a. Location: Between existing roof curb and rooftop equipment.
- b. Construction: Aluminum.
- c. Integral vibration isolation to conform to requirements of this section.
- d. Weather exposed components consist of corrosion resistant materials.

#### 2. Non-Seismic Curb:

- a. Location: Between structure and rooftop equipment.
- b. Construction: Aluminum.
- c. Integral vibration isolation to conform to requirements of this section.
- d. Weather exposed components consist of corrosion resistant materials.

## PART 3 EXECUTION

### 3.1 INSTALLATION - GENERAL

- A. Install in accordance with manufacturer's instructions.
- B. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- C. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- D. Provide pairs of horizontal limit springs on fans with more than 6.0 inches WC static pressure, and on hanger supported, horizontally mounted axial fans.

- E. Support piping connections to equipment mounted on isolators using isolators or resilient hangers for scheduled distance.
  - 1. Up to 4 Inches Pipe Size: First three points of support.
  - 2. 5 to 8 Inches Pipe Size: First four points of support.
  - 3. 10 inches Pipe Size and Over: First six points of support.
  - 4. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.
- F. Support piping within generator room using isolators or resilient hangers.
- G. Support ductwork within generator room using isolators or resilient hangers.

### 3.2 FIELD QUALITY CONTROL

- A. Inspect isolated equipment after installation and submit report. Include static deflections.

### 3.3 SCHEDULE

- A. Pipe Isolation Schedule.
  - 1. 1 Inch Pipe Size: Isolate 120 diameters from equipment.
  - 2. 2 Inch Pipe Size: Isolate 90 diameters from equipment.
  - 3. 3 Inch Pipe Size: Isolate 80 diameters from equipment.
  - 4. 4 Inch Pipe Size: Isolate 75 diameters from equipment.
  - 5. 6 Inch Pipe Size: Isolate 60 diameters from equipment.
  - 6. 8 Inch Pipe Size: Isolate 60 diameters from equipment.
  - 7. 10 Inch Pipe Size: Isolate 54 diameters from equipment.
  - 8. 12 Inch Pipe Size: Isolate 50 diameters from equipment.
  - 9. 16 Inch Pipe Size: Isolate 45 diameters from equipment.
  - 10. 24 Inch Pipe Size: Isolate 38 diameters from equipment.
  - 11. 11. Over 24 Inch Pipe Size: As indicated.
- B. Equipment Isolation Schedule.
  - 1. Air Cooled Condensing Units.
    - a. Base: Structural steel base.
    - b. Isolator Type: Restrained housed spring isolators.
    - c. Isolator Deflection: 2.0 inches.

2. Suspended Air Handling Units (Up to 5hp).
  - a. Isolator Type: Restrained spring hangers.
  - b. Isolator Deflection: [1.0] inches.
3. Packaged Roof Top Air Conditioning Units.
  - a. Base: Vibration Isolation Curb.
  - b. Isolator Type: Vibration Isolation Curb.
  - c. Isolator Deflection: 1.0 inches.
4. Inline, Tube and Vane Axial Fans, Suspended.
  - a. Isolator Type: Restrained spring hangers.
  - b. Isolator Deflection: [1.0] inches.

END OF SECTION

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## SECTION 23 05 93

### TESTING, ADJUSTING, AND BALANCING FOR HVAC

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic, refrigerating systems.
- C. Measurement of final operating condition of HVAC systems.

##### 1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, Adjusting, and Balancing.
- D. TAB Firm: Entity responsible for performing and reporting TAB procedures.
- E. TAB Specialist: Entity engaged by TAB Firm to perform TAB work.

##### 1.3 REFERENCE STANDARDS

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition 2016.
- B. ASHRAE Std 110 - Methods of Testing Performance of Laboratory Fume Hoods 2016.
- C. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems 2008, with Errata (2019).
- D. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems 2015, with Errata (2017).
- E. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing 2002.

##### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

- B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
- C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
  - 1. Submit to Architect/Engineer of Record.
  - 2. Submit six weeks prior to starting the testing, adjusting, and balancing work.
  - 3. Include certification that the plan developer has reviewed Contract Documents, the equipment and systems, and the control system with the Architect/Engineer of Record and other installers to sufficiently understand the design intent for each system.
  - 4. Include at least the following in the plan:
    - a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
    - b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
    - c. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
    - d. Final test report forms to be used.
    - e. Procedures for formal deficiency reports, including scope, frequency and distribution.
- D. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
  - 1. Revise TAB plan to reflect actual procedures and submit as part of final report.
  - 2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Engineer of Record and for inclusion in operating and maintenance manuals.
  - 3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
  - 4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
  - 5. Units of Measure: Report data in I-P (inch-pound) units only.

- E. Sample report forms. Submit two copies of the sample TAB report forms
- F. Instrument calibration reports, including the following:
  - 1. Instrument type and make.
  - 2. Serial number.
  - 3. Application.
  - 4. Dates of use.
  - 5. Dates of calibration.

## 1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.
  - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB.
  - 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB as a TAB technician.
- B. TAB Conference: Prior to the start of the TAB work, and at Contractor's direction, coordinate a meeting at the Site to review the TAB strategies and procedures plan and to develop a mutual understanding of the details of the work involved. The meeting shall include the Architect/Engineer of Record, the Owner's Representative, the Commissioning Authority (CxA) (if applicable), the TAB field supervisor, and the TAB technicians. Provide at least seven days' advance notice of meeting date and time.
  - 1. Agenda Items:
    - a. The Contract Documents examination report.
    - b. The TAB plan.
    - c. Coordination and cooperation of trades and subcontractors.
    - d. Coordination of documentation and communication flow.
    - e. Submittal distribution requirements.
    - f. Work Schedule and Project-Site requirements.
  - 2. Record minutes and distribute copies within 5 days after meeting to participants as well as Architect/Engineer of Record, Owner and those affected by decisions made.
- C. Certification of TAB Reports: Certify TAB field data reports and perform the following:
  - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.

2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard TAB forms from NEBB or AABC as well as providing any additional information required by this specification.
- E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE Std 111, Section 5, "Instrumentation."
- F. Owner reserves the right to select at random 10% of the TAB report data for field verification witnessed by the commission agent. The TAB contractor will be given sufficient notice of the date of field verification. The same instruments that were used when the original test was recorded shall be used. A failure of more than 10% of the selected field verification items shall result in a repeat of the testing of the entire system at the TAB contractor's expense. The repeated work is also subject to field verification.

## 1.6 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

## 1.7 WARRANTY

- A. Provide warranty in accordance with AABC or NEBB standards:
  1. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents.
  2. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents.
  3. Guarantee shall include the following provisions:
    - a. The certified TAB firm has tested and balanced systems according to the Contract Documents.

- b. Systems are balanced to optimum performance capabilities within design and installation limits.

## PART 2 PRODUCTS - NOT USED

## PART 3 EXECUTION

### 3.1 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
  - 1. AABC (NSTSB), AABC National Standards for Total System Balance.
  - 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
  - 3. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
  - 4. SMACNA (TAB).
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

### 3.2 EXAMINATION

- A. Examine the Contract Documents and field conditions to become familiar with Project requirements and to discover conditions that may preclude proper TAB of systems and equipment.
- B. Examine the approved submittals for HVAC systems and equipment.
- C. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
  - 1. Systems are started and operating in a safe and normal condition.
  - 2. Temperature control systems are installed complete and operable.
  - 3. Proper thermal overload protection is in place for electrical equipment.

4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  5. Duct systems are clean of debris.
  6. HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
  7. Fans are rotating correctly.
  8. Fire and volume dampers are in place and open.
  9. Terminal units, such as variable-air-volume boxes, are accessible and their controls are connected and functioning.
  10. Air coil fins are cleaned and combed.
  11. Access doors are closed and duct end caps are in place.
  12. Air outlets are installed and connected.
  13. Duct system leakage is minimized.
  14. Hydronic systems are flushed, filled, and vented.
  15. Pumps are rotating correctly.
  16. Air has been eliminated from closed loop hydronic systems.
  17. Proper strainer baskets are clean and in place.
  18. Service and balance valves are open.
  19. Installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers- verify that locations of these balancing devices are accessible and all required devices have been installed for proper balancing of the systems.
- D. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- E. Beginning of work means acceptance of existing conditions.

### 3.3 PREPARATION

- A. Hold a pre-balancing meeting at least one week prior to starting TAB work.

1. Require attendance by all installers whose work will be tested, adjusted, or balanced.
- B. Provide a TAB Plan that includes strategies and step-by-step procedures.
- C. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer of Record to facilitate spot checks during testing.
- D. Provide additional balancing devices as required.

#### 3.4 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- C. Heating Water Systems: Adjust to within plus or minus 10 percent of design.
- D. Cooling Water Systems: Adjust to within plus or minus 5 percent of design.

#### 3.5 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
  1. Running log of events and issues.
  2. Discrepancies, deficient or uncompleted work by others.
  3. Contract interpretation requests.
  4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

### 3.6 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust fans to deliver the design air flow capacity at the design static pressure. Fan sheaves shall be replaced as necessary to obtain desired results. Provide all labor and material.
- E. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- F. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- G. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- H. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- I. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- J. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- K. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- L. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- M. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.
- N. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

- O. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.
- P. On fan powered VAV boxes, adjust air flow switches for proper operation.
- Q. Balance all individual air inlets and outlets.

### 3.7 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.
- G. Report flow rates that are not within plus/minus 10 percent of design flow.

### 3.8 HEAT EXCHANGER PROCEDURE

- A. Measure water flow through all circuits.
- B. Adjust water flow to within specified tolerances.
- C. Measure inlet and outlet water temperatures.
- D. Measure inlet steam pressure.
- E. Check settings and operation of safety and relief valves. Record settings.

### 3.9 MOTOR PROCEDURE

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
  - 1. Manufacturer's name, model number, and serial number.
  - 2. Motor horsepower rating.
  - 3. Motor rpm.
  - 4. Efficiency rating.
  - 5. Nameplate and measured voltage, each phase.
  - 6. Nameplate and measured amperage, each phase.
  - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

### 3.10 TEMPERATURE CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.

- I. Check main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

### 3.11 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

### 3.12 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
  - 1. Pump curves.
  - 2. Fan curves.
  - 3. Manufacturers' test data.
  - 4. Field test reports prepared by system and equipment installers.
  - 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
  - 1. Title page.

2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
  - a. Indicated versus final performance.
  - b. Notable characteristics of systems.
  - c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
  - a. Settings for outdoor-, return-, and exhaust-air dampers.
  - b. Conditions of filters.
  - c. Cooling coil, wet- and dry-bulb conditions.
  - d. Face and bypass damper settings at coils.
  - e. Fan drive settings including settings and percentage of maximum pitch diameter.
  - f. Inlet vane settings for variable-air-volume systems.
  - g. Settings for supply-air, static-pressure controller.
  - h. Other system operating conditions that affect performance.

- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
  2. Water and steam flow rates.
  3. Duct, outlet, and inlet sizes.
  4. Pipe and valve sizes and locations.
  5. Terminal units.
  6. Balancing stations.
  7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement and class.
    - g. Discharge arrangement.
    - h. Sheave make, size in inches, and bore.
    - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    - j. Number, make, and size of belts.
    - k. Number, type, and size of filters.
  2. Motor Data:
    - a. Motor make, and frame type and size.
    - b. Horsepower and rpm.
    - c. Volts, phase, and hertz.
    - d. Full-load amperage and service factor.
    - e. Sheave make, size in inches, and bore.
    - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
  3. Test Data (Indicated and Actual Values):
    - a. Total air flow rate in cfm.

- b. Total system static pressure in inches wg.
- c. Fan rpm.
- d. Discharge static pressure in inches wg.
- e. Filter static-pressure differential in inches wg.
- f. Preheat coil static-pressure differential in inches wg.
- g. Cooling coil static-pressure differential in inches wg.
- h. Heating coil static-pressure differential in inches wg.
- i. Outdoor airflow in cfm.
- j. Return airflow in cfm.
- k. Outdoor-air damper position.
- l. Return-air damper position.
- m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

- a. System identification.
- b. Location.
- c. Coil type.
- d. Number of rows.
- e. Fin spacing in fins per inch.
- f. Make and model number.
- g. Face area in sq. ft.
- h. Tube size in NPS.
- i. Tube and fin materials.
- j. arrangement.

2. Test Data (Indicated and Actual Values):

- a. Air flow rate in cfm.
- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.
- d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
- e. Return-air, wet- and dry-bulb temperatures in deg F.
- f. Entering-air, wet- and dry-bulb temperatures in deg F.
- g. Leaving-air, wet- and dry-bulb temperatures in deg F.
- h. Water flow rate in gpm.
- i. Water pressure differential in feet of head or psig.
- j. Entering-water temperature in deg F.
- k. Leaving-water temperature in deg F.
- l. Refrigerant expansion valve and refrigerant types.
- m. Refrigerant suction pressure in psig.
- n. Refrigerant suction temperature in deg F.
- o. Inlet steam pressure in psig.

G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

- a. System identification.
- b. Location.
- c. Make and type.
- d. Model number and unit size.
- e. Manufacturer's serial number.
- f. Fuel type in input data.
- g. Output capacity in Btu/h.
- h. Ignition type.
- i. Burner-control types.
- j. Motor horsepower and rpm.
- k. Motor volts, phase, and hertz.
- l. Motor full-load amperage and service factor.
- m. Sheave make, size in inches, and bore.
- n. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

- a. Total air flow rate in cfm.
- b. Entering-air temperature in deg F.
- c. Leaving-air temperature in deg F.
- d. Air temperature differential in deg F.
- e. Entering-air static pressure in inches wg.
- f. Leaving-air static pressure in inches wg.
- g. Air static-pressure differential in inches wg.
- h. Low-fire fuel input in Btu/h.
- i. High-fire fuel input in Btu/h.
- j. Manifold pressure in psig.
- k. High-temperature-limit setting in deg F.
- l. Operating set point in Btu/h.
- m. Motor voltage at each connection.
- n. Motor amperage for each phase.
- o. Heating value of fuel in Btu/h.

H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

- a. System identification.
- b. Location.
- c. Coil identification.

- d. Capacity in kW
- e. Number of stages.
- f. Connected volts, phase, and hertz.
- g. Rated amperage.
- h. Air flow rate in cfm.
- i. Face area in sq. ft.
- j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

- a. Heat output in kW
- b. Air flow rate in cfm.
- c. Air velocity in fpm.
- d. Entering-air temperature in deg F.
- e. Leaving-air temperature in deg F.
- f. Voltage at each connection.
- g. Amperage for each phase.

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

- a. System identification.
- b. Location.
- c. Make and type.
- d. Model number and size.
- e. Manufacturer's serial number.
- f. Arrangement and class.
- g. Sheave make, size in inches, and bore.
- h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

- a. Motor make, and frame type and size.
- b. Horsepower and rpm.
- c. Volts, phase, and hertz.
- d. Full-load amperage and service factor.
- e. Sheave make, size in inches, and bore.
- f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
- g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

- a. Total airflow rate in cfm.
- b. Total system static pressure in inches wg.
- c. Fan rpm.

- d. Discharge static pressure in inches wg.
  - e. Suction static pressure in inches wg.
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
- 1. Report Data:
    - a. System and air-handling-unit number.
    - b. Location and zone.
    - c. Traverse air temperature in deg F.
    - d. Duct static pressure in inches wg.
    - e. Duct size in inches.
    - f. Duct area in sq. ft.
    - g. Indicated air flow rate in cfm.
    - h. Indicated velocity in fpm.
    - i. Actual air flow rate in cfm.
    - j. Actual average velocity in fpm.
    - k. Barometric pressure in psig.
- K. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:
- 1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Unit make and model number.
    - d. Compressor make.
    - e. Compressor model and serial numbers.
    - f. Refrigerant weight in lb.
    - g. Low ambient temperature cutoff in deg F.
  - 2. Test Data (Indicated and Actual Values):
    - a. Inlet-duct static pressure in inches wg.
    - b. Outlet-duct static pressure in inches wg.
    - c. Entering-air, dry-bulb temperature in deg F.
    - d. Leaving-air, dry-bulb temperature in deg F.
    - e. Condenser entering-water temperature in deg F.
    - f. Condenser leaving-water temperature in deg F.
    - g. Condenser-water temperature differential in deg F.
    - h. Condenser entering-water pressure in feet of head or psig.
    - i. Condenser leaving-water pressure in feet of head or psig.
    - j. Condenser-water pressure differential in feet of head or psig.
    - k. Control settings.

- l. Unloader set points.
  - m. Low-pressure-cutout set point in psig.
  - n. High-pressure-cutout set point in psig.
  - o. Suction pressure in psig.
  - p. Suction temperature in deg F.
  - q. Condenser refrigerant pressure in psig.
  - r. Condenser refrigerant temperature in deg F.
  - s. Oil pressure in psig.
  - t. Oil temperature in deg F.
  - u. Voltage at each connection.
  - v. Amperage for each phase.
  - w. Kilowatt input.
  - x. Crankcase heater kilowatt.
  - y. Number of fans.
  - z. Condenser fan rpm.
  - aa. Condenser fan airflow rate in cfm.
  - bb. Condenser fan motor make, frame size, rpm, and horsepower.
  - cc. Condenser fan motor voltage at each connection.
  - dd. Condenser fan motor amperage for each phase.
- L. Heat-Exchanger/Converter Test Reports: For steam and hot-water heat exchangers, include the following:
- 1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Service.
    - d. Make and type.
    - e. Model and serial numbers.
    - f. Ratings.
  - 2. Steam Test Data (Indicated and Actual Values):
    - a. Inlet pressure in psig.
    - b. Condensate flow rate in lb/h.
  - 3. Primary Water Test Data (Indicated and Actual Values):
    - a. Entering-water temperature in deg F.
    - b. Leaving-water temperature in deg F.
    - c. Entering-water pressure in feet of head or psig.
    - d. Water pressure differential in feet of head or psig.
    - e. Water flow rate in gpm.
  - 4. Secondary Water Test Data (Indicated and Actual Values):
    - a. Entering-water temperature in deg F.

- b. Leaving-water temperature in deg F.
- c. Entering-water pressure in feet of head or psig.
- d. Water pressure differential in feet of head or psig.
- e. Water flow rate in gpm

M. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.13 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
  - a. Measure airflow of at least 10 percent of air outlets.
  - b. Measure water flow of at least 5 percent of terminals.
  - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
  - d. Verify that balancing devices are marked with final balance position.
  - e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner's Representative.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of the Owner's Representative.
3. The Owner's Representative shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
  5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
  2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- D. Prepare test and inspection reports.

#### 3.14 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

## SECTION 23 07 13

### HVAC INSULATION

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Duct insulation.
- B. Duct liner.
- C. Insulation jackets.
- D. Equipment insulation.
- E. Covering.
- F. Piping insulation.
- G. Flexible removable and reusable blanket insulation.
- H. Jackets and accessories.

##### 1.2 REFERENCE STANDARDS

- A. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2016.
- B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- D. ASTM C165 - Standard Test Method for Measuring Compressive Properties of Thermal Insulations; 2007 (Reapproved 2012).
- E. ASTM C302 - Standard Test Method for Density and Dimensions of Preformed Pipe-Covering-Type Thermal Insulation; 2013.
- F. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging; 2008 (Reapproved 2014).
- G. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.

- H. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2013.
- I. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013.
- J. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing; 2010 (Reapproved 2016).
- K. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014.
- L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- M. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- N. City of Chicago Building Code - Municipal Code of Chicago for the Building Industry; 2017.
- O. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

### 1.3 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- B. Shop Drawings:
  1. Detail insulation application at elbows, fittings, flanges, and specialties for each type of insulation.
  2. Detail removable insulation at equipment connections, and access panels.
  3. Detail application of field-applied jackets.
  4. Detail application of identification
  5. Detail application at linkages of control devices.
  6. Detail field application for each equipment type.
  7. Detail outdoor duct insulation installation.
- C. Samples: For each type of insulation jacket, and identification indicated. Identify each Sample, describing product and intended use.

1. Sample Sizes:

- a. Sheet Form Insulation Materials: 12 inches square.
- b. Sheet Jacket Materials: 12 inches square.
- c. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

D. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.6 SCHEDULING

A. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.7 WARRANTY

A. Special Warranty: Submit a written warranty, signed by the manufacturer and Installer, agreeing to replace components that fail in material or workmanship within 18 months from date of delivery, or one year from date of Preliminary Acceptance / Substantial Completion, whichever is longer.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

B. Regulatory Requirements: Insulation installations shall comply with the City of Chicago Building Code, Chapter 18-13, "Energy Conservation," and the Illinois Energy Conservation Code. Where conflicts exist between the codes identified above and this section, the more stringent requirement shall apply.

## 2.2 GLASS FIBER

- A. Manufacturers:
  - 1. Johns Manville Corporation; Micro-Lok
  - 2. Knauf Insulation; Earthwool 1000 Degree Pipe Insulation
  - 3. Owens Corning Corporation; Fiberglas Pipe Insulation ASJ
- B. Insulation(Hot Pipes): ASTM C547 and ASTM C795; rigid molded, noncombustible.
  - 1. 'K' Value: ASTM C177, 0.24 at 75 degrees F.
  - 2. Maximum Service Temperature: 850 degrees F.
  - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Insulation(Cold Pipes): ASTM C547 and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
  - 1. 'K' Value: ASTM C177, 0.23 at 75 degrees F.
  - 2. Maximum Service Temperature: 220 degrees F.
  - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- D. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.
- E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- F. Vapor Barrier Lap Adhesive: Compatible with insulation.
  - 1. Manufacturers:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    - b. Vimasco Corporation; 749.
  - 2. Water-Vapor Permeance: ASTM E96/E96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  - 3. Service Temperature Range: Minus 20 to plus 180 deg F

4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.
- G. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
- H. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- I. Outdoor Breather Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- J. Insulating Cement: ASTM C449.

### 2.3 GLASS FIBER, FLEXIBLE

- A. Manufacturer:
1. Johns Manville; \_\_\_\_\_: [www.jm.com/#sle](http://www.jm.com/#sle).
  2. Owens Corning Corporation; \_\_\_\_\_: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
  3. CertainTeed Corporation; \_\_\_\_\_: [www.certainteed.com/#sle](http://www.certainteed.com/#sle).
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
1. 'K' value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
  2. Maximum Service Temperature: 1200 degrees F.
  3. Maximum Water Vapor Absorption: 5.0 percent by weight.
- C. Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
  2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
  3. Secure with pressure sensitive tape.
- D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

- E. Outdoor Vapor Barrier Mastic:
  - 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, white color.

- F. Tie Wire: Annealed steel, 16 gage, 0.0508 inch diameter.

## 2.4 GLASS FIBER, RIGID

- A. Manufacturer:

- 1. Johns Manville
- 2. Owens Corning Corporation; 700 Series FIBERGLAS Insulation
- 3. CertainTeed Corporation

- B. Insulation: ASTM C612; rigid, noncombustible blanket.

- 1. 'K' Value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
- 2. Maximum Service Temperature: 450 degrees F.
- 3. Maximum Water Vapor Absorption: 5.0 percent.
- 4. Maximum Density: 8.0 lb/cu ft.

- C. Vapor Barrier Jacket:

- 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
- 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
- 3. Secure with pressure sensitive tape.

- D. Vapor Barrier Tape:

- 1. Manufacturers:
  - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
  - b. Compac Corporation; 110 and 111.
  - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
  - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
- 2. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

## 2.5 MINERAL-FIBER BLANKET INSULATION

- A. Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II and ASTM C1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Article "Jackets", Paragraph "Factory-Applied Jackets."
- B. Products: Subject to compliance with requirements, provide one of the following:
  - 1. CertainTeed Corp.; SoftTouch Duct Wrap.
  - 2. Johns Manville; Microlite XG.
  - 3. Knauf Insulation; Friendly Feel Duct Wrap.
  - 4. Manson Insulation Inc.; Alley Wrap.
  - 5. Owens Corning; SOFTR All-Service Duct Wrap.

## 2.6 MINERAL-FIBER BOARD INSULATION

- A. Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in Article "Jackets", Paragraph "Factory-Applied Jackets."
- B. Products: Subject to compliance with requirements, provide one of the following:
  - 1. CertainTeed Corp.; Commercial Board.
  - 2. Johns Manville; 800 Series Spin-Glas.
  - 3. Knauf Insulation; Insulation Board.
  - 4. Manson Insulation Inc.; AK Board.
  - 5. Owens Corning; Fiberglas 700 Series.

## 2.7 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturer:
  - 1. Aeroflex USA, Inc
  - 2. Armacell LLC; AP Armaflex FS
  - 3. K-Flex USA LLC; Insul-Sheet

- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
  - 1. Minimum Service Temperature: Minus 40 degrees F.
  - 2. Maximum Service Temperature: 220 degrees F.
  - 3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.
  - 1. Manufacturers:
    - a. Aeroflex USA Inc.; Aeroseal.
    - b. Armacell LCC; Armaflex 520 Adhesive.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
    - d. K-Flex USA; R-373 Contact Adhesive

## 2.8 CALCIUM SILICATE INSULATION:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Industrial Insulation Group, LLC (IIG).
- B. Properties:
  - 1. Compressive Strength: ASTM C165; 100 psi, minimum, at 5 percent deformation.
  - 2. Dry Density, Average: ASTM C302; 14.0 pcf, minimum.
  - 3. Fire-Test-Response Characteristics: ASTM E84; flame spread index of 0 and smoke developed index of 0, as determined by testing identical products per ASTM E84 by UL or another testing and inspecting agency acceptable to the authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
- C. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C533, Type I.
- D. Prefabricated Fitting Covers: Comply with ASTM C450 and ASTM C585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

## 2.9 SECUREMENTS

### A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. ITW Insulation Systems; Gerrard Strapping and Seals.
  - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Stainless Steel: ASTM A240/A240M, Type 304; 0.020-inch thick, 3/4 inch wide with wing seal or closed seal.
  - a. Type 304 for interior installations.
  - b. Type 316 for exterior installations, and interior installations subject to high humidity.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

### B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - (1) AGM Industries, Inc.; CWP-1.
    - (2) GEMCO; CD.
    - (3) Midwest Fasteners, Inc.; CD.
    - (4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - (1) AGM Industries, Inc.; CHP-1.
    - (2) GEMCO; Cupped Head Weld Pin.
    - (3) Midwest Fasteners, Inc.; Cupped Head.
    - (4) Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following:
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - (1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
    - (2) GEMCO; Perforated Base.
    - (3) Midwest Fasteners, Inc.; Spindle.
  - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following:
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - (1) GEMCO; Nylon Hangers.
    - (2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
  - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
  - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Products: Subject to compliance with requirements, provide one of the following:

- (1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
  - (2) GEMCO; Peel & Press.
  - (3) Midwest Fasteners, Inc.; Self Stick.
- b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
    - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
  7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. C & F Wire.
    - b. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company.
    - c. ITW Insulation Systems / PABCO Metals Corporation.
    - d. RPR Products, Inc.

## 2.10 JACKETS

- A. Aluminum Jacket: ASTM B209 (ASTM B209M).
  1. Thickness: 0.016 inch sheet.
  2. Finish: Smooth.
  3. Joining: Longitudinal slip joints and 2 inch laps.
  4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.

5. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.
- B. Stainless Steel Jacket: ASTM A240/A240M
1. Sheet and roll stock ready for shop or field sizing.
  2. Material, finish, and thickness are indicated in field-applied jacket schedules.
  3. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
  4. Moisture Barrier for Outdoor Applications: 2.5-mil-thick polysurlyn.
  5. Factory-Fabricated Fitting Covers: Fabricated from the same material, finish, and thickness as jacket. Provide factory-fabricated covers for preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows; tee covers; flange and union covers; end caps; beveled collars; and valve covers. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

## 2.11 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by UL or another testing and inspecting agency acceptable to the authorities having jurisdiction.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; FlameChek.
    - b. Johns Manville; Firetemp Wrap.
    - c. Nelson Firestop Products; Nelson FSB Flameshield Blanket.
    - d. Thermal Ceramics; FireMaster Duct Wrap.
    - e. 3M; Fire Barrier Wrap Products.
    - f. Unifrax Corporation; FyreWrap.

## 2.12 DUCT LINER

# PART 3 EXECUTION

## 3.1 EXAMINATION

- A. Verify that ducts have been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

## 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Keep insulation materials dry during application and finishing.
- C. Install insulation with least number of joints practical.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- F. Install multiple layers of insulation with longitudinal and end seams staggered.
- G. Insulated ducts conveying air below ambient temperature:
  - 1. Provide insulation with vapor barrier jackets.
  - 2. Finish with tape and vapor barrier jacket.
  - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
  - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- H. Insulated ducts conveying air above ambient temperature:
  - 1. Provide with or without standard vapor barrier jacket.
  - 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- I. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
  - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  - 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

- a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
- b. On duct sides with dimensions larger than 18 inches space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
- c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
- d. Do not over compress insulation during installation.
- e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

J. Weatherproof Rectangular Duct Insulation

- 1. Provide flexible elastomeric insulation as required to provide the required R-values indicated in the schedule at the end of Part 3. Provide on the exterior of all supply and return ducts exposed to the weather. Cover insulation with a field-applied jacket.
- 2. Install duct insulation in shingled fashion to shed water, beginning at the bottom and working to the top of the duct. Top of duct insulation shall overlap the side of duct insulation. Side of duct insulation shall overlap the bottom of duct insulation. Provide corner angles at each corner.
- 3. The ductwork shall be sloped to prevent water from accumulating. Ducts shall be sloped not less than 1/4-inch per foot (2 percent) from the high point to the low points at the outside edges. Insulation thickness shall be the minimum required to provide the R-values indicated in the schedule at the end of Part 3. Duct pitch shall be provided by the duct supports
- 4. Flexible elastomeric insulation shall be completely adhered directly to clean, oil-free surfaces with a full coverage of waterproof adhesive recommended by the insulation manufacturer.
- 5. Butt-edge seams shall be adhered using adhesives recommended by the insulation manufacturer. Provisions for expansion and contraction shall be made. Overlap the insulation 1/4-inch at the butt-edge seams and compress the edges into place.
- 6. Standing metal duct seams shall be insulated as required to provide the R-values indicated in the schedule at the end of Part 3.
- 7. Insulation seams shall be staggered when applying multiple layers of insulation. Secure each layer of insulation to duct with manufacturer's recommended adhesive.

8. Longitudinal seams and end joints shall be sealed with adhesive recommended by insulation manufacturer, as required to eliminate openings in insulation and prevent passage of outside air to surface of duct being insulated.
9. Vapor retarder type mastic, or joint sealer, shall be applied on longitudinal and butt joints to prevent moisture and moisture vapor infiltration. Vapor retarder butt joints shall be sealed with 3-inch wide vapor retarder tape.
10. Tightly wrap the insulation circumferentially with saran film. Overlap the seams by a minimum of 2 inches. Seal the overlapped seams with vapor retarder tape.
11. Jacketing shall be secured with 1/2-inch wide stainless steel bands on 12-inch centers. Rivets, screws, staples, or any other fastener capable of penetrating the underlying vapor retarder shall not be used.

K. Weatherproof Round Duct Insulation

1. Provide flexible elastomeric insulation as required to provide the required R-values indicated in the schedule at the end of Part 3. Provide on the exterior of all supply and return ducts exposed to the weather. Cover insulation with a field-applied jacket.
2. Blanket type insulation shall be used on all round ductwork. Insulation shall be wrapped around the duct - stretching of insulation is not acceptable. Longitudinal seams shall be located on the lower half of round ductwork.
3. Flexible elastomeric insulation shall be completely adhered to clean oil-free surfaces with a full coverage of waterproof adhesive recommended by the insulation manufacturer.
4. Butt-edge seams shall be adhered using adhesives recommended by the insulation manufacturer. Provisions for expansion and contraction shall be made. Overlap the insulation 1/4-inch at the butt-edge seams and compress the edges into place.
5. Standing metal duct seams shall be insulated as required to provide the required R-values shown in the schedule at the end of Part 3.
6. Vapor retarder type mastic, or joint sealer, shall be applied on longitudinal and butt joints to prevent moisture and moisture vapor infiltration. Vapor retarder butt joints shall be sealed with 3-inch wide vapor retarder tape.
7. Insulation seams shall be staggered when applying multiple layers of insulation. Secure each layer of insulation to duct with adhesive recommended by insulation manufacturer.

8. Tightly wrap the insulation circumferentially with saran film. Overlap the seams by a minimum of 2 inches. Seal the overlapped seams with vapor retarder tape.
  9. Jacketing shall be secured with 1/2-inch wide stainless steel bands on 12-inch centers. Rivets, screws, staples, or any other fastener capable of penetrating the underlying vapor retarder shall not be used.
- L. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with with calked aluminum jacket with seams located on bottom side of horizontal duct section.
- M. Equipment, Tank, and Vessel Insulation Installation
1. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
    - a. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
    - b. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
    - c. Protect exposed corners with secured corner angles.
    - d. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
      - (1) Do not weld anchor pins to ASME-labeled pressure vessels.
      - (2) Select insulation hangers and adhesives that are compatible with service temperature and with substrate.
      - (3) On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
      - (4) Do not over-compress insulation during installation.
      - (5) Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
      - (6) Impale insulation over anchor pins and attach speed washers.
      - (7) Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
    - e. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
    - f. Where insulation hangers on equipment and vessels are not permitted or practical, where insulation support rings are not provided, or where insulation is to be secured with tie wire or bands, install a girdle network for securing insulation.
      - (1) Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs.

- (2) Place one circumferential girdle around equipment approximately 6 inches from each end.
  - (3) Install wire or cable between two circumferential girdles 12 inches o.c.
  - (4) Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle.
  - (5) Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c.
- g. Stagger joints between insulation layers at least 3 inches.
  - h. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
  - i. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
  - j. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
2. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
- a. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
  - b. Seal longitudinal seams and end joints.
3. Insulation Installation on Pumps:
- a. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch-diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
  - b. For hot water systems, fabricate boxes from galvanized steel, at least 0.050-inch thick.
  - c. For dual temperature, chilled water or cold water systems, fabricate boxes from stainless steel at least 0.050-inch thick.
  - d. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

### 3.3 INSTALLATION OF CALCIUM SILICATE INSULATION

#### A. Insulation Installation on Boiler Breechings and Ductwork:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation material.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch, soft-annealed, stainless steel wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth. Apply a thin finish coat to achieve smooth, uniform finish.

#### B. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Apply a thin finish coat to achieve smooth, uniform finish.

#### C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
4. Finish flange insulation same as pipe insulation.

- D. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
  2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with stainless steel wire.
  3. Finish fittings insulation same as pipe insulation.
- E. Insulation Installation on Valves and Pipe Specialties:
1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to strainer basket without disturbing insulation.
  2. Install insulation to flanges as specified for flange insulation application.
  3. Finish valve and specialty insulation same as pipe insulation.
- F. Metal Jacket: Where indicated, apply metal jacket over finished insulation as specified in this Section for installation of metal jackets.

### 3.4 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies in accordance with Division 07 Section "Penetration Firestopping."

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor shall engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
1. Inspect ductwork, randomly selected by Architect/Engineer of Record, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each duct system defined in the Article "Duct Insulation Schedule, General".

2. Inspect field-insulated equipment, randomly selected by Architect/Engineer of Record, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each type of equipment requiring insulation for this project. For large equipment, remove only a portion adequate to determine compliance.
  3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect/Engineer of Record, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the Article "Piping Insulation Schedule, General".
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements. Architect/Engineer of Record may reject all work if sample work is found to be defective.

### 3.6 SCHEDULES

#### A. Duct Insulation Application

1. Plenums and Ducts Requiring Insulation:
  - a. Indoor, supply and outdoor air.
  - b. Indoor, concealed return located in non-conditioned space.
  - c. Indoor, return located in non-conditioned space.
  - d. Indoor, kitchen hood exhaust.
  - e. Indoor, exhaust between isolation damper and penetration of building exterior.
  - f. Outdoor, supply and return air.
2. Items Not Insulated:
  - a. Factory-insulated flexible ducts.
  - b. Factory-insulated plenums and casings.
  - c. Flexible connectors.
  - d. Vibration-control devices.
  - e. Factory-insulated access panels and doors.

B. Duct Systems Insulation Schedule

Duct Location	Outdoor Air, Supply Air, Exhaust Air (Downstream of Damper) Insulation-Installed R-Value	Return Air Insulation-Installed R-Value
Unconditioned Space (Notes 2,5,6,7)	12.0	12.0
Indirectly Conditioned Space (Notes 7)	6.0	N/A
Ceiling Cavity/ Shafts/ Soffits/ Mechanical Spaces and Rooms (Notes 4,5,6)	6.0	N/A
Exposed Locations within Conditioned Space	6.0	N/A

1. INSULATION R-VALUES, MEASURED IN (H X FT<sup>2</sup> X F)/BTU, ARE FOR THE INSULATION AS INSTALLED AND DO NOT INCLUDE FILM RESISTANCE. WHERE EXTERIOR WALLS ARE USED AS PLENUM WALLS, WALL INSULATION SHALL BE AS REQUIRED BY APPLICABLE CODES AND AUTHORITIES HAVING JURISDICTION. INSULATION RESISTANCE MEASURED ON A HORIZONTAL PLANE IN ACCORDANCE WITH ASTM C518 AT A MEAN TEMPERATURE OF 75 DEG F AT THE INSTALLED THICKNESS.
2. INCLUDING CRAWL SPACES (BOTH VENTILATED/NON-VENTILATED), FRAMED CAVITIES IN WALLS, FLOOR AND CEILING ASSEMBLIES WHICH (A) SEPARATE CONDITIONED SPACE FROM UNCONDITIONED SPACE OR OUTSIDE AIR, AND (B) ARE UNINSULATED ON THE SIDE FACING AWAY FROM CONDITIONED SPACE.
3. CAVITY CONTAINED WITHIN THE INSULATED BUILDING ENVELOPE.
4. VAPOR BARRIER REQUIRED.
5. FIELD APPLIED JACKET (STAINLESS STEEL, OR ALUMINUM, FOR EXTERIOR APPLICATIONS, PVC FOR INTERIOR EXPOSED LOCATIONS).
6. PROVIDE MINERAL FIBER BOARD WITH FIELD APPLIED JACKET (SS, OR AL, ALL SERVICE INTERIOR) IN EXPOSED LOCATIONS IN LIEU OF MINERAL FIBER BLANKET.

7. PROVIDE FLEXIBLE ELASTOMERIC INSULATION FOR OUTDOOR DUCTWORK

C. Piping System Insulation Schedule

Pipe System	Operating Temp (F)	Insulation	Type	Thickness (In.)					
				<1	1 to 1 1/4	1 1/2 to 3 1/2	4 to 6	8 and larger	
Generator Flue	>350	Glass Fiber Note 8	Flexible Elastomeric	4.5	5.0	5.0	5.0	5.0	
Hot Water and Dual Temp	141-200	X	X	1.5	1.5	2.0	2.0	2.0	
Hot Water Steam	60-140 Any	X	X	1.0	1.0	2.0	2.0	2.0	
Condensate AC	40-60	X	X	1.0	1.5	2.0	2.0	2.0	
Condensate Drain		X	X	1.0	1.0	1.0	1.0	1.0	

1. GLASS-FIBER INSULATION ONLY FOR HYDRONIC PIPING.
2. PVC, ALUMINUM, OR STAINLESS STEEL FIELD-APPLIED JACKET ON OUTDOOR INSTALLATIONS, EXPOSED AND CONCEALED.
3. FOR OUTDOOR USE ONLY.
4. PIPING INSULATION IS NOT REQUIRED BETWEEN THE CONTROL VALVE AND COIL ON RUNOUTS, WHEN THE CONTROL VALVE IS WITHIN 4-FEET OF THE COIL AND THE PIPE SIZE IS 1-INCH OR LESS.
5. FOR PIPING EXPOSED TO OUTDOOR AIR, INCREASE INSULATION THICKNESS BY 1-INCH.
6. INSULATION THICKNESS IS BASED ON INSULATION HAVING A THERMAL CONDUCTIVITY OF 0.27 BTU·INCH/(H·FT<sup>2</sup>·deg F).
7. VAPOR BARRIER REQUIRED.
8. CALCIUM SILICATE INSULATION WITH ALUMINUM JACKET.

D. Heat-exchanger (water-to-water for heating service) insulation shall be one of the following:

1. Mineral-Fiber Board: 2 inches thick and 3 pcf nominal density. PVC jacket.
2. Mineral-Fiber Pipe and Tank: 2 inches thick. PVC jacket.

E. Dual-service heating and cooling expansion/compression tank insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch thick. Vapor barrier and PVC jacket
2. Mineral-Fiber Pipe and Tank: 1 inch thick. Vapor barrier and PVC jacket

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 23 09 00

### HVAC CONTROL

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section includes the following:
  - 1. Roof Top Units.
  - 2. Terminal Units.
  - 3. Heat Exchanger System.
  - 4. Mechanical systems with automatic control.

##### 1.2 SYSTEM DESCRIPTION

- A. This Section defines the manner and method by which controls function.

##### 1.3 SUBMITTALS

- A. Refer to Division 23 Section "Building Automation System (BAS)" and Division 01 Sections for requirements for control shop drawings, product data, Users Manual, etc.
- B. Programming Manual: Provide DDC system programming manual as well as documentation of site specific programming prior to the start of Acceptance Phase.

##### 1.4 PROJECT RECORD DOCUMENTS

- A. Within two weeks of the completion of commissioning, provide record documents to represent the final control configuration with actual setpoints and tuning parameters as existed at acceptance.
- B. Record documents shall be modified control drawings with the actual installed information. Drawings shall be delivered in both reproducible hard copy and electronic format in AutoCAD v13 or later. Provide all supporting files, blocks, fonts, etc. required by the drawings.
- C. Provide final points list
- D. Provide final detailed wiring diagrams with all wire numbers and termination points indicated

- E. Accurately record final sequences and control logic made after submission of shop drawings.

## 1.5 DEFINITIONS/ABBREVIATIONS

- A. Absolute Minimum OA: Minimum flow rate setpoint to which the OA or primary air may throttle down. This value is acceptable as long as CO2 levels are within acceptable limits.
- B. DDC: Direct Digital Control
- C. Design Minimum OA: Minimum flow rate setpoint based on code requirements or designed system and coil capacities.
- D. BAS: Building Automation System
- E. MVR: Minimum required ventilation rate
- F. OA: Outdoor Air
- G. CHW: chilled water
- H. HW: heating water
- I. Physical Point: A point on the BAS that is physically connected to an I/O device such that a hardware point exists
- J. Virtual Point: A point to store values (i.e.: a setpoint) that do not represent a physical device

## PART 2 PRODUCTS (NOT USED)

## PART 3 PART 3 - EXECUTION

### 3.1 RTU SINGLE ZONE

- A. General: The air handler shall be fully controlled by the BAS. For details on the referenced logic strategies refer to item 3.2 Air Handling Units General: Logic Strategies. Air handler control logic strategies shall include Air handler control logic strategies shall include:
  - 1. scheduled occupancy with optimum preoccupancy
  - 2. night purge
  - 3. sequenced heating and cooling

- B. Space Temperature Setpoints: Three setpoints shall apply. Normal (72°F adj.), setback heating (65°F (adj.)), and setback cooling (85°F). These three values shall be the only values changed by the operator to adjust space temperatures. All other deadbands, differentials, etc. shall be calculated in the program logic (unless another means is provided to prohibit overlap of the heating and cooling loops and ensure a dead band such as function block templates that restrict the setpoint input). During the normal periods, separate heating and cooling setpoints shall be calculated.
1. Normal space cooling setpoint: shall be the normal space temperature plus 2°F (adj.)
  2. Normal space heating setpoint: shall be the normal space temperature minus 2°F (adj.)
  3. The space temperature setpoints above shall be the only values changed by the operator to adjust space temperatures. All other deadbands, differentials, etc. shall be calculated in the program logic (unless another means is provided to prohibit overlap of the heating and cooling loops and ensure a dead band such as function block templates that restrict the setpoint input).
- C. Discharge Air Setpoint: The discharge air setpoint will be reset by space temperature on a ratchet loop that increases and decreases the setpoint based upon variance from space temperature.
1. Heating: The discharge air temperature will be reset from 68°F (adj.) to a fixed maximum of 95°F (adj.) based upon the variance of space temperature from setpoint.
  2. Cooling: The discharge air temperature will be reset from 68°F (adj.) to a fixed minimum of 55°F (adj.) based upon the variance of space temperature from setpoint.
  3. The BAS shall shut down the RTU through software and require a manual reset if the discharge air temperature falls below 40°F (adj.) for more than 1 minute.
- D. Supply Fan Enable: BAS shall control the fans as follows:
1. Start/Stop: BAS shall command the operation of the fan and it shall run continuously in occupied and night purge modes.] Unit shall cycle on as needed during the night setback mode.
  2. Proof: BAS shall prove fan operation and use the status indication to accumulate runtime. Upon failure of the fan, the BAS shall enunciate an alarm as specified above.

- E. Economizer Dampers: BAS shall control the dampers as follows:
1. Closed: When AH is deenergized, dampers shall remain in their “off” positions. When the unit is energized during the unoccupied period, the minimum damper position/ flow rate shall be 0% / 0cfm.
  2. Minimum Damper Position (constant): During the occupied period, applicable RA and OA dampers shall never be positioned less than the position set for the required minimum OA ventilation rate. This minimum position shall be determined by the Test & Balance Contractor. The BAS contractor shall coordinate with the T&B contractor and input the minimum position into the applicable controller logic.
  3. Airside Economizer: BAS shall modulate the mixing dampers to provide “free cooling” when conditions merit. The free cooling shall generally be staged before any mechanical cooling. While conditions merit, dampers shall be modulated in a PID loop to maintain the mixed air temperature at its setpoint. The mixed air temperature setpoint shall be equal to the discharge air temperature setpoint - 2°F. Economizer logic shall remain enabled during night purge where applicable. Economizer mode shall be active while the unit is energized AND outside air temperature falls below the switching setpoint of 70°F (adj.) (with 5°F cycle differential). Economizer mode shall be inactive when outside air temperature rises above switching setpoint, dampers shall return to their scheduled minimum positions as specified above.
- F. Electrical Heat:
1. The staging of the electrical heater will be controlled locally by an integral control loop supplied with the RTU. The BAS will have the ability to reset the discharge air setpoint.
  2. Or, the electrical heater will be controlled via a PID loop to maintain the discharge temperature at the heating discharge temperature setpoint. The heating discharge temperature setpoint equal the discharge air temperature setpoint -2°F.
- G. DX Cooling:
1. The staging of the DX cooling system will be controlled locally by an integral control loop supplied with the RTU.
  2. Or, the DX system will be controlled via a PID loop to maintain the discharge air temperature at the discharge temperature setpoint.

H. Diagnostics: BAS execute the following diagnostic strategies as detailed in item 3.2 Air Handling Units General: Diagnostics. Diagnostic Logic strategies shall include:

1. Run Time Limit
2. DP Transmitter Filter Monitoring

### 3.2 UNIT HEATER ELECTRIC

A. General: A wall mounted thermostat will cycle the staged electric heating to maintain an adjustable setpoint.

### 3.3 EXHAUST FANS

A. General Exhaust fans: BAS shall control the starting and stopping of these fans as follows.

1. Start/Stop: BAS shall command the operation of the Exhaust fan and it shall run continuously during the occupied period.
2. Proof: BAS shall prove fan operation and use the status indication to accumulate runtime. Upon failure of the exhaust fan, the BAS shall enunciate an alarm as specified above.

B. T-Stat controlled Exhaust fans and heater shall be controlled by a thermostat to maintain a maximum of 85°F. Whenever the fan runs, its associated isolation damper & OA damper shall open. Whenever the fan stops, the dampers shall close. Thermostat shall also operate unit heater to maintain a minimum temperature of 65°F.

### 3.4 ELECTRICAL/TELECOM ROOM MONITORING

A. Provide a space temperature sensor to monitor the temperature of the room through the BAS.

### 3.5 HEAT EXCHANGERS

A. General: BAS shall control the heat exchangers of generator jacket water system and provide monitoring and diagnostic information for management purposes.

1. Cooling Enable: Cooling shall always be enabled when the generator is enabled.

B. Jacket Water Supply Temperature Setpoint: The jacket water supply temperature setpoint will be adjustable from 120°F to 140°F.

C. Heating Water Supply Temperature Control:

1. The BAS shall modulate the cooling water control valves to the Heat Exchanger in series via PID loop to maintain the jacket water supply temperature setpoint.
2. A temperature switch will monitor the temperature of the jacket water circuit. The switch will be hard wired to close the control valves if the water temperature exceeds 160F. The switch will have a second set of contacts to provide an alarm input to the BAS.

END OF SECTION

SECTION 23 21 13  
HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Hydronic system requirements.
- B. Heating water and dual temperature piping, above grade.
- C. Condenser water piping, above grade
- D. Equipment drains and overflows
- E. Pipe hangers and supports.
- F. Unions, flanges, mechanical couplings, and dielectric connections.

1.2 REFERENCE STANDARDS

- A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators; 2017.
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.
- C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2012.
- D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.
- E. ASME B31.9 - Building Services Piping; 2014.
- F. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; 2017.
- G. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- H. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service; 2015.
- I. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2017.

- J. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2014).
- K. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).
- L. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2016.
- M. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2016.
- N. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992 (Reapproved 2014).
- O. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2013).
- P. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011 (Amended 2012).
- Q. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).
- R. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010.
- S. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2012.
- T. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2017.
- U. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2017.
- V. AWWA C606 - Grooved and Shouldered Joints; 2015.
- W. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.

### 1.3 SUBMITTALS

- A. Product Data:
  1. Include data on pipe materials, pipe fittings, valves, and accessories.
  2. Provide manufacturers catalogue information.
  3. Indicate valve data and ratings.
  4. Show grooved joint couplings, fittings, valves, and specialties on drawings and product submittals, specifically identified with the manufacturer's style or series designation.

- B. Provide 1/4" scale layout/fabrication shop drawings for all piping systems.
- C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- D. Maintenance Data: Include record drawings, installation instructions, spare parts lists, exploded assembly views.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M.
- C. Welding: Qualify processes and operators according to ASME BPVC-IX.
  - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
  - 3. All welders certificates shall be on file at project site
  - 4. ASME Compliance: Comply with ASME B31.9 for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME BPVC-VIII-1.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

## PART 2 PRODUCTS

### 2.1 HYDRONIC SYSTEM REQUIREMENTS

- A. Comply with ASME B31.9 and applicable federal, state, and local regulations.
- B. Piping: Provide piping, fittings, hangers and supports as required, as indicated, and as follows:
  - 1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
  - 2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
  - 3. Grooved mechanical joints may be used in accessible locations only.
    - a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Architect/Engineer of Record.
    - b. Grooved mechanical connections and joints comply with AWWA C606.
      - (1) Ductile Iron: Comply with ASTM A536, Grade 65-45-12.
      - (2) Steel: Comply with ASTM A106/A106M, Grade B or ASTM A53/A53M.
  - 4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
- C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
  - 1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.
- D. Valves: Provide valves where indicated:
  - 1. Provide drain valves where indicated, and if not indicated provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch ball valves with cap; pipe to nearest floor drain.
  - 2. On discharge of condenser water pumps, use spring loaded check valves.

3. For throttling, bypass, or manual flow control services, use globe, ball, or butterfly valves.
4. For throttling and isolation service in chilled and condenser water systems, use only butterfly valves.
5. For shut-off and to isolate parts of systems or vertical risers, use ball or butterfly valves.

## 2.2 HEATING WATER AND DUAL TEMPERATURE PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:
  1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
  2. Threaded Joints: ASME B16.3, malleable iron fittings.
  3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
- B. Steel Pipe Sizes 12 Inch and Greater: ASTM A53/A53M, 3/8 inch wall, black, using one of the following joint types:
  1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
  2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
- C. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn, using one of the following joint types:
  1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
    - a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
    - b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
  2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
  3. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.

## 2.3 CONDENSER WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 80, black.
  - 1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings with finish matching piping; AWS D1.1/D1.1M welded.
  - 2. Threaded Joints: ASME B16.3, malleable iron fittings with finish matching piping.
  - 3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
  
- B. Steel Pipe Sizes 12 Inch and Greater: ASTM A53/A53M, 3/8 inch wall, black; using one of the following joint types:
  - 1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
  - 2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
  
- C. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn; using one of the following joint types:
  - 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
    - a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
  - 2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
  - 3. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.

## 2.4 EQUIPMENT DRAINS AND OVERFLOWS, AND MAKEUP WATER.

- A. Steel Pipe: ASTM A53/A53M, Schedule 40 galvanized; using one of the following joint types:
  - 1. Threaded Joints: Galvanized cast iron, or ASME B16.3 malleable iron fittings.
  - 2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn; using one of the following joint types:

1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
2. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.

## 2.5 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 Inches and Greater: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 Inches and Greater: Adjustable steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Greater: Steel channels with welded spacers and hanger rods, cast iron roll.
8. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
9. Wall Support for Pipe Sizes 4 Inches and Greater: Welded steel bracket and wrought steel clamp.
10. Wall Support for Hot Pipe Sizes 6 Inches and Greater: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
11. Vertical Support: Steel riser clamp.
12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

14. Floor Support for Hot Pipe Sizes 6 Inches and Greater: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
  15. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
  16. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
  17. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
- B. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.
- 2.6 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS
- A. Unions for Pipe 2 Inches and Less:
1. Ferrous Piping: 150 psig malleable iron, threaded.
  2. Copper Pipe: Bronze, soldered joints.
- B. Flanges for Pipe 2 Inches and Greater:
1. Ferrous Piping: 150 psig forged steel, slip-on.
  2. Copper Piping: Bronze.
  3. Gaskets: 1/16 inch thick preformed neoprene.
- C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
1. Dimensions and Testing: In accordance with AWWA C606.
  2. Mechanical Couplings: Comply with ASTM F1476.
  3. Housing Material: Ductile iron, galvanized complying with ASTM A536.
  4. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
  5. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
  6. When pipe is field grooved, provide coupling manufacturer's grooving tools.

7. Manufacturers:
  - a. Grinnell Products, a Tyco Business
  - b. Victaulic Company
  - c. Anvil

D. Dielectric Connections:

1. Waterways:
  - a. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
  - b. Dry insulation barrier able to withstand 600 volt breakdown test.
  - c. Construct of galvanized steel with threaded end connections to match connecting piping.
  - d. Suitable for the required operating pressures and temperatures.
2. Flanges:
  - a. Dielectric flanges with same pressure ratings as standard flanges.
  - b. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
  - c. Dry insulation barrier able to withstand 600 volt breakdown test.
  - d. Construct of galvanized steel with threaded end connections to match connecting piping.
  - e. Suitable for the required operating pressures and temperatures.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.
- C. Remove scale and dirt on inside and outside before assembly.
- D. Prepare piping connections to equipment using jointing system specified.
- E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- F. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 - HVAC Water Treatment for additional requirements.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install heating water, glycol, chilled water, condenser water, and engine exhaust piping to ASME B31.9 requirements.
- C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space and to avoid interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Sleeve pipe passing through partitions, walls and floors.
- G. Install firestopping to preserve fire resistance rating of partitions and other elements.
- H. Slope piping and arrange to drain at low points.
- I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.
  - 1. Flexible couplings may be used in header piping to accommodate thermal growth, thermal contraction in lieu of expansion loops.
  - 2. Use flexible couplings in expansion loops.
- J. Grooved Joints:
  - 1. Install in accordance with the manufacturer's latest published installation instructions.
  - 2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.
- K. Inserts:
  - 1. Provide inserts for placement in concrete formwork.
  - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
  - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

L. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.
9. Prime coat exposed steel hangers and supports. Refer to Section 09 91 23. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

M. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 19 - HVAC Piping Insulation.

N. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

O. No dual-temperature piping shall be installed below ground and within slabs.

### 3.3 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.

3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used (compressed air may not be used).
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9.
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.

6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

### 3.4 SCHEDULES

#### A. Hanger Spacing for Copper Tubing.

1. 1/2 inch and 3/4 inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. 1 inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. 1-1/2 inch and 2 inch: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. 2-1/2 inch: Maximum span, 9 feet; minimum rod size, 3/8 inch.
5. 3 inch: Maximum span, 10 feet; minimum rod size, 3/8 inch.
6. 4 inch: Maximum span, 12 feet; minimum rod size, 1/2 inch.

#### B. Hanger Spacing for Steel Piping.

1. 1/2 inch, 3/4 inch, and 1 inch: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. 1-1/4 inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
3. 1-1/2 inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. 2 inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. 2-1/2 inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. 3 inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. 4 inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. 6 inches: Maximum span, 17 feet; minimum rod size, 1/2 inch.
9. 8 inches: Maximum span, 19 feet; minimum rod size, 5/8 inch.
10. 10 inches: Maximum span, 20 feet; minimum rod size, 3/4 inch.
11. 12 inches: Maximum span, 23 feet; minimum rod size, 7/8 inch.
12. 14 inches: Maximum span, 25 feet; minimum rod size, 1 inch.
13. 16 inches: Maximum span, 27 feet; minimum rod size, 1 inch.

14. 18 inches: Maximum span, 28 feet; minimum rod size, 1-1/4 inch.
15. 20 inches: Maximum span, 30 feet; minimum rod size, 1-1/4 inch.

END OF SECTION

SECTION 23 21 14  
HYDRONIC SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Expansion tanks.
- B. Air vents.
- C. Strainers.
- D. Pressure-temperature test plugs.
- E. Balancing valves.
- F. Relief valves.
- G. Automatic fill valves.

1.2 REFERENCE STANDARDS

- A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; 2017.

1.3 SUBMITTALS

- A. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.
- B. Certificates: Inspection certificates for pressure vessels from authority having jurisdiction.
- C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- D. Project Record Documents: Record actual locations of flow controls.
- E. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

### PART 2 PRODUCTS

#### 2.1 EXPANSION TANKS

- A. Manufacturers:
  - 1. Amtrol Inc
  - 2. Armstrong International, Inc
  - 3. ITT Bell & Gossett
  - 4. Taco, Inc
  - 5. Wessels
- B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psi, with flexible EPDM diaphragm or bladder sealed into tank, and steel support stand.
- C. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psi.

#### 2.2 AIR VENTS

- A. Manufacturers:
  - 1. Armstrong International, Inc

2. ITT Bell & Gossett
  3. Taco, Inc
- B. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.
- C. Float Type:
1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.
  2. Cast iron body and cover, float, bronze pilot valve mechanism suitable for system operating temperature and pressure; with isolating valve.

### 2.3 STRAINERS

- A. Manufacturers:
1. Armstrong International, Inc
  2. Flexicraft Industries
  3. Grinnell Products, a Tyco Business
  4. The Metraflex Company; LPD Y Strainer
- B. Size 2 inch and Under:
1. Screwed brass or iron body for 175 psi working pressure, Y pattern with 1/32 inch stainless steel perforated screen. Include blow down valve with hose connection.
- C. Size 2-1/2 inch to 4 inch:
1. Provide flanged iron body for 175 psi working pressure, Y pattern with 1/16 inch, or 3/64 inch stainless steel perforated screen. Include blow down valve with hose connection.
- D. Size 5 inch and Larger:
1. Provide flanged iron body for 175 psi working pressure, Y pattern with 1/8 inch stainless steel perforated screen. Include blow down valve with hose connection.

## 2.4 PRESSURE-TEMPERATURE TEST PLUGS

- A. Manufacturers:
  - 1. Ferguson Enterprises Inc
  - 2. Peterson Equipment Company Inc
  - 3. Sisco Manufacturing Company Inc
- B. Construction: Brass body designed to receive temperature or pressure probe with removable protective cap, and Neoprene rated for minimum 200 degrees F.
- C. Application: Use extended length plugs to clear insulated piping.

## 2.5 BALANCING VALVES

- A. Manufacturers:
  - 1. Armstrong International, Inc
  - 2. ITT Bell & Gossett
  - 3. Taco, Inc
  - 4. Griswold Controls.
  - 5. Nexus.
  - 6. Hays
  - 7. Victaulic
- B. Size 2 inch and Smaller:
  - 1. Provide ball or globe style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and NPT threaded or soldered connections.
  - 2. Metal construction materials consist of bronze or brass.
  - 3. Non-metal construction materials consist of Teflon, EPDM, or engineered resin.
- C. Size 2.5 inch and Larger:
  - 1. Provide ball, globe, or butterfly style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and flanged connections.

2. Valve body construction materials consist of cast iron or carbon steel.
3. Internal components construction materials consist of brass, bronze, Teflon, or EPDM.

## 2.6 RELIEF VALVES

### A. Manufacturers:

1. Armstrong International, Inc
2. ITT Bell & Gossett
3. Conbraco Industries

- B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

## 2.7 AUTOMATIC FILL VALVES

### A. Manufacturers:

1. Amtrol Inc.
2. Armstrong International, Inc
3. ITT Bell & Gossett
4. Taco, Inc
5. Spence Engineering Company, Inc.
6. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

- B. Operation: Automatically feeds make-up water to the hydronic system whenever pressure in the system drops below the pressure setting of the valve. Refer to Section 23 21 13 - Hydronic Piping.

### C. Materials of Construction:

1. Valve Body: Constructed of bronze or brass.
2. Internal Components: Construct of stainless steel or brass and engineered plastics or composition material.

- D. Connections:
  - 1. NPT threaded: 0.50 inch, or 0.75 inch.
  - 2. Soldered: 0.50 inch.
- E. Provide integral check valve and strainer.
- F. Maximum Inlet Pressure: 100 psi.
- G. Maximum Fluid Temperature: 180 degrees F.
- H. Operating Pressure Range: Between 10 psi and 25 psi.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions and standard mechanical details.
- B. Provide manual air vents at system high points and as indicated.
- C. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.
- D. Provide air separator on suction side of system circulation pump and connect to expansion tank in accordance with standard mechanical details.
- E. Install piping from boiler air outlet or air separator to expansion tank with a 2 percent upward slope toward tank.
- F. Provide valved drain and hose connection on strainer blow down connection.
- G. Provide pump suction fitting on suction side of base mounted centrifugal pumps where indicated and in accordance with standard mechanical details. Remove temporary strainers after cleaning systems.
- H. Support pump fittings with floor mounted pipe and flange supports.
- I. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.
- J. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
- K. Pipe relief valve outlet to nearest floor drain.

- L. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.
- M. Chemically clean and flush glycol system before adding glycol solution.
- N. Feed glycol solution to system through make-up line with pressure regulator, venting system high points.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 23 23 00

### REFRIGERANT PIPING

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Valves.
- E. Strainers.
- F. Check valves.
- G. Pressure relief valves.
- H. Filter-driers.
- I. Expansion valves.

##### 1.2 REFERENCE STANDARDS

- A. AHRI 710 - Performance Rating of Liquid-Line Driers; 2009.
- B. AHRI 750 - Thermostatic Refrigerant Expansion Valves; 2007.
- C. AHRI 760 - Performance Rating of Solenoid Valves for Use With Volatile Refrigerants; 2007.
- D. ASHRAE (REFR) - ASHRAE Handbook - Refrigeration; 2014.
- E. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2013.
- F. ASME BPVC - Boiler and Pressure Vessel Code; 2017.
- G. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators; 2017.
- H. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2013.

- I. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2016.
- J. ASME B31.9 - Building Services Piping; 2014.
- K. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- L. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2016.
- M. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011 (Amended 2012).
- N. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.
- O. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- P. UL 429 - Electrically Operated Valves; Current Edition, Including All Revisions.

### 1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. See Section 01 33 29 - LEED Sustainable Design Reporting, when required.
- C. Product Data: Provide general assembly of specialties, including manufacturers catalog information. Provide manufacturers catalog data including load capacity.
- D. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.
- E. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
  - 1. Shop Drawing Scale: 1/4 inch equals 1 foot.
- F. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- G. Test Reports: Indicate results of leak test, acid test.
- H. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.
- I. Submit welders certification of compliance with ASME BPVC-IX.

- J. Project Record Documents: Record exact locations of equipment and refrigeration accessories on record drawings.
- K. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.

#### 1.4 QUALITY ASSURANCE

- A. Designer Qualifications: Design piping system under direct supervision of a Professional Engineer experienced in design of this type of work.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum 3 years of documented experience.
- C. Comply with all City of Chicago code requirements for installation.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties in shipping containers with labeling in place.
- B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
- C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

### PART 2 PRODUCTS

#### 2.1 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 for installation of piping system.
- B. Welding Materials and Procedures: Conform to ASME BPVC-IX and applicable state labor regulations.
- C. Welders Certification: In accordance with ASME BPVC-IX.
- D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.
- E. Comply with ASHRAE Std 15.
- F. Comply with ASME B31.5
- G. Comply with all requirements of the City of Chicago Mechanical Code for relief valve requirements based on refrigerant system volume, and requirements that limit refrigerant components in the airstream.

## 2.2 PIPING

- A. Copper Tube: ASTM B280, H58 hard drawn, Type ACR or Type K complying with ASTM B88.
  - 1. Fittings: ASME B16.22 wrought copper.
  - 2. Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.
- B. Pipe Supports and Anchors:
  - 1. Provide hangers and supports that comply with MSS SP-58.
    - a. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
  - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron adjustable swivel, split ring.
  - 3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
  - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  - 5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
  - 6. Vertical Support: Steel riser clamp.
  - 7. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
  - 8. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
  - 9. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
  - 10. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
    - a. Bases: High density, UV tolerant, polypropylene or reinforced PVC.
    - b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
    - c. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.

- d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
- e. Height: Provide minimum clearance of 12 inches under pipe to top of roofing.

## 2.3 REFRIGERANT

### A. Manufacturers:

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

- B. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.

## 2.4 MOISTURE AND LIQUID INDICATORS

### A. Manufacturers:

1. Henry Technologies; \_\_\_\_\_: [www.henrytech.com/#sle](http://www.henrytech.com/#sle).
2. Parker Hannifin/Refrigeration and Air Conditioning; \_\_\_\_\_: [www.parker.com/#sle](http://www.parker.com/#sle).
3. Sporlan, a Division of Parker Hannifin; \_\_\_\_\_: [www.parker.com/#sle](http://www.parker.com/#sle).

- B. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

## 2.5 VALVES

### A. Diaphragm Packless Valves:

1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

B. Packed Angle Valves:

1. Forged brass or nickel plated forged steel, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, solder or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

C. Ball Valves:

1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.

D. Service Valves:

1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve with stainless steel springs, flared or solder ends, for maximum pressure of 500 psi.

2.6 STRAINERS

A. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

B. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

## 2.7 CHECK VALVES

### A. Globe Type:

1. Cast bronze, ductile iron, or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, removable PTFE seat; for maximum temperature of 300 degrees F and maximum working pressure of 425 psi.

## 2.8 PRESSURE RELIEF VALVES

- ### A. Straight Through or Angle Type:
- Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB, selected to ASHRAE Std 15, with standard setting of 235 psi.

## 2.9 FILTER-DRIERS

### A. Performance:

1. Flow Capacity - Liquid Line: \_\_\_\_ ton, minimum, rated in accordance with AHRI 710.
2. Pressure Drop: 2 psi, maximum, when operating at full connected evaporator capacity.
3. Design Working Pressure: 500 psi, minimum.
4. Maximum Operating Temperature: 240 deg. F.

- ### B. Cores:
- Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns, with secondary filtration to 10 microns.; of construction that will not pass into refrigerant lines.

### C. Construction: UL listed.

1. Connections: As specified for applicable pipe type.

## 2.10 EXPANSION VALVES

- ### A. Angle or Straight Through Type:
- AHRI 750; design suitable for refrigerant, brass or steel body, internal or external equalizer, bleed hole, adjustable superheat setting, replaceable inlet strainer, with non-replaceable capillary tube and remote sensing bulb and remote bulb well. Working pressure rating of 700 psig.

- ### B. Selection:
- Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.

## 2.11 ELECTRONIC EXPANSION VALVES

- A. Valve:
  - 1. Brass body with flared or solder connection, needle valve with floating needle and machined seat, stepper motor drive.
- B. Refrigeration System Control: Electronic microprocessor based unit in enclosed case, with proportional integral control of valve, on/off thermostat, air temperature alarm (high and low), solenoid valve control, liquid injection adaptive superheat control, maximum operating pressure function, night setback thermostat, timer for defrost control.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

### 3.2 INSTALLATION

- A. All refrigerant pipe sizing shall be the responsibility of the Contractor in accordance with the equipment manufacturer's recommendations.
- B. Pipe sizing shall be in accordance with the recommendations in the ASHRAE (REFR), Chapter 2 - System Practices for Halocarbon Refrigerants.
- C. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
- D. Install refrigeration specialties in accordance with manufacturer's instructions.
- E. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- F. Install piping to conserve building space and avoid interference with use of space.
- G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- H. Install refrigerant piping in protective conduit where installed belowground.

- I. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- J. Slope refrigerant piping as follows:
  - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
  - 2. Install horizontal suction lines with a uniform slope downward to compressor.
  - 3. Install traps and double risers to entrain oil in vertical runs.
  - 4. Liquid lines may be installed level.
- K. Valve and Specialties Installation:
  - 1. Install packed-angle valves in suction and discharge lines of compressor.
  - 2. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
  - 3. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
  - 4. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.
  - 5. Install thermostatic expansion valves as close as possible to distributors on evaporators.
    - a. Install valve so diaphragm case is warmer than bulb.
    - b. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
    - c. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
  - 6. Install safety relief valves where required by ASME BPVC. Pipe safety-relief-valve discharge line to outside according to ASHRAE Std 15.
  - 7. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
  - 8. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
    - a. Solenoid valves.
    - b. Thermostatic expansion valves.

- c. Hot-gas bypass valves.
  - d. Compressor.
- 9. Install receivers sized to accommodate pump-down charge.
- L. Pipe Hangers and Supports:
  - 1. Install in accordance with ASME B31.5.
  - 2. Support horizontal piping as indicated.
  - 3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
  - 4. Place hangers within 12 inches of each horizontal elbow.
  - 5. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
  - 6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
  - 7. Provide copper plated hangers and supports for copper piping.
- M. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers properly sized for the unloading of the compressor as required to entrain oil in vertical runs. Slope horizontal piping 0.40 percent in direction of flow.
- N. Provide clearance for installation of insulation and access to valves and fittings.
- O. Provide access to concealed valves and fittings.
- P. Flood piping system with nitrogen when brazing.
- Q. Insulate piping and equipment; refer to Section and Section 23 07 16.
- R. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.
- S. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.
- T. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.
- U. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- V. Fully charge completed system with refrigerant after testing.

- W. Provide electrical connection to solenoid valves. Refer to Section 26 05 83 - Wiring Connections.
- X. Install refrigerant piping in protective conduit where installed underground.
- Y. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

### 3.3 FIELD QUALITY CONTROL

- A. Test refrigeration system in accordance with ASME B31.5.
- B. Pressure test system with dry nitrogen to 200 psi. Perform final tests at 27 inches vacuum and 200 psi using halide torch. Test to no leakage.

### 3.4 SYSTEM CHARGING

- A. Charge system using the following procedures:
  1. Install core in filter dryers after leak test but before evacuation.
  2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
  3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
  4. Charge system with a new filter-dryer core in charging line.

### 3.5 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
  1. Open shutoff valves in condenser water circuit.
  2. Verify that compressor oil level is correct.
  3. Open compressor suction and discharge valves.
  4. Open refrigerant valves except bypass valves that are used for other purposes.

5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

### 3.6 SCHEDULES

A. Hanger Spacing for Copper Tubing.

1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. 1-3/8 inch OD: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. 1-5/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. 2-1/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. 2-5/8 inch OD: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. 3-1/8 inch OD: Maximum span, 10 feet; minimum rod size, 3/8 inch.
8. 3-5/8 inch OD: Maximum span, 11 feet; minimum rod size, 1/2 inch.
9. 4-1/8 inch OD: Maximum span, 12 feet; minimum rod size, 1/2 inch.

END OF SECTION

## SECTION 23 31 00

### HVAC DUCTS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Metal ductwork.
- B. Manufactured ductwork and fittings

##### 1.2 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- B. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2017.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
- D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- E. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- F. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2016.
- G. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- I. AWS D9.1/D9.1M - Sheet Metal Welding Code; 2018.
- J. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.
- K. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2018.
- L. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2017.

- M. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).
- N. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines; 2001.
- O. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; 2012, 2nd Edition.
- P. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

### 1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. See Section 01 33 29 - LEED Sustainable Design Reporting, when required.
- C. Product Data: Provide data for duct materials.
- D. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for all systems. Drawn at a scale of not less than 1/4" = 1'-0".
  - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
  - 2. Duct layout indicating sizes and pressure classes.
  - 3. Elevations of top and bottom of ducts.
  - 4. Dimensions of main duct runs from building grid lines.
  - 5. Fittings.
  - 6. Reinforcement and spacing.
  - 7. Seam and joint construction.
  - 8. Penetrations through fire-rated and other partitions.
  - 9. Equipment installation based on equipment being used on Project.
  - 10. Duct accessories, including access doors and panels.
  - 11. Hangers and supports, including methods for duct and building attachment and vibration isolation.

- E. Delegated-Design Submittal:
    - 1. Spacing of hangers and supports.
    - 2. Design calculations: Calculations, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports.
  - F. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
    - 1. Ceiling suspension assembly members.
    - 2. Other systems installed in same space as ducts.
    - 3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
    - 4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
  - G. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK).
  - H. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.
- 1.4 QUALITY ASSURANCE
- A. Welding: Qualify procedures and personnel according to AWS D9.1/D9.1M for duct joint and seam welding.
- 1.5 DELIVERY, STORAGE AND HANDLING
- A. All materials shall be stored in a designated area and protected from inclement weather.
  - B. All materials shall be secured so as not to be a hazard during the construction process.
  - C. Store ductwork with tight-fitting seals on open ends to ensure ductwork is free of all dirt, debris and moisture during the installation process.
- 1.6 FIELD CONDITIONS
- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.
- B. Aluminum for Ducts: ASTM B209 (ASTM B209M); aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength.
- C. Stainless Steel for Ducts: ASTM A480/A480M, Type 304 and 316.
- D. Carbon-Steel Sheets: ASTM A36/A36M, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.
- E. PVC Coating for Steel Ducts: 4 mils polyvinyl chloride plastic on both sides.
- F. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
  - 1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
  - 2. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
- G. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
  - 1. Hangers Installed in Corrosive Atmospheres: All-thread rods used in pool areas, pool equipment rooms, and pool supporting spaces shall be aluminum if the ducts are aluminum and stainless steel if the ducts are stainless steel.
  - 2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
  - 3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

- H. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
  - 1. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
    - a. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
    - b. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- I. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- J. Trapeze and Riser Supports: Steel shapes complying with ASTM A36/A36M.
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
  - 3. Supports for Aluminum Ducts: Aluminum support materials.
- K. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
- L. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.
- M. Insulated Flexible Ducts: Flexible ducts wrapped with flexible glass fiber insulation, enclosed by seamless aluminum pigmented plastic vapor barrier jacket; maximum 0.23 K value at 75 degrees F.
- N. Sealant Materials
  - 1. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes combinations of open-weave fabric strips and mastics.
  - 2. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.
  - 3. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use O.
  - 4. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

## 2.2 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.
- B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.
- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- E. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).
- F. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

## 2.3 MANUFACTURED DUCTWORK AND FITTINGS

- A. Double Wall Insulated Round Ducts: Round spiral lockseam duct with galvanized steel outer wall, solid galvanized steel inner wall; fitting with solid inner wall.
  - 1. Manufacture in accordance with SMACNA (DCS).
  - 2. Insulation:
    - a. Interstitial Insulation: Fibrous-glass liner complying with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
      - (1) Maximum "R" Value: R = 5.0 for interior ducts., R = 8.0 for exterior ducts.
      - (2) Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
      - (3) Coat insulation with antimicrobial coating.
  - 3. Manufacturers:
    - a. Lindab Inc.
    - b. McGill AirFlow LLC.
    - c. SEMCO Incorporated.
    - d. Sheet Metal Connectors, Inc.

- B. Duct Joints:
1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
  2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
  3. Ducts Larger Than 72 Inches in Diameter: Companion angle flanged joints per SMACNA (DCS), Figure 3-2.
  4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
  5. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.
- C. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA (DCS) with metal thicknesses specified for longitudinal-seam straight ducts.
- D. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- E. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA (DCS) unless otherwise indicated.
  2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:
    - a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
    - b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.
    - c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
    - d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
  3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:
    - a. Ducts 3 to 26 Inches in Diameter: 0.034 inch.
    - b. Ducts 27 to 50 Inches in Diameter: 0.040 inch.
    - c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
    - d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.

4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.
5. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
6. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
7. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
8. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
9. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick with 2-piece welded construction.
10. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.
11. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.

## PART 3 EXECUTION

### 3.1 DUCT APPLICATIONS

- A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:
  1. Supply Ducts (constant volume units): +2".
  2. Supply Ducts (before Air Terminal Units): +4".
  3. Supply Ducts (after Air Terminal Units): +2".
  4. Supply Ducts (between fan and first system fire damper): +8".
  5. Return Ducts (Negative Pressure): -2".
  6. Return Ducts (between nearest fire damper and return fan inlet): -4".

7. Return Ducts (return fan discharge and AHU intake / exhaust damper): -4".
8. Exhaust Ducts (Negative Pressure): -2".

### 3.2 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Install in accordance with manufacturer's instructions.
- C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- D. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- E. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- F. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- G. At exterior wall louvers, seal duct to louver frame and install blank-out panels.
- H. Identify and label all fire dampers and reheat coil locations on the ceiling or on a set of drawings.
- I. Provide a paint grip finish on all ductwork that is indicated on drawings to be painted.

### 3.3 CLEANING

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment that could be harmed by excessive dirt with temporary filters, or bypass during cleaning.
- B. Unless otherwise noted, do not clean existing ductwork.

### 3.4 SEAM AND JOINT SEALING

- A. Seal all duct seams and joints to the most severe requirement between the latest Chicago Building Code and SMACNA (DCS) for duct pressure class indicated.
- B. Utilize sealant designed for outdoor use with ductwork exposed to the outdoors.

- C. Seal ducts before external insulation is applied.

### 3.5 HANGING AND SUPPORTING

- A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.
- B. Support vertical ducts at maximum intervals of 16 feet and at each floor.
- C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- D. For concrete structure installations: Install concrete inserts before placing concrete.
- E. For concrete structure installations: Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

### 3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors according to Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA (DCS) for branch, outlet and inlet, and terminal unit connections.

### 3.7 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections according to SMACNA (LEAK) and prepare test reports:
  - 1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  - 2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
  - 3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat-oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch wg (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg.

4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

END OF SECTION

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## SECTION 23 33 00

### AIR DUCT ACCESSORIES

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Air turning devices/extractors.
- B. Backdraft dampers - metal.
- C. Duct access doors.
- D. Duct test holes.
- E. Fire dampers.
- F. Flexible duct connectors.
- G. Flexible ductwork
- H. Volume control dampers.

##### 1.2 REFERENCE STANDARDS

- A. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2017.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
- C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- E. ASTM E477 - Standard Test Method for Laboratory Measurements of Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers; 2013, with Editorial Revision.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.

- G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.
- H. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2018.
- I. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).
- J. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.
- K. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.
- L. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.

### 1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide for shop fabricated assemblies including volume control dampers. Include electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers.
- D. Manufacturer's Installation Instructions: Provide instructions for fire dampers.
- E. Project Record Drawings: Record actual locations of access doors and test holes.

### 1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A and NFPA 90B

### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.
- B. Materials delivered to the site must be coordinated with the site supervisor prior to delivery.
- C. All materials shall be stored in a designated area and protected from the environment.
- D. All materials shall be secured so as not to be a hazard during the construction process.

- E. All materials must be free of all dirt, debris and moisture during the installation process.

## PART 2 PRODUCTS

### 2.1 SHEET METAL MATERIALS

- A. Comply with SMACNA (DCS) for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A653/A653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Stainless Steel: ASTM A480/A480M Type 304 (specify Type 314 as required by the application).
- D. Aluminum Sheets: ASTM B209 alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: ASTM B221, alloy 6063, temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.
- H. All accessories installed in harsh environments (Natatorium, shower, fume hood exhaust, etc.) shall be provided with corrosion protection appropriate to the application.

### 2.2 AIR TURNING DEVICES/EXTRACTORS

- A. Manufacturers:
  - 1. Carlisle HVAC Products; Dynair Hollow Vane and Rail (Double Wall Vane)
  - 2. Krueger-HVAC, Division of Air System Components
  - 3. Ruskin Company, a brand of Johnson Controls
  - 4. Titus HVAC, a brand of Johnson Controls
- B. Fabricate to comply with SMACNA (DCS) for vanes and vane runners. Vane runners shall automatically align vanes.

- C. Manufactured Turning Vanes: Fabricate 1-1/2-inch- wide, single-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.
- D. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

## 2.3 BACKDRAFT DAMPERS - METAL

### A. Manufacturers:

1. Nailor Industries, Inc; \_\_\_\_\_: [www.nailor.com/#sle](http://www.nailor.com/#sle).
2. Ruskin Company, a brand of Johnson Controls; \_\_\_\_\_: [www.ruskin.com/#sle](http://www.ruskin.com/#sle).
3. Greenheck
4. Vent Products Co.
5. Price

B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

C. Frame: 0.063-inch thick extruded aluminum, with welded corners and mounting flange.

D. Blades: 0.050-inch thick aluminum sheet.

E. Blade Seals: Neoprene.

F. Blade Axles: Galvanized steel.

G. Tie Bars and Brackets: Galvanized steel.

H. Return Spring: Adjustable tension.

## 2.4 DUCT ACCESS DOORS

### A. Manufacturers:

1. Nailor Industries, Inc
2. Ruskin Company, a brand of Johnson Controls

3. CESCO Products
  4. Ductmate Industries
  5. Greenheck
  6. Vent Products Co.
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1 inch thick insulation with sheet metal cover.
1. Less Than 12 inches Square: Secure with sash locks.
  2. Up to 18 inches Square: Continuous hinge and two sash locks.
  3. Up to 24 by 48 inches: Continuous hinge and two compression latches with outside and inside handles.
  4. Access doors shall be double wall construction.

## 2.5 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.
1. Manufacturers:
    - a. Carlisle HVAC Products; Dynair Test Port with Red Cap with O-Ring Seal: [www.carlislehvac.com/#sle](http://www.carlislehvac.com/#sle).

## 2.6 FIRE DAMPERS

- A. Manufacturers:
1. Nailor Industries, Inc
  2. Ruskin Company, a brand of Johnson Controls
  3. Greenheck
  4. Vent Products Co.
  5. Price

- B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
- C. Ceiling Dampers: Galvanized steel, 22 gage, 0.0299 inch frame and 16 gage, 0.0598 inch flap, two layers 0.125 inch ceramic fiber on top side and one layer on bottom side for round flaps, with locking clip.
- D. Horizontal Dampers: Galvanized steel, 22 gage, 0.0299 inch frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.
- E. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1.0 inch pressure class ducts up to 12 inches in height.
- F. Multiple Blade Dampers: 16 gage, 0.0598 inch galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 by 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- G. Fusible Links: UL 33, separate at 160 degrees F with adjustable link straps for combination fire/balancing dampers.

## 2.7 FLEXIBLE DUCT CONNECTIONS

- A. Manufacturers:
  - 1. Carlisle HVAC Products; Dynair Connector Plus G90 Steel Offset Seam Neoprene Fabric: [www.carlislehvac.com/#sle](http://www.carlislehvac.com/#sle).
  - 2. Ductmate Industries
  - 3. Ventfabrics, Inc.
  - 4. Ward Industries
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Indoor Flexible Duct Connections: Fabric crimped into metal edging strip.
  - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
    - a. Net Fabric Width: Approximately 2 inches wide.
- D. Outdoor Flexible Duct Connections: shall be constructed of hypalon material for UV and water resistance.

## 2.8 MANUAL VOLUME CONTROL DAMPERS

- A. Manufacturers:

1. Nailor Industries, Inc; \_\_\_\_\_: [www.nailor.com/#sle](http://www.nailor.com/#sle).
  2. Ruskin Company, a brand of Johnson Controls
  3. Vent Products Co.
  4. Price
  5. Greenheck
  6. TAMCO
- B. Fabricate in accordance with SMACNA (DCS) and as indicated.
- C. Splitter Dampers:
1. Material: Same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.
  2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.
  3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw .
- D. Single Blade Dampers:
1. Fabricate for duct sizes up to 6 by 30 inch.
  2. Blade: 24 gage, 0.0239 inch, minimum.
- E. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
1. Steel Frames (For use in steel ductwork): Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
  2. Roll-Formed Steel Blades (For use with steel frames): 0.064-inch- thick, galvanized sheet steel.
  3. Aluminum Frames (For use in stainless steel or aluminum ductwork): Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.

4. Roll-Formed Aluminum Blades (For use with aluminum frames): 0.10-inch-thick aluminum sheet.
  5. Extruded-Aluminum Blades (For use with aluminum frames): 0.050-inch-thick extruded aluminum.
  6. Blade Axles: Galvanized steel. Drive shaft will be the full length of the blade.
  7. Bearings: Stainless-steel sleeve.
  8. Tie Bars and Brackets: Aluminum (aluminum or stainless steel ductwork applications), Galvanized steel (galvanized steel ductwork applications).
- F. Low-Leakage Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
1. Steel Frames (For use in steel ductwork) : galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
  2. Roll-Formed Steel Blades (For use with steel frames): 0.064-inch- thick, galvanized sheet steel.
  3. Aluminum Frames (For use in stainless steel or aluminum ductwork) : 0.10-inch- thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
  4. Roll-Formed Aluminum Blades (For use with aluminum frames): 0.10-inch-thick aluminum sheet.
  5. Extruded-Aluminum Blades (For use with aluminum frames): 0.050-inch-thick extruded aluminum.
  6. Blade Axles: Galvanized steel. Drive shaft will be the full length of the blade.
  7. Bearings: Stainless-steel sleeve thrust or ball.
  8. Blade Seals: Neoprene.
  9. Jamb Seals: Cambered stainless steel.
  10. Tie Bars and Brackets: Aluminum (aluminum or stainless steel ductwork applications), Galvanized steel (galvanized steel ductwork applications).

- G. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

### 3.2 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 23 31 00 - HVAC Ducts and Casings for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts (300 cfm or less) nearest to outside and where indicated. Provide motorized isolation damper on exhaust fans/ducts greater than 300 cfm.
- C. Install duct access doors to allow for inspecting, adjusting, and maintaining duct accessories, control devices - sensors and terminal units as follows:
  - 1. On both sides of duct coils. On terminal units coordinate upstream coil access door with equipment supplier.
  - 2. Downstream from volume dampers, turning vanes, and duct mounted equipment.
  - 3. Adjacent to fire dampers, providing access to reset or reinstall fusible links.
  - 4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot spacing.
  - 5. On sides of ducts where adequate clearance is available.
  - 6. Where indicated on plans.
  - 7. Upstream and downstream of ducted fans.
- D. Provide turning vanes in all short radius / square elbows (>45 degrees) and tees.
- E. Provide duct test holes where indicated and required for testing and balancing purposes.
- F. Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction.

Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

- G. Demonstrate re-setting of fire dampers to Board's representative.
- H. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- I. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.
  - 1. Refer to Section 23 05 48 - Vibration Controls for HVAC Piping and Equipment.
- J. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
- K. Use splitter dampers only where indicated.
- L. Install duct silencers rigidly to ducts.
- M. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- N. Connect diffusers or light troffer boots to low pressure ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- O. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

### 3.3 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

END OF SECTION

## SECTION 23 34 23

### HVAC FANS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Roof exhausters.
- B. Tubeaxial fans.
- C. Vaneaxial fans.

##### 1.2 REFERENCE STANDARDS

- A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program 2015.
- B. AMCA 99 - Standards Handbook 2016.
- C. AMCA 204 - Balance Quality and Vibration Levels for Fans 2020.
- D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating 2016.
- E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans 2014.
- F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data 2014.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- H. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations 2021.
- J. UL 705 - Power Ventilators Current Edition, Including All Revisions.
- K. UL 762 - Outline of Investigation for Power Roof Ventilators for Restaurant Exhaust Appliances Current Edition, Including All Revisions.

##### 1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

- B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. Provide wiring Diagrams: Power, signal, and control wiring.
- D. Manufacturer's Instructions: Indicate installation instructions.
- E. E. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Fan Belts: One set for each individual fan.

#### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standard: Power ventilators shall comply with UL 705.

#### 1.5 FIELD CONDITIONS

- A. Permanent ventilators may not be used for ventilation during construction.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

## 1.7 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on sea level.
- B. Operating Limits: Classify according to AMCA 99.

## 1.8 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

## 1.9 EXTRA MATERIALS

- A. Furnish one set of belts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Greenheck Fan Corporation: [www.greenheck.com](http://www.greenheck.com)
- B. Loren Cook Company: [www.lorencook.com](http://www.lorencook.com)
- C. PennBarry, Division of Air System Components: [www.pennbarry.com](http://www.pennbarry.com)
- D. Twin City Fan & Blower: [www.tcf.com](http://www.tcf.com)

### 2.2 POWER VENTILATORS - GENERAL

- A. Static and Dynamically Balanced: Comply with AMCA 204.
- B. In general, direct drive fans with ECM motors/speed controller are preferred over belt drive fans.
- C. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.
- D. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.
- E. Fabrication: Comply with AMCA 99.
- F. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- G. Kitchen Hood Exhaust Fans: Comply with requirements of NFPA 96 and UL 762.

- H. Hazardous/Fume Hood exhaust and Natatorium exhaust shall have corrosion resistant coating.
- I. Motors and Electrical Accessories: Comply with the requirements of NEMA standards.

### 2.3 ROOF EXHAUSTERS

- A. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch mesh, 0.62 inch thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.
- B. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- C. Down blast discharge direction.
- D. Direct drive motor assembly with ECM motor and variable speed controller.
- E. Roof Curb: 16 inch high self-flashing of galvanized steel with continuously welded seams, built-in cant strips.
- F. Disconnect Switch: NEMA 3R, Factory wired, non-fusible, in housing for thermal overload protected motor.
- G. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
- H. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.

### 2.4 VANEAXIAL FANS

- A. Performance Requirements:
  - 1. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.
  - 2. Sound Ratings: AMCA 301, tested to AMCA 300, and bearing the AMCA Certified Sound Rating Seal.
  - 3. Fabrication: Conform to AMCA 99.
  - 4. Performance Base: Sea level conditions.
  - 5. Temperature Limit: Maximum 300 degrees F.

B. Hub and Impeller:

1. Airfoil Impeller Blades: Adjustable die cast aluminum alloy glass reinforced polyester resin or welded steel die formed blades with belt drive.
2. Hub: Die cast aluminum alloy or cast iron hub or with belt drive of spun, welded steel, bored and keyed to shaft; to facilitate indexing of blade angle with automatic adjustment stops.
3. Cast Components: X-ray components after fabrication and statically and dynamically balance assembly before attachment to motor or shaft.

C. Casing:

1. Fabricate casing of 1/4 inch steel for fans 40 inch in diameter and smaller and 3/8 inch steel for larger fans.
2. Continuously weld, with inlet and outlet flange connections, and motor or shaft supports. Incorporate flow straightening guide vanes for fans specified for static pressures greater than 1 inch wg.
3. Finish with one coat enamel applied to interior and exterior.

D. Bearings and Drives:

1. Bearings: Heavy duty pillow block type, self-aligning, grease-lubricated ball bearings, with ABMA STD 9, L-10 life at 50,000 hours.
2. Shafts: Hot rolled steel, ground and polished, with keyway; protectively coated with lubricating oil.
3. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.
4. Belt Guard: Fabricate to SMACNA (DCS); 0.106 inch thick, 3/4 inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
5. Lubrication: Extend lubrication fittings to outside of casing.

E. Accessories:

1. Guide Vanes: Welded steel construction with airfoil vanes and casing flanges, finished to match casing.
2. Adjustable Inlet Vanes: Steel construction with blades supported at both ends with two permanently lubricated bearings, variable mechanism out of air stream terminating in single control lever with control shaft for double width fans and locking quadrant.
3. Inlet Bell: Bell mouth inlet fabricated of steel with flange.
4. Outlet Cones: Fabricated of steel with flanges, outlet area/inlet area ratio of 1.5/1.0, with center pod as recommended by manufacturer.
5. Inlet Screens: Galvanized steel welded grid to fit inlet bell.
6. Dampers: Welded steel construction, consisting of two semi-circular vanes pivoted on oil-retaining bearings in short casing section, finished with one coat enamel. Provide airstream operation closing blades by reverse air flow and gravity.
7. Access Doors: Shaped to conform to casing with quick opening latches and gaskets.

2.5 TUBEAXIAL FANS

A. Performance Requirements:

1. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.
2. Sound Ratings: AMCA 301, tested to AMCA 300, and bearing the AMCA Certified Sound Rating Seal.
3. Fabrication: Conform to AMCA 99.
4. Performance Base: Sea level conditions.
5. Temperature Limit: Maximum 300 degrees F.

B. Hub and Impeller:

1. Airfoil Impeller Blades: Adjustable die cast aluminum alloy glass reinforced polyester resin or welded steel die formed blades with belt drive.
2. Hub: Die cast aluminum alloy or cast iron hub or with belt drive of spun, welded steel, bored and keyed to shaft; to facilitate indexing of blade angle with automatic adjustment stops.

3. Cast Components: X-ray components after fabrication and statically and dynamically balance assembly before attachment to motor or shaft.

C. Casing:

1. Fabricate casing of 1/4 inch steel for fans 40 inch in diameter and smaller and 3/8 inch steel for larger fans.
2. Continuously weld, with inlet and outlet flange connections, and motor or shaft supports. Incorporate flow straightening guide vanes for fans specified for static pressures greater than 1 inch wg.
3. Finish with one coat enamel applied to interior and exterior.

D. Bearings and Drives:

1. Bearings: Heavy duty pillow block type, self-aligning, grease-lubricated ball bearings, with ABMA STD 9, L-10 life at 50,000 hours.
2. Shafts: Hot rolled steel, ground and polished, with keyway; protectively coated with lubricating oil.
3. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.
4. Belt Guard: Fabricate to SMACNA (DCS); 0.106 inch thick, 3/4 inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
5. Lubrication: Extend lubrication fittings to outside of casing.

E. Accessories:

1. Inlet Bell: Bell mouth inlet fabricated of steel with flange.
2. Outlet Cones: Fabricated of steel with flanges, outlet area/inlet area ratio of 1.5/1.0, with center pod as recommended by manufacturer.
3. Inlet Screens: Galvanized steel welded grid to fit inlet bell.
4. Dampers: Welded steel construction, consisting of two semi-circular vanes pivoted on oil-retaining bearings in short casing section, finished with one

coat enamel. Provide airstream operation closing blades by reverse air flow and gravity.

5. Access Doors: Shaped to conform to casing with quick opening latches and gaskets.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions and standard mechanical details.
- B. Install units with clearances for service and maintenance.
- C. Install power ventilators level and plumb.
- D. Secure roof exhausters with cadmium plated steel lag screws to roof curb.
- E. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.
- F. Install floor-mounting units on concrete bases.
- G. Hung Cabinet Fans:
  1. Install fans with resilient mountings and flexible electrical leads. Refer to Section 23 05 48 - Vibration Controls for HVAC Piping and Equipment.
  2. Install flexible connections specified in Section 23 33 00 - Air Duct Accessories between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
- H. Provide sheaves required for final air balance.
- I. Install dampers on inlet to roof and wall exhausters in accordance with standard mechanical details.
- J. Provide dampers on outlet from cabinet and ceiling exhauster fans and in accordance with standard mechanical details.

### 3.2 AXIAL FANS INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install axial fans level and plumb.
- C. Install units with clearances for service and maintenance.

- D. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Section 23 05 48 - Vibration Controls for HVAC.
- E. Install with resilient mountings and with flexible electrical leads; refer to Section 23 05 48 - Vibration Controls for HVAC.
- F. Install flexible connections specified in Section 23 33 00 - Air Duct Accessories between axial fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and axial fan while running.
- G. Provide fixed sheaves required for final air balance.
- H. Provide safety screen where inlet or outlet is exposed.
- I. Provide backdraft dampers on discharge of exhaust fans and as indicated.
- J. Provide access to adjustable blade axial fan wheels for varying blade angle setting. Adjust blades for varying range of volume and pressure.
- K. Provide floor mounted axial fans with reinforced legs. Provide ceiling suspended units with support brackets bolted to casing flange.

### 3.3 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Refer to Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

### 3.4 CLEANING

- A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.
- B. Clean fan interiors to remove foreign material and construction debris. Vacuum clean fan wheel and cabinet.

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. Verify that shipping, blocking, and bracing are removed.
  - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
  - 3. Verify that cleaning and adjusting are complete.
  - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
  - 5. Adjust belt tension.
  - 6. Adjust damper linkages for proper damper operation.
  - 7. Verify lubrication for bearings and other moving parts.
  - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
  - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
  - 10. Shut unit down and reconnect automatic temperature-control operators.
  - 11. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.
- D. Clean fan interiors to remove foreign material and construction debris. Vacuum clean fan wheel and cabinet.

### 3.6 CONTRACTOR STARTUP AND REPORTING

- A. Final Checks before Startup: Perform the following operations and checks before startup. Startup service includes the testing, inspections and startup test reports:
  - 1. Verify that shipping, blocking, and bracing are removed.

2. Verify that unit is secure on mountings and supporting devices and that connections for piping, ducts, and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnects.
  3. Perform cleaning and adjusting specified in this Section.
  4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
  5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
  6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in the fully open position.
  7. Disable automatic temperature-control operators.
- B. Starting procedures for fans are as follows:
1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
  2. Measure and record motor voltage and amperage.
- C. Shut unit down and reconnect automatic temperature-control operators.
- D. Refer to Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC for procedures for air-handling-system testing, adjusting, and balancing.
- E. Replace fan and motor pulleys as required to achieve design conditions.

### 3.7 DEMONSTRATION AND COMMISSIONING

- A. Engage a factory-authorized service representative to train maintenance personnel to adjust, operate, and maintain the fans.
1. Train maintenance personnel on procedures and schedules for starting up and shutting down, troubleshooting, servicing, and maintaining fans. The training will occur after the startup report has been provided to the Owner and the trainer will provide two (2) Installation and Operations manuals for the use of the Owner's personnel during training.
  2. Review data in maintenance manuals. Refer to Division 01. All required and recommended maintenance will be reviewed as well as operational trouble shooting. If the IOM does not include a written trouble shooting guide one will be provided.

3. Schedule training with Owner, through Architect/Engineer of Record, with at least seven days' advance notice.
- B. Demonstrate proper operation of equipment to commissioning agent or designated Owner personnel. The scope of the demonstration will include functional performance requirements under both local and building automation control as well as any commissioning requirements in Division 01 and 23.

END OF SECTION

## SECTION 23 37 00

### AIR OUTLETS AND INLETS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Registers/grilles.
- B. Door and transfer grilles.
- C. Gravity ventilators.

##### 1.2 REFERENCE STANDARDS

- A. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2011 with Addendum 1.
- B. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Inlets; 2006 (R2011).
- C. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2009 (Reapproved 2015).
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
- F. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.
- G. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.
- H. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).

##### 1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to material, size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, pressure drop, throw velocity, and noise level.

- C. Coordination Drawings: Roof framing plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. Structural members to which roof curbs and ventilators will be attached.
  - 2. Sizes and locations of roof openings.

#### 1.4 QUALITY ASSURANCE

- A. AHRI Compliance: Test and rate diffusers, registers, and grilles in accordance with AHRI 880 (I-P).
- B. ASHRAE Compliance: Test and rate diffusers, registers, and grilles in accordance with ASHRAE Std 70.
- C. ADC Compliance: Test and rate diffusers, registers, and grilles in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".
- D. ADC Seal: Provide diffusers, registers, and grilles bearing ADC Certified Rating Seal.
- E. NFPA Compliance: Install diffusers, registers, and grilles in accordance with NFPA 90A.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to final locations, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

#### 1.6 WARRANTY

- A. Provide warranty on materials and labor for 18 months starting from date of delivery, or one year from date of substantial completion, whichever is longer.

### PART 2 PRODUCTS

#### 2.1 GENERAL APPLICATION INFORMATION

- A. In general, diffusers, registers, and grilles shall be constructed of steel with color as selected by AOR/EOR.

- B. For wet environments, all diffusers, registers, and grilles shall be constructed of aluminum.
- C. For harsh and/or corrosive environments such as natatorium, diffusers, registers, and grilles shall be provided with a complete corrosion resistant coating applicable to the environment where installed.

## 2.2 MANUFACTURERS

- A. Diffusers, Registers, and Grilles
  - 1. Price Industries: [www.price-hvac.com](http://www.price-hvac.com).
  - 2. Titus: [www.titus-hvac.com](http://www.titus-hvac.com).
  - 3. Tuttle and Bailey: [www.tuttleandbailey.com/sle](http://www.tuttleandbailey.com/sle).
  - 4. Nailor
- B. Louvered Penthouses, Hoods, and Gravity Ventilators
  - 1. Greenheck
  - 2. Loren Cook Company
  - 3. Penn Ventilation

## 2.3 CEILING SUPPLY REGISTERS/GRILLES

- A. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, one-way deflection.
- B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.
- C. Construction: Made of steel with factory enamel finish.
- D. Color: As selected by Architect/Engineer of Record from manufacturer's standard range.
- E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face. To be used for inaccessible hard ceiling applications only.

## 2.4 CEILING EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees, vertical face.
- B. Frame: 1-1/4 inch margin with countersunk screw mounting.

- C. Fabrication: Steel with 20 gage, 0.0359 inch minimum frames and 22 gage, 0.0299 inch minimum blades, steel and aluminum with 20 gage, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.
- D. Color: To be selected by Architect/Engineer of Record from manufacturer's standard range.
- E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans. To be used for inaccessible hard ceiling applications only.

## 2.5 WALL SUPPLY REGISTERS/GRILLES

- A. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, vertical face, single deflection.
- B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.
- C. Fabrication: Steel with 20 gage, 0.0359 inch minimum frames and 22 gage, 0.0299 inch minimum blades, steel and aluminum with 20 gage, 0.0359 inch minimum frame, or aluminum extrusions, with factory baked enamel finish.
- D. Color: To be selected by Architect/Engineer of Record from manufacturer's standard range.
- E. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.

## 2.6 WALL EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, vertical face.
- B. Frame: 1-1/4 inch margin with countersunk screw mounting.
- C. Fabrication: Steel frames and blades, with factory baked enamel finish.
- D. Color: To be selected by Architect/Engineer of Record from manufacturer's standard range.
- E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

## 2.7 DOOR AND TRANSFER GRILLES

- A. General: Except as otherwise indicated, provide manufacturer's standard wall registers and grilles where shown; of size, shape, capacity and type indicated;

constructed of materials and components as indicated, and as required for complete installation.

- B. Performance: Provide wall registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- C. Construction: Outer borders shall be constructed of heavy extruded aluminum and shall have countersunk screw holes for a neat appearance. Border shall be interlocked at the four corners and mechanically staked to form a rigid frame. Extruded aluminum inverted V-blades with a deflection shall be used to create a sight proof design and provide additional stiffness to the grille.
- D. Types: Provide wall grilles of type, capacity, and with accessories and finishes as listed on schedule.

## 2.8 GRAVITY VENTILATORS

### A. Hood Relief Gravity Ventilator:

- 1. Manufacturers:
  - a. Greenheck Fan Corporation
  - b. Loren Cook Company
- 2. General:
  - a. Low silhouette for intake applications with natural gravity or negative pressure system(s).
  - b. Suitable for non-ducted applications.
  - c. Equipment to bear permanently affixed manufacturer's nameplate listing model and serial number.
- 3. Hood and Base:
  - a. Material: Aluminum.
  - b. Hood Construction: Precision formed, arched panels with interlocking seams.
  - c. Vertical End Panels: Fully locked into hood end panels.
  - d. Curb Cap: Pre-punched mounting holes for installation.
- 4. Birdscreen:
  - a. Fabricate in accordance with ASTM B221 (ASTM B221M).
  - b. Construction: 1/2 inch Galvanized mesh.
  - c. Horizontally mounted across hood intake area.

5. Hood Support: Galvanized steel construction and fastened so hood can be removed completely from the base or hinged open.
6. Options/Accessories:
  - a. Roof Curbs:
    - (1) Flat Roofs:
      - (a) Welded, straight side curb with flashing flange and wood nailer.
    - (2) Pitched Roofs: Welded, straight side curb with flashing flange and wood nailer.
    - (3) Mounted on the roof with fan.
    - (4) Material: Aluminum.
    - (5) Insulation Thickness: 1 inch.
  - b. Provide extended base minimum 7 inch extension to base height making overall base 14 inches in height to prevent snow or moisture intake.
  - c. Curb Seal: Rubber seal between fan and roof curb.
  - d. Dampers:
    - (1) Type: Gravity (under 300 cfm) or Motorized (over 300 cfm).
    - (2) Factory designed to prevent outside air from entering back into building when fan is off.
    - (3) Balanced for minimal resistance to flow.
    - (4) Galvanized frames with pre-punched mounting holes.
  - e. Factory Finish: Baked enamel matching or complementing building colors.
  - f. Hood Insulation or Coating: Provide 1/2 inch fiberglass insulation lining or anti-condensate coating to prevent condensation and reduce sound levels.
  - g. Insect Screen:
    - (1) Fabricate in accordance with ASTM B221 (ASTM B221M).
    - (2) Construct of fine mesh aluminum.
    - (3) Fitted to top of the throat to prevent entry of insects.
    - (4) Coating: Thermo-setting polyester urethane.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install intake and relief ventilators level, plumb, and at indicated alignment with adjacent work.
- C. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- D. Comply with SMACNA (ASMM) for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.
- E. Secure intake and relief ventilators to roof curbs with cadmium-plated hardware. Use concealed anchorages where possible
- F. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- G. Install diffusers to ductwork with air tight connection.
- H. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

### 3.2 CLEANING

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

### 3.3 CONTRACTOR STARTUP AND REPORTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 23 51 00

### BREECHINGS, CHIMNEYS, AND STACKS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Stationary auxiliary power generator engine exhaust piping.

##### 1.2 REFERENCE STANDARDS

- A. ANSI Z21.66 - American National Standard for Automatic Damper Devices for Use with Gas-Fired Appliances; 2015.
- B. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2017.
- C. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges; 2016.
- D. ASME B31.9 - Building Services Piping; 2014.
- E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- F. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General - Purpose Piping; 2014.
- G. ASTM A193/A193M - Standard Specification for Alloy - Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications; 2016.
- H. ASTM A194/A194M - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both; 2017.
- I. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2017.
- J. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
- K. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2017.

- L. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- M. ASTM A959 - Standard Guide for Specifying Harmonized Standard Grade Compositions for Wrought Stainless Steels; 2016.
- N. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).
- O. AWS D9.1/D9.1M - Sheet Metal Welding Code; 2018.
- P. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.
- Q. NFPA 31 - Standard for the Installation of Oil Burning Equipment; 2016.
- R. NFPA 82 - Standard on Incinerators and Waste and Linen Handling Systems and Equipment; 2014.
- S. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; 2016.
- T. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).
- U. UL 103 - Factory-Built Chimneys for Residential Type and Building Heating Appliances; Current Edition, Including All Revisions.
- V. UL 1738 - UL Standard for Safety Venting Systems for Gas-Burning Appliances, Categories II, III, and IV; 2014.
- W. UL 441 - Standard for Gas Vents; Current Edition, Including All Revisions.
- X. UL 959 - Medium Heat Appliance Factory Built Chimneys; Current Edition, Including All Revisions.

### 1.3 DESIGN REQUIREMENTS

- A. Factory built vents and chimneys used for venting natural draft appliances shall comply with NFPA 211 and be UL listed and labeled.

### 1.4 SUBMITTALS

- A. **Product Data:** Provide data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics and connection requirements.
- B. **Shop Drawings:** Indicate general construction, dimensions, weights, support and layout of breechings. Submit layout drawings indicating plan view and elevations where factory built units are used.

- C. Manufacturer's Instructions: Include installation instructions, and indicate assembly, support details, and connection requirements.
- D. Welding certificates.
- E. Calculations: Provide computer calculation for flue sizing based on actual installed equipment at operating temperature, routing and sizing for each flue. Calculation shall include all inputs and a sketch indicating all lengths, fittings and sizes used. Calculation shall be stamped by a licensed professional engineer in the state of Illinois.

#### 1.5 QUALITY ASSURANCE

- A. Designer Qualifications: Design stacks under direct supervision of a Professional Structural Engineer experienced in design of the type of work specified and licensed in Illinois.
- B. Source Limitations: Obtain listed system components through one source from a single manufacturer.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M for hangers and supports and AWS D9.1/D9.1M for shop and field welding of joints and seams in vents, breechings, and stacks.
- D. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

#### 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of venting system that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, structural failures caused by expansion and contraction.

- 1. Warranty Period: 10 years from date of Preliminary Acceptance.

### PART 2 PRODUCTS

#### 2.1 STATIONARY AUXILIARY POWER GENERATOR ENGINE EXHAUST PIPING

- A. Steel Pipe: ASTM A53/A53M, Schedule 40.
  - 1. Fittings:
    - a. Buttweld conforming to ASTM A234/A234M.
    - b. Wall thickness and material same as adjoining pipe.

- c. Built-up miter welded fittings are acceptable where miter angles of each individual section do not exceed 22.5 degrees total and not more than 11.25 degrees relative to the axis of the pipe at any one cut.
  - 2. Flanges:
    - a. Class 150, slip-on, forged steel welding flanges in accordance with ASME B16.5.
    - b. Material in accordance with ASTM A181/A181M, Grade I.
    - c. Provide for connections to engines, exhaust silencers, and flexible connections.
  - 3. Gaskets:
    - a. High temperature asbestos-free material suitable for the service.
    - b. ASME B16.21 composition ring, 0.0625 inch thick.
  - 4. Bolts: Alloy-steel, conforming to ASTM A193/A193M, Grade B7, and of sufficient strength for full bearing on nuts, projecting not more than two full threads beyond the nut.
  - 5. Nuts: Alloy-steel, conforming to ASTM A194/A194M, Grade 7.
  - 6. Provide stainless steel counterbalance type rain caps at exhaust pipe termination points.
- B. Flexible joints:
- 1. Provide flanged, multiple, corrugated, stainless steel expansion joints with liners, between exhaust manifold and exhaust piping to absorb thermal expansion and vibration.
  - 2. Suitable for operation at 200 degrees F above normal exhaust gas temperature at 100 percent load, 10,000 cycles minimum.
  - 3. Design and construct for diesel engine exhaust application.
- C. Hangers and Supports: Provide hangers and supports that comply with MSS SP-58.
- D. Piping Sleeves:
- 1. Outside Walls Below and Above Grade, Floor, or Roof Slabs: Standard weight zinc coated pipe.
  - 2. Partitions: Zinc coated sheet steel having nominal weight of not less than 0.90 lb per square foot.
  - 3. Piping Insulation: Provide insulation in accordance with Section 22 07 19.

## 2.2 GUYING AND BRACING MATERIALS

- A. For use on chimneys/vents/flues extending more than 6 ft above the roof/
- B. Cable: Minimum four galvanized, stranded wires (final quantity as recommended by chimney/stack/flue vent manufacturer for project specific application) of the following thickness:
  - 1. Minimum Size: 1/4 inch in diameter.
  - 2. For ID Sizes 4 to 15 Inches: 5/16 inch.
  - 3. For ID Sizes 18 to 24 Inches: 3/8 inch.
  - 4. For ID Sizes 27 to 30 Inches: 7/16 inch.
  - 5. For ID Sizes 33 to 36 Inches: 1/2 inch.
  - 6. For ID Sizes 39 to 48 Inches: 9/16 inch.
- C. Pipe: Minimum three galvanized steel, NPS 1-1/4.
- D. Angle Iron: Minimum three galvanized steel, 2 by 2 by 0.25 inch.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install breechings with minimum of joints. Align accurately at connections, with internal surfaces smooth.
- C. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.
- D. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.
- E. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading. Where maximum unsupported lengths of stack are exceeded, support chimneys as follows:
  - 1. Guy wires.

2. Rigid pipe braces.
  3. Rigid angle-iron braces.
- F. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.
- G. Lap joints in direction of flow.
- H. Support breechings from building structure, rigidly with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 12 foot spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA (DCS) for equivalent duct support configuration and size.
- I. Install concrete inserts for support of breechings, chimneys, and stacks in coordination with formwork.
- J. Pitch breechings with positive slope up from fuel-fired equipment to chimney or stack.
- K. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- L. Coordinate installation of draft control devices and dampers with breeching system.
1. Install listed components in a manner complying with the listing.
  2. Secure barometric dampers to breechings with hardware compatible with connected materials.
  3. Locate barometric and motorized vent dampers as close to draft hood collar as possible.
  4. Secure barometric and motorized vent dampers to appliances, breechings, or chimneys with hardware compatible with connected materials.
- M. Insulate breechings in accordance with Section 23 07 16.
- N. For Type B double wall gas vents, maintain UL listed minimum clearances from combustibles. Assemble pipe and accessories as required for complete installation.
- O. Install vent dampers, locating close to draft hood collar, and secured to breeching.
- P. Assemble and install stack sections in accordance with NFPA 82, industry practices, and in compliance with UL listing. Join sections with acid-resistant joint cement. Connect base section to foundation using anchor lugs.
- Q. Level and plumb chimney and stacks.

- R. Clean breechings, chimneys, and stacks during installation, removing dust and debris.
- S. Do not use flue cap or rain cap on condensing boiler applications.
- T. Provide drain at base of stack for condensing boiler applications.
- U. Provide acid neutralization basin for condensing applications and drain stack and boilers back to basin.
- V. At appliances, provide slip joints permitting removal of appliances without removal or dismantling of breechings, breeching insulation, chimneys, or stacks.
- W. Engine Exhaust:
  - 1. Install engine exhaust piping in accordance with MSS SP-58 and ASME B31.9.
  - 2. Install exhaust silencer provided in accordance with Section 26 32 13.
  - 3. Provide sleeves with sufficient length to pass through entire thickness of walls, floors, roofs, partitions, or slabs.
  - 4. Extend sleeves in floor slabs 2 inches above finished floor.
  - 5. Firmly pack insulation between pipe and sleeve and caulk both ends with plastic waterproof cement.
  - 6. Space Between Pipe Insulation and Sleeve: Not less than 0.25 inch thick.

### 3.2 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.
- B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.
- C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

### 3.3 PROTECTION

- A. Temporary Closure: Provide at ends of breechings and chimneys that are not completed or connected to equipment.

### 3.4 CONNECTIONS

- A. Ground equipment according to Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Connect wiring according to Section 26 05 83 - Wiring Connections.
- C. Remove and replace malfunctioning components and recheck.

### 3.5 ADJUSTING

- A. Set field-adjustable switches and controls as indicated.

### 3.6 DEMONSTRATION AND COMMISSIONING

- A. Demonstration: Engage a factory-authorized service representative to train Board's maintenance personnel to adjust, operate, and maintain draft control devices. Refer to Division 01.

END OF SECTION

SECTION 23 51 13  
NATURAL GAS PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipes, tubes, and fittings.
- B. Piping specialties.
- C. Joining materials for piping and tubing.
- D. Valves.
- E. Pressure regulators.
- F. Mechanical sleeve seals.
- G. Grout.

1.2 REFERENCE STANDARDS

- A. ANSI Z21.18/CSA 6.3 - Gas Appliance Pressure Regulators; 2007 (Reaffirmed 2016).
- B. ANSI Z21.24/CSA 6.10 - Connectors for gas appliances; 2015.
- C. ANSI Z21.69/CSA 6.16 - Connectors for Moveable Gas Appliances; 2015.
- D. ANSI Z21.75/CSA 6.27 - Connectors for Outdoor Gas Appliances and Manufactured Homes; 2016.
- E. ASME B1.20.1 - Pipe Threads, General Purpose (Inch); 2013.
- F. ASME B1.20.3 - Dryseal Pipe Threads (Inch); 1976.
- G. ASME B16.20 - Metallic Gaskets for Pipe Flanges - Ring-Joint, Spiral Wound, and Jacketed; 2012.
- H. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.
- I. ASME B16.33 - Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 175 psi (Sizes NPS ½ Through NPS 2); 2012.

- J. ASME B16.38 - Large Metallic Valves for Gas Distribution Manually Operated, NPS 2 1/2 (DN 65) to NPS 12 (DN 300), 125 psig (8.6 bar) Maximum; 2012.
- K. ASME B16.39 - Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300; 2014.
- L. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2017.
- M. ASME B18.2.1 - Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series); 2012, Including July 2013 Errata.
- N. ASME BPVC - Boiler and Pressure Vessel Code; 2017.
- O. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2014).
- P. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2017.
- Q. Q. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- R. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications; 2014.
- S. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings; 2016a.
- T. ASTM D2657 - Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings; 2007 (Reapproved 2015).
- U. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing; 2014.
- V. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping; 2012.
- W. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing; 2016.
- X. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).
- Y. AWS D10.12M/D10.12 - Guid for Welding Mild Steel Pipe; 2000.
- Z. ICC (IFGC) - International Fuel Gas Code; 2018.

- AA. ANEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- BB. ANEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000, with Errata (2008).
- CC. ANFPA 54 - National Fuel Gas Code; 2018.
- DD. ANFPA 70 - National Electrical Code; 2017.
- EE. AUL 508A - Industrial Control Panels; 2013.

### 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roofs, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Anodeless Risers and Sweeps: Fittings that can be installed without additional cathodic protection.

### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination
  - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
  - 2. Coordinate installation of anchorages for natural-gas systems. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete. Deliver such items to Project site in time for installation and to not cause a delay in the Work.
  - 3. Coordinate requirements for access panels and doors for valves and controls installed concealed behind finished surfaces, and for areas requiring routine maintenance. Comply with requirements in Section 08 31 00 - Access Doors and Panels as applicable.

### 1.5 PERFORMANCE REQUIREMENTS

- A. Natural-Gas System Pressure within Buildings: 35-psig or less.

B. Operating Pressure Ratings:

1. Piping and Valves: 100-psig minimum unless otherwise indicated.
2. Service Regulators: 65-psig minimum unless otherwise indicated.
3. Operating Pressure of Service Meter: 5-psig minimum unless otherwise indicated.

1.6 SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Corrugated, stainless-steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Dielectric fittings.
6. Mechanical sleeve seals.
7. Escutcheons.
8. Packaged Gas Boosters: Include certified performance curves with operating points plotted; rated capacities of selected models; and furnished specialties and accessories. Include information on the following:
  - a. Piping.
  - b. Flexible connectors.
  - c. Plug valves.
  - d. Inlet check valve.
  - e. Pressure gauge.
  - f. Pressure switch.
  - g. Recirculation loop and valve.
  - h. Heat exchanger.
  - i. Control panel.

B. Shop Drawings: Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail locations of anchors, alignment guides, and expansion joints and loops. Include a site plan, on which natural-gas piping is indicated and coordinated with other services and utilities.

1. Shop Drawing Scale: Not less than 1/4" = 1'-0".
  2. Packaged Gas Boosters: Provide detailed shop drawings for packaged gas boosters and accessories. Include plans, elevations, sections, details, and attachment to other work; power, signal, and control wiring diagrams; dimensioned outline drawings of equipment package, identifying center of gravity and including detailed mounting and anchorage provisions; vibration isolation, including detailed fabrication information, attachments to concrete slabs and supported equipment; operation and maintenance data, including emergency, standard operation and maintenance manuals.
- C. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.
- D. Installer Qualifications.
- E. Welding Certificates.
- F. Reports:
1. Field quality-control reports.
  2. Startup Reports: Submit reports documenting activities required during startup of gas boosters. Reports shall be submitted within two weeks following completion of startup activities.
  3. Training Reports: Submit reports regarding training of Board's maintenance personnel. Include date(s) of training and list of attendees.
- G. Operation and Maintenance Data: For motorized gas valves, pressure regulators, and service meters, include data in emergency, operation, and maintenance manuals.
- H. Record Drawings: Indicate, at 1/4" = 1'-0" scale, the actual natural-gas piping installation layout and elevations, sections, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an installer that is experienced in the installation of natural-gas piping of the types required for the Project, and whose work has resulted in a record of successful in-service performance. Installer licensed to perform natural-gas piping installation and maintenance in Chicago, IL.
- B. Product Options: Drawings indicate size, profiles, and dimensional requirements of packaged gas boosters and are based on the specific system indicated.

- C. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M
- D. Pipe Welding Qualifications: Qualify procedures and operators according to ASME BPVC.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Packaged Gas Boosters: Installed according to NFPA 70 and NFPA 54.
- G. Regulatory Requirements: Natural-gas piping installations shall comply with ICC (IFGC).

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose flammable liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps throughout shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored polyethylene pipes and valves from direct sunlight.
- E. Gas Boosters: Retain gas booster shipping flange protective covers and coatings, protect bearings and couplings against damage, and comply with manufacturer's written rigging instructions when handling packaged gas boosters.

#### 1.9 FIELD CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.
- B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by the Board or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
  - 1. Notify the Board no fewer than seven days in advance of proposed interruption of natural-gas service.
  - 2. Do not proceed with interruption of natural-gas service without Board's written permission.

## 1.10 WARRANTY

- A. Special Warranty: Submit written warranty, executed by the manufacturer and Installer, agreeing to repair or replace components that develop defects in material or workmanship within the specified warranty period.
  - 1. Warranty Period for Natural-Gas Systems: One year from date of Preliminary Acceptance. or eighteen months from date of shipment, whichever is greater.
  - 2. Warranty Period for Controls and Control Panels: Three years from date of Preliminary Acceptance.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the manufacturers indicated for each component:
  - 1. Appliance Flexible Connector: No preference.
  - 2. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
    - a. Conbraco Industries, Inc.; Apollo Div.
    - b. Lyall, R. W. & Company, Inc.
    - c. McDonald, A. Y. Mfg. Co.
    - d. Perfection Corporation; a subsidiary of American Meter Company.
  - 3. Bronze Plug Valves:
    - a. Lee Brass Company.
    - b. McDonald, A. Y. Mfg. Co.
  - 4. Cast-Iron, Non-lubricated Plug Valves:
    - a. McDonald, A. Y. Mfg. Co.
    - b. Mueller Co.; Gas Products Div.
    - c. Xomox Corporation; a Crane company.

5. Cast-Iron, Lubricated Plug Valves:
  - a. Flowserve.
  - b. McDonald, A. Y. Mfg. Co.
  - c. Mueller Co.; Gas Products Div.
  - d. R&M Energy Systems, a Unit of Robbins & Myers, Inc.
  
6. Automatic Gas Valves:
  - a. ASCO Power Technologies, LP; Division of Emerson.
  - b. Eaton Corporation; Controls Div.
  - c. Eclipse Combustion, Inc.
  - d. Honeywell International Inc.
  - e. Johnson Controls.
  
7. Electrically Operated Valves:
  - a. ASCO Power Technologies, LP; Division of Emerson.
  - b. Eclipse Combustion, Inc.
  - c. Goyen Valve Corp.; Tyco Environmental Systems.
  - d. Magnatrol Valve Corporation.
  - e. Parker Hannifin Corporation; Climate & Industrial Controls Group; Skinner Valve Div.
  - f. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
  
8. Line Pressure Regulators:
  - a. Eclipse Combustion, Inc.
  - b. Fisher Control Valves and Regulators; Division of Emerson Process Management.
  - c. Invensys.
  - d. Maxitrol Company.
  - e. Richards Industries; Jordan Valve Div.
  
9. Appliance Pressure Regulators:
  - a. Eaton Corporation; Controls Div.
  - b. Harper Wyman Co.
  - c. Maxitrol Company.
  - d. SCP, Inc.
  
10. Dielectric Unions: No preference.
  
11. Dielectric Flanges: No preference.
  
12. Mechanical Sleeves: No preference.

## 2.2 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.
  - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
  - 2. Wrought-Steel Welding Fittings: ASTM A234/A234M for butt welding and socket welding.
  - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
  - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
    - a. Material Group: 1.1.
    - b. End Connections: Threaded or butt welding to match pipe.
    - c. Lapped Face: Not permitted underground.
    - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

## 2.3 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
  - 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24/CSA 6.10.
  - 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69/CSA 6.16.
  - 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75/CSA 6.27.
  - 4. Corrugated stainless-steel tubing with polymer coating.
  - 5. Operating-Pressure Rating: 0.0.5-psig End Fittings: Zinc-coated steel.
  - 6. Threaded Ends: Comply with ASME B1.20.1.
  - 7. Maximum Length: 72-inches.

B. Y-Pattern Strainers:

1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 50-percent free area.
4. CWP Rating: 125-psig.

C. Basket Strainers:

1. Body: ASTM A126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125-psig.

D. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 57-percent free area.
4. CWP Rating: 750-psig.

- E. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

## 2.4 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural-gas pipe.
- B. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## 2.5 MANUAL GAS SHUTOFF VALVES

- A. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
  - 1. CWP Rating: 125-psig.
  - 2. Threaded Ends: Comply with ASME B1.20.1.
  - 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
  - 4. Tamperproof Feature: Locking feature for valves indicated in Articles "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule."
  - 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch diameter and smaller.
  - 6. Service Mark: Valves NPS 1-1/4 to NPS 2 shall have initials "WOG" permanently marked on valve body.
  
- B. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
  - 1. CWP Rating: 125-psig.
  - 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
  - 3. Tamperproof Feature: Locking feature for valves indicated in Articles "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule."
  - 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
  
- C. Two-Piece, Full-Port, Bronze Body: Complying with ASTM B584.
  - 1. Ball: Chrome-plated bronze.
  - 2. Stem: Bronze; blowout proof.
  - 3. Seats: Reinforced TFE; blowout proof.
  - 4. Packing: Threaded-body packnut design with adjustable-stem packing.
  - 5. Ends: Threaded, flared, or socket as indicated in Articles "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule."
  - 6. CWP Rating: 600-psig.

7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- D. Bronze Plug Valves: MSS SP-78.
1. Body: Bronze, complying with ASTM B584.
  2. Plug: Bronze.
  3. Ends: Threaded, socket, or flanged as indicated in Articles "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule."
  4. Operator: Square head or lug type with tamperproof feature where indicated.
  5. Pressure Class: 125-psig.
  6. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  7. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Cast-Iron, Non-lubricated Plug Valves: MSS SP-78.
1. Body: Cast iron, complying with ASTM A126, Class B.
  2. Plug: Bronze or nickel-plated cast iron.
  3. Seat: Coated with thermoplastic.
  4. Stem Seal: Compatible with natural-gas.
  5. Ends: Threaded or flanged as indicated in Articles "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule."
  6. Operator: Square head or lug type with tamperproof feature where indicated.
  7. Pressure Class: 125-psig.
  8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

- F. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
1. Body: Cast iron, complying with ASTM A126, Class B.
  2. Plug: Bronze or nickel-plated cast iron.
  3. Seat: Coated with thermoplastic.
  4. Stem Seal: Compatible with natural-gas.
  5. Ends: Threaded or flanged as indicated in Articles "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule."
  6. Operator: Square head or lug type with tamperproof feature where indicated.
  7. Pressure Class: 125- psig.
  8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Valve Boxes:

1. Cast-iron, two-section box.
2. Top section with embossed cover with letters "GAS".
3. Bottom section with base to fit over valve and a minimum 5-inches diameter barrel.
4. Adjustable cast-iron extensions of length required for depth of embedment.
5. Include tee-handle, steel operating wrench with socket end fitting, either valve nut or flat head, with stem of length required to operate valve.

## 2.6 MOTORIZED GAS VALVES

A. Automatic Gas Valves: Comply with ANSI Z21.21.

1. Body: Brass or aluminum.
2. Seats and Disc: Nitrile rubber.
3. Springs and Valve Trim: Stainless steel.
4. Normally closed.

5. Visual position indicator.
  6. Electrical -OR- Mechanical operator for actuation by appliance automatic shutoff device.
- B. Electrically Operated Valves: Comply with UL 429.
1. Pilot operated.
  2. Body: Brass or aluminum.
  3. Seats and Disc: Nitrile rubber.
  4. Springs and Valve Trim: Stainless steel.
  5. 120-V ac, 60-Hz, Class B, continuous-duty molded coil, and replaceable.
  6. NEMA ICS 6, Type 4, coil enclosure.
  7. Normally closed.
  8. Visual position indicator.

## 2.7 PRESSURE REGULATORS

- A. General Requirements:
1. Single stage and suitable for natural-gas.
  2. Steel jacket and corrosion-resistant components.
  3. Elevation compensator.
  4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.
- B. Line Pressure Regulators: Comply with ANSI Z21.80/CSA 6.22.
1. Body and Diaphragm Case: Cast iron or die-cast aluminum.
  2. Springs: Zinc-plated steel; interchangeable.
  3. Diaphragm Plate: Zinc-plated steel.
  4. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
  5. Orifice: Aluminum; interchangeable.

6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
  7. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
  8. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 1.5 times the design discharge pressure at shutoff.
  9. Overpressure Protection Device: Factory mounted on pressure regulator.
  10. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
  11. Maximum Inlet Pressure: 2-psig.
- C. Appliance Pressure Regulators: Comply with ANSI Z21.18/CSA 6.3.
1. Body and Diaphragm Case: Die-cast aluminum.
  2. Springs: Zinc-plated steel; interchangeable.
  3. Diaphragm Plate: Zinc-plated steel.
  4. Seat Disc: Nitrile rubber.
  5. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
  6. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
  7. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
  8. Maximum Inlet Pressure: 2-psig

## 2.8 DIELECTRIC FITTINGS

- A. Dielectric Unions:
1. Minimum Operating-Pressure Rating: 150-psig.
  2. Combination fitting of copper alloy and ferrous materials.
  3. Insulating materials suitable for natural-gas.
  4. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

B. Dielectric Flanges:

1. Minimum Operating-Pressure Rating: 150-psig
2. Combination fitting of copper alloy and ferrous materials.
3. Insulating materials suitable for natural-gas.
4. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.9 SLEEVES

- A. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

2.10 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
2. Pressure Plates: Stainless steel.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

2.11 ESCUTCHEONS

- A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.
- B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Stamped-Steel Escutcheons: With set screw and chrome-plated finish.
- D. Split-Plate, Stamped-Steel Escutcheons: With concealed hinge, set screw, and chrome-plated finish.
- E. One-Piece, Floor-Plate Escutcheons: Cast-iron floor plate.

- F. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

## 2.12 IDENTIFICATION MATERIALS

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6-inches wide and 4-mils thick, continuously inscribed with a description of utility and the word "CAUTION", and colored yellow.
- B. Safety Tracer Wire: Metallic core (copper minimum AWG 14) encased in a protective insulated jacket for corrosion protection, detectable by metal detector when tape is buried up to 36-inches deep; colored yellow.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Close equipment shutoff valves before turning off natural-gas to premises or piping section.
- B. Inspect natural gas piping according to the ICC (IFGC) to determine that natural gas utilization devices are turned off in piping section(s) affected.
- C. Comply with the ICC (IFGC) requirements for prevention of accidental ignition.

### 3.3 INSTALLATION - INDOOR PIPING

- A. Comply with the ICC (IFGC) for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved by Architect/Engineer of Record.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building surfaces. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install escutcheons at penetrations of interior walls, ceilings, and floors.
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - c. Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
    - d. Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw.
    - e. Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
    - f. Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
  - 2. Existing Piping:
    - a. Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
    - b. Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
    - c. Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge and set screw or spring clips.
    - d. Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
    - e. Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- K. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials. Comply with requirements in Section 07 84 00 - Firestopping.

- L. Verify final equipment locations for roughing-in.
- M. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- N. Drips and Sediment Traps: Provide drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
  - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- O. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- P. Concealed natural-gas piping shall be installed according to the ICC (IFGC).
- Q. Natural-gas piping valves and regulators shall not be installed in concealed spaces.
  - 1. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
  - 2. Prohibited Locations:
    - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator hoistways.
    - b. Do not install natural-gas piping in solid walls or partitions.
    - c. Do not install natural-gas piping underground below building slabs.
- R. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- S. Connect branch piping from top or side of horizontal piping.
- T. Provide unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- U. Do not use natural-gas piping as grounding electrode.
- V. Provide strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

- W. Provide pressure gage upstream and downstream from each pipe regulator. Pressure gages are specified in Division 23.

#### 3.4 INSTALLATION - VALVES

- A. Provide manual gas shutoff valve for each gas appliance ahead of appliance flexible connector. Valve shall be located in same room as equipment.
- B. Provide outdoor underground valves with valve boxes.
- C. Provide a shutoff valve, acceptable to the authority having jurisdiction, on the outside riser.
- D. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- E. Provide anode for metallic valves in underground PE piping.

#### 3.5 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes and fittings before assembly.
- C. Threaded Joints:
  - 1. Thread pipe with tapered pipe threads according to ASME B1.20.1
  - 2. Cut threads full and clean using sharp dies.
  - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
  - 4. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Flanged Joints: Provide gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

F. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

### 3.6 INSTALLATION - HANGERS AND SUPPORTS

A. Comply with requirements for pipe hangers and supports specified in Division 23.

B. Provide hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

### 3.7 CONNECTIONS

A. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

B. Install piping adjacent to appliances to allow service and maintenance of appliances.

- C. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- D. Sediment Traps: Provide tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.
- E. Connect natural-gas piping to booster pump package:
  - 1. Provide suction and discharge pipes equal to, or greater than, the size of the unit connections.
  - 2. Install inlet check valve furnished with the unit.
  - 3. Install accessories shipped loose with the unit.
  - 4. Install piping to allow service and maintenance operations.
- F. Electrically ground booster pump package according to Division 26.
- G. Connect wiring according to Division 26.

### 3.8 IDENTIFICATION

- A. Comply with requirements in Division 23 for piping and valve identification.
- B. Below Grade: Provide detectable warning tape continuously and directly above gas piping, 12-inches below finish grade; 6-inches below sub-grade under pavements and concrete slabs.
- C. Provide equipment identifying markers and signs on booster pump packages. Labeling and identification materials are specified in Division 22.

### 3.9 PAINTING

- A. Comply with requirements in Division 09 for painting interior and exterior natural-gas piping.

### 3.10 FIELD QUALITY CONTROL

- A. Test, inspect, and purge natural-gas according to the ICC (IFGC) and authorities having jurisdiction.
  - 1. Natural-gas piping will be considered defective if it does not pass tests and inspections.
  - 2. Prepare test and inspection reports.

3.11 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5 PSIG

- A. Aboveground piping shall be the following:
1. Steel pipe with malleable-iron fittings and threaded joints smaller or equal to NPS 2.
  2. Steel pipe with steel welding fittings and welded joints NPS 2-1/2 and larger.
  3. All concealed natural-gas piping shall be in a double wall configuration and vented to the outdoors.

3.12 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 5 PSIG

- A. Aboveground piping shall be the following:
1. Steel pipe with steel welding fittings and welded joints.
  2. All concealed natural-gas piping shall be in a double wall configuration and vented to the outdoors.

3.13 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2 and smaller at service meter shall be the following:
1. Two-piece, full-port, bronze ball valves with bronze trim.
  2. Bronze plug valve.
- B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be the following:
1. Two-piece, full-port, bronze ball valves with bronze trim.
  2. Bronze plug valve.
  3. Cast-iron, non-lubricated plug valve.
- C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be the following:
1. Two-piece, full-port, bronze ball valves with bronze trim.
  2. Bronze plug valve.

- D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be the following:
  - 1. Two-piece, full-port, bronze ball valves with bronze trim.
  - 2. Bronze plug valve.
  - 3. Cast-iron, lubricated plug valve.
- E. Valves in branch piping for single appliance shall be the following:
  - 1. Two-piece, full-port, bronze ball valves with bronze trim.
  - 2. Bronze plug valve.

### 3.14 SYSTEM STARTUP

- A. Engage a factory-authorized service representative to perform the following startup service:
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Check piping for tightness.
  - 3. Clean strainer.
  - 4. Verify that booster pump controls are correct for the required application.
  - 5. Prepare a written report documenting services performed.
- B. Perform the following startup checks for each booster in the package before starting:
  - 1. Verify bearing lubrication.
  - 2. Start motor.
  - 3. Slowly open discharge valves.
  - 4. Adjust settings.
- C. Occupancy Adjustments: When requested, within 12-months of Preliminary Acceptance, perform on-site assistance adjusting boosters to suit actual occupied conditions. Perform two visits to Project outside normal occupancy hours for this purpose.
- D. Check piping connections for tightness.
- E. Controls: Set for automatic starting, stopping, sequencing, and alarm operations.

- F. Final checks before starting: Perform the following preventive maintenance operations:
  - 1. Lubricate bearings.
  - 2. Verify that each booster is free to rotate manually. Do not operate booster if it is bound or drags, until the cause of the trouble has been corrected.
- G. Starting procedure for boosters:
  - 1. Prime boosters by opening suction valves and prepare boosters for operation.
  - 2. Open valves so that boosters are not operated against dead shutoff.
  - 3. Start motors.
  - 4. Slowly open discharge valves.
  - 5. Check general operation of boosters and motors.
  - 6. Close valves once there is sufficient flow to prevent over-heating.
- H. Review maintenance and troubleshooting data in Maintenance Manuals.
  - 1. Provide a written troubleshooting guide if the Installation and Operation Manual does not include one.

### 3.15 TRAINING AND DEMONSTRATION

- A. Engage a factory-authorized service representative to train Board's designated maintenance personnel to adjust, operate, and maintain gas booster packages as specified below.
  - 1. Train Board's designated maintenance personnel on procedures and schedules for starting up and shutting down, troubleshooting, servicing, and maintaining gas boosters. The training shall occur after the startup report has been submitted to the Board. The trainer shall furnish four IOMs for the use of the Board's personnel during training.
  - 2. Review data in IOMs. All required and recommended maintenance will be reviewed as well as operational troubleshooting. If the IOMs do not include a written troubleshooting guide, one shall be provided for each manual.
  - 3. Schedule training with Board, through the Architect/Engineer of Record, with at least 7-days advance notice.
  - 4. Training will occur in one 2-hour session on a separate date from the one on which the boosters were started.

- B. Demonstrate proper operation of equipment to commissioning agent and the Board's designated maintenance personnel, including functional performance requirements under both local and building automation system control, as well as project-specific commissioning requirements.

END OF SECTION

## SECTION 23 74 16

### PACKAGED ROOFTOP UNIT

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Packaged, electric heat/DX cooled, rooftop air handling units

##### 1.2 REFERENCE STANDARDS

- A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2008, Including All Addenda.
- B. AHRI 270 - Sound Performance Rating of Outdoor Unitary Equipment; 2015.
- C. AHRI 340/360 - Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment; 2011.
- D. ANSI Z21.47 - American National Standard for Gas-Fired Central Furnaces; 2016.
- E. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2013.
- F. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2017.
- G. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality; 2016.
- H. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2013, Including All Amendments and Errata.
- I. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2016.
- J. City of Chicago Building Code - Municipal Code of Chicago for the Building Industry; 2017.
- K. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2016.
- L. NFPA 54 - National Fuel Gas Code; 2018.
- M. NFPA 70 - National Electrical Code; 2017.
- N. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.

- O. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2018.

### 1.3 SUBMITTALS

- A. Product Data: Include refrigerant, rated capacities, operating characteristics, furnished specialties, and accessories.

1. Performance at AHRI standard conditions and at conditions scheduled (provide EER).
2. Performance at AHRI standard unloading conditions and at conditions scheduled (provide EER).
3. Refrigerant type and capacity of unit.
4. Characteristics of safety relief valves.
5. Minimum entering condenser-air temperature
6. Sound data.
7. Weight
8. Dimensions
9. Unit construction.
10. Components
11. Options
12. Required clearances
13. Characteristics
14. Furnished specialties
15. Accessories.
16. ASHRAE Std 90.1 I-P for energy compliance statement.

- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

- C. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Structural members to which RTUs will be attached.
  - 2. Roof openings
  - 3. Roof curbs and flashing.
- D. Manufacturer's Instructions: Include assembly instructions, support details, connection requirements, and start-up instructions.
- E. Operation and Maintenance Data: Provide maintenance data, parts lists, controls, and accessories. Include trouble-shooting guide.
- F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- G. Field quality control test reports.

#### 1.4 QUALITY ASSURANCE

- A. AHRI Compliance:
  - 1. Comply with AHRI 210/240 and AHRI 340/360 for testing and rating energy efficiencies for RTUs.
  - 2. Comply with AHRI 270 for testing and rating sound performance for RTUs.
- B. ASHRAE Compliance:
  - 1. Comply with ASHRAE Std 15 for refrigeration system safety.
  - 2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
  - 3. Comply with ASHRAE Std 62.1 for condensate drain pans.
  - 4. Comply with ASHRAE Std 90.1 I-P for minimum efficiency of heating and cooling.
- C. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
- D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect finished cabinets from physical damage by leaving factory packing cases in place before installation and providing temporary covers after installation.
- B. Follow manufacturer's instructions for unloading, rigging and storage of equipment.
- C. Maintain manufacturer's recommended temperature and humidity limits during storage and installation. Protect equipment from dirt, dust and other jobsite contaminants and conditions detrimental to the equipment.

## 1.6 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period. Provide warranty on materials and labor for 18 months starting from date of delivery, or one year from date of preliminary acceptance, whichever is longer.
  - 1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of preliminary acceptance.
  - 2. Warranty Period for Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than ten years from date of preliminary acceptance.
  - 3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than one year from date of preliminary acceptance.
  - 4. Warranty Period for Control Boards: Manufacturer's standard, but not less than one year from date of preliminary acceptance.

## 1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fan Belts: One set for each belt-driven fan.
  - 2. Filters: One set of filters for each unit.
  - 3. Provide fan sheaves as required for final air balance.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Carrier:

- B. Trane, a brand of Ingersoll Rand
- C. Daikin
- D. York International Corporation/Johnson Controls Inc

## 2.2 AIR CONDITIONING UNITS

- A. Description: Factory assembled and tested, packaged, self-contained, roof-mounted, air cooled air conditioning units, with electric refrigeration system, gas fired heating, outside air louvers, built-in temperature controls; fully charged with refrigerant and filled with oil.
- B. Energy Efficiency:
  - 1. Air conditioners shall have a EER better than ASHRAE Std 90.1 I-P under AHRI test procedures. When air conditioners with higher efficiencies than the Standard are scheduled on the drawings, the more efficient value shall be the minimum project requirement.

## 2.3 CASING

- A. General: Casings shall be formed and reinforced, minimum 2" thick, double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed and access doors with neoprene gasket.
- B. Exterior casing material shall be galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs. Cabinet shall be tested 1000 hour in salt spray test in compliance with ASTM B117.
- C. Casing Insulation shall comply with NFPA 90A or NFPA 90B and ASTM C1071, Type I. Minimum thickness shall be 1/2 inch, with an aluminum foil or neoprene coating on all surfaces in contact with the air stream.
- D. Condensate drain pans shall be formed sections of stainless steel, with a minimum 3/4" NPT drain connection.
- E. Provide with steel hail guard.

## 2.4 FANS

- A. Evaporator fan shall be forward-curved, double-width, double inlet constant volume centrifugal. Fans shall be belt-driven with adjustable pulleys. Bearings shall be sealed and permanently lubricated.

- B. Condenser fans shall be propeller, mounted on shaft of permanently lubricated motor.
- C. Fan Motor: Comply with requirements in Section 23 05 13 - Common Motor Requirements for HVAC Equipment
- D. Provide power exhaust fan.

## 2.5 COILS

- A. Evaporator and condenser refrigerant coils shall incorporate aluminum-plate fins mechanically bonded to seamless copper tubes. Coils shall be factory pressure tested per AHRI standards and leak tested at 150 psig.

## 2.6 REFRIGERANT CIRCUIT COMPONENTS

- A. Compressor: Scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection. For units more than 7.5 tons, provide two compressors. Motor shall be suction gas cooled.
- B. Refrigeration Specialties:
  - 1. Refrigerant Charge: R-407 or 410A. Units shall be fully charged when delivered to the site.
  - 2. Expansion valve with replaceable thermostatic element.
  - 3. Refrigerant filter/dryer.
  - 4. Manual-reset high-pressure safety switch.
  - 5. Automatic-reset compressor motor thermal overload.
  - 6. Service ports installed in compressor suction and liquid lines.

## 2.7 AIR FILTRATION

- A. Minimum arrestance according to ASHRAE Std 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE Std 52.2. Filters shall be glass fiber, two-inch thick (MERV 8).

## 2.8 DAMPERS

- A. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.

1. Damper Motor: Modulating with adjustable minimum position.
2. Relief-Air Damper: Gravity actuated with bird screen and hood.

## 2.9 ELECTRICAL POWER CONNECTION

- A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

## 2.10 CONTROLS

- A. Control equipment and sequence are specified in Division 23 Sections.

## 2.11 ACCESSORIES

- A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required.
- B. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.
- C. Demand controlled ventilation.

## 2.12 ROOF CURBS

- A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards. Roof curb height shall be 14 inches minimum.
- B. Provide vibration isolation curb.

# PART 3 EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.
- B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.
- C. Examine roofs for suitable conditions where RTUs will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Roof Curb: Install on roof structure, level and secure, according to AHRI Guideline B. Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Division 07. Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.
- C. Install condensate drain, pipe shall be minimum 1 1/2" copper piping, with trap and indirect connection to nearest roof drain or area drain.
- D. Install piping adjacent to RTUs to allow service and maintenance.
  - 1. Gas Piping: Comply with applicable requirements in Section 33 51 13 - Natural Gas Piping. Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.
- E. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
  - 1. Install ducts to termination at top of roof curb.
  - 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
  - 3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 23 33 00 - Air Duct Accessories.
  - 4. Install return-air duct continuously through roof structure.

### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.
- B. Tests and Inspections:
  - 1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.

2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
  3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

#### 3.4 CLEANING AND ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of preliminary acceptance, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.
- B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

#### 3.5 CONTRACTOR STARTUP AND REPORTING

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
  1. Inspect for visible damage to unit casing.
  2. Inspect for visible damage to furnace combustion chamber.
  3. Inspect for visible damage to compressor, coils, and fans.
  4. Inspect internal insulation.
  5. Verify that labels are clearly visible.
  6. Verify that clearances have been provided for servicing.
  7. Verify that controls are connected and operable.
  8. Verify that filters are installed.
  9. Clean condenser coil and inspect for construction debris.
  10. Clean furnace flue and inspect for construction debris.
  11. Connect and purge gas line.

12. Remove packing from vibration isolators.
13. Verify lubrication on fan and motor bearings.
14. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
15. Adjust fan belts to proper alignment and tension.
16. Start unit according to manufacturer's written instructions.
  - a. Start refrigeration system.
  - b. Do not operate below recommended low-ambient temperature.
  - c. Complete startup sheets and attach copy with Contractor's startup report.
17. Inspect and record performance of interlocks and protective devices; verify sequences.
18. Operate unit for an initial period as recommended or required by manufacturer.
19. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.
  - a. Measure gas pressure on manifold.
  - b. Inspect operation of power vents.
  - c. Measure combustion-air temperature at inlet to combustion chamber.
  - d. Measure flue-gas temperature at furnace discharge.
  - e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
  - f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
20. Calibrate thermostats.
21. Adjust and inspect high-temperature limits.
22. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
23. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:
  - a. Coil leaving-air, dry- and wet-bulb temperatures.
  - b. Coil entering-air, dry- and wet-bulb temperatures.

- c. Outdoor-air, dry-bulb temperature.
  - d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
24. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
25. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
- a. Supply-air volume.
  - b. Return-air volume.
  - c. Relief-air volume.
  - d. Outdoor-air intake volume.
26. Simulate maximum cooling demand and inspect the following:
- a. Compressor refrigerant suction and hot-gas pressures.
  - b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.
27. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
- a. High-temperature limit on gas-fired heat exchanger.
  - b. Low-temperature safety operation.
  - c. Filter high-pressure differential alarm.
  - d. Economizer to minimum outdoor-air changeover.
  - e. Relief-air fan operation.
  - f. Smoke and firestat alarms.
28. After startup and performance testing and prior to preliminary acceptance, replace existing filters with new filters.
29. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs.

### 3.6 DEMONSTRATION AND COMMISSIONING

- A. Engage a factory-authorized service representative to train maintenance personnel to adjust, operate, and maintain RTUs. Refer to Division 01.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 23 81 26

### SPLIT-SYSTEM AIR CONDITIONERS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Indoor units for ductless systems.
- B. Outdoor units.

##### 1.2 REFERENCE STANDARDS

- A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2008, Including All Addenda.
- B. AHRI 270 - Sound Performance Rating of Outdoor Unitary Equipment; 2015.
- C. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.
- D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2013.
- E. ASHRAE Std 23.1 - Methods of Testing for Rating the Performance of Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Temperatures of the Refrigerant; 2010.
- F. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality; 2016.
- G. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2013, Including All Amendments and Errata.
- H. City of Chicago Electrical Code - National Electrical Code with Chicago Amendments; 2017.
- I. NEMA MG 1 - Motors and Generators; 2017.
- J. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2018.
- K. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2018.
- L. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

### 1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. See Section 01 33 29 - LEED Sustainable Design Reporting, when required.
- C. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- D. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
- E. Field quality-control reports.
- F. Design Data: Indicate refrigerant pipe sizing.
- G. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.
- H. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- I. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- J. Project Record Documents: Record actual locations of components and connections.
- K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Extra Filters: One for each unit.

### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in City of Chicago Electrical Code, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
  - 1. Fabricate and label refrigeration system to comply with ASHRAE Std 15.

2. ASHRAE Compliance: Applicable requirements in ASHRAE Std 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-Up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE Std 90.1 I-P.

## 1.5 COORDINATION

A. Ground-Mounted Remote Condensing Units: Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Roof-Mounted Remote Condensing Units: Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

## 1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

- a. Compressor: Six years from date of Preliminary Acceptance.
- b. Parts: One year from date of Preliminary Acceptance.

## 1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set for each air-handling unit.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Carrier Corporation

B. Trane Inc

C. York International Corporation / Johnson Controls

D. Mitsubishi Electric & Electronics USA, Inc.

- E. Daikin
- F. LG Electronics USA, Inc.

## 2.2 SYSTEM DESIGN

- A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
  - 1. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.

## 2.3 INDOOR UNITS FOR DUCTLESS SYSTEMS

- A. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect/Engineer of Record, and discharge drain pans with drain connection.
- B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
- C. Fan: Direct drive, centrifugal.
- D. Fan Motors:
  - 1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 23.
  - 2. Multi-tapped, multi-speed with internal thermal protection and permanent lubrication.
  - 3. Enclosure Type: Totally enclosed, fan cooled.
  - 4. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
  - 5. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
  - 6. Mount unit-mounted disconnect switches on exterior or interior of unit.
- E. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE Std 62.1.
- F. Condensate Drain Pans:
  - 1. Fabricated with one or two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

- a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE Std 62.1.
    - b. Pan Depth: 1 inch, minimum.
  - G. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
    - 1. Minimum Connection Size: NPS 1.
  - H. Condensate pump
- 2.4 OUTDOOR UNITS
- A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
    - 1. Comply with AHRI 210/240.
    - 2. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.
    - 3. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.
    - 4. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23.1 and UL 207.
    - 5. Sound Rating: 69 dBA, when measured in accordance with AHRI 270.
  - B. Compressor: Hermetic, two speed 1800 and 3600 rpm, AHRI 520 resiliently mounted integral with condenser, with positive lubrication, crankcase heater, high pressure control, motor overload protection, service valves and drier. Provide time delay control to prevent short cycling and rapid speed changes.
  - C. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
    - 1. Condenser Fans: Direct-drive propeller type.
    - 2. Condenser Fan Motor: Enclosed, 1-phase type, permanently lubricated.
  - D. Coil: Air-cooled, aluminum fins bonded to copper tubes.

- E. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).
  - 1. Reversing valve (for heat pump applications).
  - 2. Wind baffle
- F. Operating Controls:
  - 1. Control by room thermostat to maintain room temperature setting.
  - 2. Low Ambient Kit: Provide refrigerant pressure switch to cycle condenser fan on when condenser refrigerant pressure is above 285 psig and off when pressure drops below 140 psig for operation to -10 degrees F.
  - 3. Automatic-reset timer to prevent rapid cycling of compressor.
  - 4. 24-hour time control of system stop and start.
  - 5. Liquid crystal display indicating temperature, setpoint temperature, time setting, operating mode, and fan speed.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.
- B. Verify that proper power supply is available and in correct location.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.
- B. Install in accordance with NFPA 90A and NFPA 90B.
- C. Install refrigeration systems in accordance with ASHRAE Std 15.
- D. Pipe drain from cooling coils or condensate pump to nearest open site drain.
- E. Install units level and plumb.
- F. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

- G. Install ground-mounted, compressor-condenser components on 4-inches thick, reinforced concrete base that is 4 inches larger, on each side, than unit, with cast-in anchor-bolt inserts. Concrete, reinforcement, and formwork are specified in Division 03.
- H. Install roof-mounted, compressor-condenser components on equipment supports specified in Division 07. Anchor units to supports with removable, cadmium-plated fasteners.
- I. Install and connect pre-charged refrigerant pipes to component's quick-connect fittings. Install pipes to allow access to unit.
- J. Pipe installations shall allow space for service and maintenance of system components.

### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and repeat test until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 3. Controls and Safeties: Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

### 3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.

### 3.5 TRAINING AND DEMONSTRATION

- A. Engage a factory-authorized service representative to train maintenance personnel to adjust, operate, and maintain unit as specified below:
  - 1. Train maintenance personnel on procedures and schedules for starting up and shutting down, troubleshooting, servicing, and maintaining system components. The training will occur after the startup report has been provided

to the Owner and the trainer will provide four Installation and Operation manuals for the use of the Owner's personnel during training.

2. Review data in maintenance manuals. Refer to Division 01. All required and recommended maintenance will be reviewed as well as operational troubleshooting. If the IOM does not include a written troubleshooting guide, one will be provided.
  3. Schedule training with Owner, through Architect/Engineer of Record, with at least seven days advance notice.
- B. Demonstrate proper operation of equipment to commissioning agent, if one, and designated Owner's personnel. The scope of the demonstration shall include functional performance requirements under local control.
- C. Video record the training session(s). The manufacturer may submit a standard training video or training CD for review as an alternate to recording of the training session. The standard video must be reviewed and accepted by the Owner for the alternate to be acceptable.

END OF SECTION

## SECTION 23 82 00

### UNIT HEATERS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Unit heaters.
- B. Air coils.

##### 1.2 REFERENCE STANDARDS

- A. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils 2001, with Addendum (2011).
- B. AHRI 440 - Performance Rating of Room Fan-Coils 2008.
- C. ASHRAE Std 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter 1992 Edition.
- D. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size 2017, with Errata (2020).
- E. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2018.
- G. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- H. ASTM B88 - Standard Specification for Seamless Copper Water Tube 2020.
- I. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric) 2020.
- J. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.

- L. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2005 (Revised 2009).
- M. UL 2021 - Fixed and Location Dedicated Electric Room Heaters Current Edition, Including All Revisions.

### 1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
  - 1. Ensure required submittals have been provided with sufficient time for review prior to scheduling the Preinstallation Meeting.
  - 2. Review the detailed requirements for the work of this section and to review the drawings and specifications for this work
  - 3. Require attendance by all affected installers including but not limited to
    - a. Contractor's Superintendent
    - b. Installer
    - c. Manufacturer/Fabricator Representative
    - d. Other affected Subcontractors
    - e. Architect/Engineer of Record
    - f. Owner's Representative
  - 4. Record minutes and distribute copies within 5 days after meeting to participants as well as Architect/Engineer of Record, Owner and those affected by decisions made.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

### 1.4 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide typical catalog of information including arrangements, fan curves, sound levels, etc.
- C. Shop Drawings:
  - 1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
  - 2. Indicate air coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.

3. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified cooling or heat required to actual cooling or heat output provided.
  4. Indicate mechanical and electrical service locations and requirements.
- D. Selection Samples: For each finish product specified, color chart representing manufacturer's full range of available colors.
- E. Verification Samples: For each finish product specified, color chip representing actual product in color and texture.
- F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.
- G. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 60 00 - Product Requirements for additional provisions.
  2. Extra Filters: One set of each type and size.

#### 1.5 QUALITY ASSURANCE

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- B. Comply with minimum COP/efficiency levels according to ASHRAE Std 90.1 I-P.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. Units shall be stored and handled in accordance with manufacturer's instructions.
- B. Protect units from damage and construction debris before installation. Cover open pipe ends during shipping and storage at the construction site.
- C. Coils:
  1. Comply with ASHRAE Std 62.1, Section 7 (practices to be followed during construction and startup). Protect equipment from rain and other sources of moisture by appropriate in-transit and on-site procedures.
  2. Follow manufacturer's recommendations for handling, unloading and storage.

3. Seal openings to protect against damage during shipping, handling and storage.
4. Provide shrink-wrap around entire exterior of coil. The membrane shall cover the entire coil to fully protect it during shipping and storage.
5. Storage: Store per manufacturer's written recommendations. Store coils indoors in a warm, clean, dry place where the units will be protected from weather, construction traffic, dirt, dust, water and moisture.

## 1.7 COORDINATION

- A. For cabinet unit heaters and fan coils that penetrate or are supported by the ceiling, coordinate layout and installation of units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate layout and installation of unit ventilators and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- C. Coordinate size and location of wall sleeves for outdoor-air intake and relief dampers.

## 1.8 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Provide warranty on materials and labor for 18 months starting from date of delivery, or one year from date of Preliminary Acceptance, whichever is longer.
- C. Special Warranty Period for Compressors: Manufacturer's standard, but not less than five (5) years from date of Preliminary Acceptance. Parts-Only warranty is not acceptable.

## PART 2 PRODUCTS

### 2.1 UNIT HEATERS

- A. Manufacturers:
  1. Airtherm, a Mestek Company: [www.airthermhvac.com](http://www.airthermhvac.com)
  2. Dunham Bush: [www.dbamericas.com](http://www.dbamericas.com)
  3. Modine Manufacturing Company: [www.modineHVAC.com](http://www.modineHVAC.com)

4. Sterling Hydronics, a Mestek Company: [www.sterlingheat.com](http://www.sterlingheat.com)
  5. Vulcan Radiator: [www.vulcanrad.com](http://www.vulcanrad.com)
  6. Airtherm
- B. Comply with UL 2021.
- C. Coils: Evenly spaced aluminum fins mechanically bonded to copper tubing. Minimum 2 row coils.
1. Evenly spaced aluminum fins mechanically bonded to copper tubes. Minimum 2 row coils.
  2. Electric Units Description: Factory-packaged units constructed according to UL 499, UL 1030, and UL 2021. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  3. Electric Heating Elements: Nickel-chromium-wire heating element enclosed in metallic sheath mechanically bonded to fins, with high-temperature cutout and sensor running the full length of the element. Element supports shall eliminate thermal expansion noise.
- D. Perform factory run test under normal operating conditions, water, and steam flow rates.
- E. Casing: Minimum 18 gauge, 0.0478 inch thick sheet steel casing with threaded pipe connections for hanger rods for horizontal models and minimum 18 gauge, 0.0478 inch thick sheet steel top and bottom plates for vertical projection models.
- F. Finish: Factory applied baked primer coat.
- G. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard; horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.
- H. Air Outlet: Adjustable pattern diffuser on vertical projection models and two way louvers on horizontal projection models.
- I. Control: Local disconnect switch with remote mounted 7-day programmable thermostat.
1. Provide aquastat and 2-position solenoid valve (hot water).
  2. Programmable night setback.

3. Lockable cover with tamper proof screws.
4. Low voltage relays and control transformers.

## 2.2 AIR COILS

### A. Manufacturers:

#### 1. Electric Coils:

- a. Brasch Manufacturing Company: [www.braschmfg.com](http://www.braschmfg.com)
- b. Chromalox: [www.chromalox.com](http://www.chromalox.com)
- c. INDEECO (Industrial Engineering and Equipment Company):  
[www.indeeco.com](http://www.indeeco.com)

### B. Electric Coils:

1. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL) as suitable for the purpose indicated.
2. Standard Built-In Components:
  - a. Contactors.
  - b. Airflow switch.
  - c. Interlocked disconnect switch.
  - d. Fused transformers.
  - e. Circuit fuses.
  - f. Load and control terminal blocks.
3. Assembly: Terminal control box with hinged or screwed access cover, heating element, casing, and controls.
4. Open Coil: Nickel chromium heating element, stainless steel or nickel plated terminals supported in ceramic bracket bushings.
5. Frame: Heavy gage galvanized steel for slip-in mounting.
6. SCR control.
7. Over-Temperature Protection: Provide thermal cutouts for primary and secondary over-temperature protection.
8. Additional Controls:
  - a. Toggle switches; one per step.
  - b. Step controller.
  - c. Time-delay relay.
  - d. Pilot lights; one per step.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify that surfaces are suitable for installation.
- B. Verify that field measurements are as indicated on drawings.

### 3.2 INSTALLATION

- A. Install in accordance with manufacturer's recommendations.
- B. Install equipment exposed to finished areas after walls and ceilings are finished and painted.
- C. Do not damage equipment or finishes.
- D. Unit Heaters:
  - 1. Hang from building structure, with pipe hangers anchored to building, not from piping or electrical conduit.
  - 2. Mount as high as possible to maintain greatest headroom unless otherwise indicated.
  - 3. Provide temperature controls.
  - 4. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls unless otherwise noted.
  - 5. Ground equipment according to Section 26 05 26 - Grounding and Bonding for Electrical Systems.
  - 6. Connect wiring according to Section 26 05 83 - Wiring Connections.
- E. Units with Electric Heating Elements:
  - 1. Install as indicated including electrical devices furnished by manufacturer but not factory installed.
  - 2. Install wiring in accordance with the manufacturer's wiring diagram submittal and Section 26 05 83 - Wiring Connections.
- F. Air Coils:
  - 1. Install in ducts and casings in accordance with SMACNA (DCS).
    - a. Support coil sections independent of piping on steel channel or double angle frames and secure to casing.

- b. Provide frames for maximum of three coil sections.
- c. Arrange supports to avoid piercing drain pans.
- d. Provide airtight seals between coil and casing or duct.
- e. Provide smooth duct transitions between coils and ducts.
- f. Provide access doors upstream and downstream of coils for maintenance.

2. Coil Safeguards:

- a. Protect coils to prevent damage to flanges and fins.
- b. Comb out damaged fins.

3. Install all coils level except cleanable coils with 1:50 pitch.

4. Make connections to hydronic and steam coils with unions and flanges.

5. Electric Coils:

- a. Provide minimum airflow switch.
- b. Provide high limit switch.
- c. Provide disconnect.
- d. Ground equipment according to Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- e. Connect wiring according to Section 26 05 83 - Wiring Connections.
- f. Perform the following field tests and inspections and prepare test reports:

- (1) Operational Test: After electrical circuitry has been energized, operate electric coils to confirm proper unit operation.
- (2) Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.3 CLEANING

- A. After construction and painting is completed, clean exposed surfaces of units.
- B. Vacuum clean coils and inside of units.
- C. Touch-up marred or scratched surfaces of factory-finished cabinets using finish materials furnished by the manufacturer.
- D. Install new filters.

END OF SECTION

## SECTION 26 05 00

### BASIC ELECTRICAL MATERIALS AND METHODS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: General requirements for providing basic electrical materials and methods.
- B. Related work specified in other sections includes, but is not limited to, the following:
  - 1. Certain equipment, control devices, conduit and wiring are shown on electrical drawings, but are specified in other sections pertaining to plumbing, heating, ventilating, air conditioning, temperature control systems, process equipment, process control systems and instrumentation. Install and connect these items to the electrical system as indicated or required in accordance with the Contract Documents.
- C. Overall Application of Specifications: This Section applies to all Division 26 sections and to other sections that include requirements for electrical equipment. Irrespective of where the electrical requirements are specified, provide and install all materials necessary for a complete operational system.
- D. Temporary Requirements: This Section applies to any temporary circuits, overcurrent devices, conduit, wiring, and other equipment required during changeover from the existing electrical system to a new electrical system. This Section also applies to temporary rewiring of lighting circuits, power circuits, instruments and devices.

##### 1.2 DEFINITIONS

- A. Corrosive Areas: The following areas are designated corrosive areas:
  - 1. Chemical Storage, Metering, and Handling Rooms
- B. Wet Locations: The following areas are designated wet locations:
  - 1. Below-grade tunnels and vaults.
  - 2. Filter galleries.
  - 3. Rooftops and outdoors.

##### 1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Design requirements are specified in the applicable sections.

- B. Performance Requirements: Performance requirements are specified in the applicable sections.

#### 1.4 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01.

- B. Product Data and Information: Furnish a complete list of electrical equipment and materials to be furnished that shows the manufacturer, catalog number, size, type, capacity, voltage rating and other pertinent information related to each item on the list.

1. Furnish catalog data for the manufacturer's standard equipment and materials. Clearly identify the equipment and devices specifically being proposed on manufacturers' catalog data sheets.
2. Identification: Furnish a complete schedule or listing of system and equipment identification labels with legends.

- C. CONTRACTOR's Shop Drawings: Furnish shop drawings on items manufactured for the Contract.

1. Furnish connection and schematic diagrams for each piece of electrical equipment where applicable. A manufacturer's standard connection or schematic diagram showing more than one method of wiring is not acceptable unless, the intended method is clearly marked.
2. Furnish diagrams that show connections to field equipment. Clearly differentiate between manufacturer's and field wiring.
3. Furnish raceway layout drawings that show conduits, boxes, and panels which contain the conductors to be provided. Include schedules listing conduit sizes, conductor content and identification.
4. Where additions and modifications are made to existing equipment, furnish drawings which clearly identify remaining existing equipment and the new Work.

- D. Coordination Drawings: Furnish coordination drawings that have a scale of 1/4"=1'-0" or larger; that show major elements, components, and systems of electrical equipment as they relate to other systems, installations, and building components. Indicate locations where access space is limited and where sequencing and coordination of installations are required for the efficient flow of the Work, including (but not limited to) the following:

1. Indicate the proposed locations of major raceway systems, equipment and materials. Include the following:

- a. Clearances for servicing equipment, including space for equipment disassembly as required for periodic maintenance.
  - b. Exterior wall and foundation penetrations.
  - c. Fire-rated wall and floor penetrations.
  - d. Equipment connections and support details.
  - e. Sizes and location of required concrete pads and bases.
2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
  3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
  4. Prepare reflected ceiling plans to coordinate the installation of air outlets and inlets, light fixtures, communications systems components, fire alarm devices, sprinklers, and other ceiling-mounted devices.
- E. Record Documents: Furnish record documents, and in addition to the requirements specified in Division 1, indicate installed conditions for:
1. Interior and exterior major raceway systems' sizes and locations; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker sizes and arrangements.
  2. Exposed and concealed equipment locations dimensioned from prominent building lines.
  3. Approved substitutions, and actual equipment and materials installed.
- F. Maintenance Manuals: Furnish maintenance manuals, and in addition to the requirements specified in Division 1, include the following information for equipment items:
1. Functional description, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and catalog numbers of replacement parts. Where a Bill of Materials is provided, include a manufacturers' data sheet for each component and device listed therein.
  2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping,

shutdown, and emergency instructions; and summer and winter operating instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.

#### 1.5 QUALITY ASSURANCE

- A. Codes: Provide all electrical Work in accordance with applicable local codes, regulations and ordinances. If there is a conflict between the requirements specified in the Contract Documents and the codes, follow the more stringent requirements as determined and approved.
- B. Testing: As a minimum, provide standard factory and field tests for each type of equipment. Other tests may be specified in the applicable equipment section.
- C. Labeling: Provide electrical equipment and materials that are listed and approved by Underwriters Laboratories or other OSHA recognized testing laboratories with the testing agency's label attached.
- D. Standard Products: Unless otherwise indicated, provide electrical materials and equipment which are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturer's latest standard design that conforms to these Specifications. Provide the products of the same manufacturer when two or more units of the same class of material and equipment are required.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 (and as follows:)
- B. Shipping and Packing: Provide materials and equipment suitably boxed, crated or otherwise completely enclosed and protected during shipment, handling, and storage. Clearly label such boxes, crates or enclosures with manufacturer's name, and name of material or equipment enclosed.
- C. Acceptance at Site: Conform to acceptance requirements as required in Division 1.
  1. Repair or replace all materials and equipment damaged by handling and storage as directed at no additional Contract cost.
- D. Storage and Protection: Protect materials and equipment from exposure to the elements and keep them dry at all times. Handle and store to prevent damage and deterioration in accordance with manufacturer's recommendations. Provide

temporary power to space heaters where provided with equipment to prevent condensation from developing.

## 1.7 PROJECT CONDITIONS

- A. General: The Drawings indicate the extent and general arrangement of the principal electrical elements, outlets, devices and circuit layouts. Install and connect all electrical elements and devices to form a complete workable system as required by the Contract Documents, regardless of whether all system components are specifically stated in the Specifications or shown. Provide necessary materials and installation wherever required to conform to the specific requirements of the furnished equipment and for proper installation of the Work.
- B. Physical Layouts: In general, the routing of feeders show general arrangement and are not intended to show exact routing and locations of raceways. Verify actual and final arrangement, equipment locations, and prepare circuit and raceway layouts before ordering materials and equipment. Equipment locations are approximate and are subject to modifications as determined by approved equipment dimensions.
- C. Coordination of Work: Coordinate the Work so that the electrical equipment may be installed without altering building components, other equipment or installations.
- D. Departure from Design: If departures from the design are deemed necessary due to structural conditions, obstructions or other problems, provide details of such departures and the reasons for requesting approval. Submit variations as soon as practical but no later than the submittal of the required raceway layout drawings. Do not depart from the design without written approval.

## PART 2 PRODUCTS

Not Used

## PART 3 EXECUTION

### 3.1 ROUGH-IN

- A. Final Location: Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

### 3.2 ELECTRICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
  - 1. Coordinate electrical systems, equipment, and materials installation with other building components.

2. Verify all dimensions by taking field measurements.
3. Arrange for chases, slots, and openings in other building components as construction progresses to provide for electrical installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in cast-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum possible headroom.
7. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide all required connections for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the ENGINEER for resolution.
9. Where installed exposed in finished spaces, install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components.
10. Provide electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
11. Provide access panels or doors where units are concealed behind finished surfaces.
12. Install systems, materials, and equipment providing right-of-way priority to systems required to be installed at a specified slope.
13. All wiring specified, scheduled, noted or shown is to be installed in conduit unless identified otherwise.

### 3.3 CUTTING AND PATCHING

- A. General: Perform cutting and patching as specified in Division 01. In addition to the requirements specified in Division 1, the following requirements apply:
1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
    - a. Uncover Work to provide for installation of ill-timed Work.
    - b. Remove and replace defective Work.
    - c. Remove and replace Work not conforming to requirements of the Contract Documents.
    - d. Remove samples of installed Work as specified for testing.
    - e. Install equipment and materials in existing structures.
    - f. Locate existing structural reinforcing with a pachometer where core drilled penetrations are required so as not to cut the steel reinforcing.
  2. Cut, remove, and properly dispose of selected electrical equipment, components, and materials as indicated. Included are the removal of electrical items indicated to be removed and items made obsolete by the new Work. Deliver all removed serviceable apparatus to the OWNER as directed.
  3. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
  4. Provide and maintain adequate temporary partitions or dust barriers that prevent the spread of dust and dirt to adjacent areas.
  5. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
  6. Patch finished surfaces and building components using new materials that are compatible with the original installation and applied by experienced installers.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 26 05 10

ELECTRICAL UTILITY COORDINATION AND REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Requirements for arranging and coordinating with the Utility Company for modifications to electrical power service.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 03 31 00 - Cast-In-Place Concrete
  - 2. Section 26 29 23 - Adjustable Frequency Drives
  - 3. Section 26 19 00 - Medium Voltage Adjustable Frequency Drives
  - 4. Section 26 05 73 - Short Circuit and Coordination Study

1.2 SYSTEM DESCRIPTION

- A. Utility Company: ComEd
- B. Utility Company Contact: \_\_\_\_\_ (Provide individual's name)  
Office Telephone \_\_\_\_\_
- C. System Characteristics:
  - 1. 4160Y/2400 Volts
  - 2. 3 Phase
  - 3. 4 Wire
  - 4. Solidly Grounded Neutral
- D. Alterations to System: Addition of two standby engine generators, each rated 4160Y/2400V, 1000 kW/1250 kVA, with closed-transition transfer.

1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 01.

- B. Correspondence: Furnish copies of all correspondence with the Utility Company including available short circuit currents and X/R ratings for each feeder.
- C. Utility Company Drawings: Furnish Utility Company prepared drawings.
- D. Layout Drawings: Furnish the following drawings:
  - 1. Equipment pad details
  - 2. Equipment mounting details.

#### 1.4 QUALITY ASSURANCE

- A. General: Perform Work in accordance with Utility Company's written requirements and standards.

#### 1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify that field measurements are as indicated on Utility Company drawings.

### PART 2 PRODUCTS

#### 2.1 UTILITY METERING

- A. Revenue Meters: Meters will be furnished by Utility Company.
- B. Meter Base: Provide meter base in accordance with the requirements of the Utility Company.
- C. Metering Transformer Cabinet: Provide a metering transformer cabinet in accordance with the requirements of the Utility Company.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. General: Verify that service equipment is ready to be connected and energized.

#### 3.2 PREPARATION

- A. Utility Company Arrangements: Make arrangements with Utility Company to obtain permanent electric service to the Project.
- B. Utility Engineering and Facility Charges: Pay all charges and fees associated with securing both temporary and permanent electrical service for the project. (DELETE IF COVERED UNDER THE GENERAL CONDITIONS OF THE SPECIFICATIONS.)

- C. Utility Company Access: Coordinate location of Utility Company's facilities to provide proper access.
- D. Coordination: Coordinate schedule of Utility Company's facilities with all other work.
- E. (Specific Requirements: Insert any other specifics required by the Utility Company)
- F. Utility Company System Information: Obtain all information required to perform the Harmonic Analysis as specified in Section 16266 and Section 16268 and the Short Circuit and Coordination Study specified in Section 16085.

### 3.3 INSTALLATION

- A. General: Install Electrical Power Service in accordance with the Utility Company's recommendations and approved shop drawings and as specified in Division 01.
- B. Metering Transformer Cabinet and Meter Base: Install metering transformer cabinet and meter base in accordance with the Utility Company requirements and as shown.
- C. Concrete Pads: Provide cast-in-place concrete pads for Utility Company transformers and other equipment.

END OF SECTION

(NO TEXT ON THIS PAGE)

## SECTION 26 05 13

### MEDIUM VOLTAGE CABLES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing single conductor medium voltage cables and accessories as indicated, in accordance with the Contract Documents.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 26 05 00 - Basic Electric Materials and Methods
  - 2. Section 26 05 53 - Electrical Identification
  - 3. Section 26 08 00 - Electrical Testing Requirements

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ASTM B 8 - Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
  - 2. ASTM B 496 - Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors
  - 3. AEIC CS8 - Specifications for Extruded Dielectric Shielded Power Cables Rated 5 through 46 kV
  - 4. UL 1072 - Standard for Medium-Voltage Power Cables
  - 5. IEEE 400 - IEEE Guide for Field Testing of Shielded Power Cable Systems Rated 5kV and Above

##### 1.3 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01 and Section 26 05 00.
- B. Product Data and Information: Furnish physical and electrical catalog data for all cables and cable components and shop drawings for splice kits and terminations.

- C. Quality Control: Furnish certified Shop Test Reports and AEIC Qualification Test Reports for all cable lengths shipped.
- D. Number of Copies: Submit six copies of all certifications and warranties described.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 and as follows:
- B. Handling: Carefully handle all cables to avoid twists and kinks or other damage to the insulation.
- C. Storage: Store cable reels on concrete, 2 x 4 wood lagging or other hard surface. .

#### 1.5 WARRANTY

- A. Written Warranty: Furnish manufacturer's standard written warranty from the cable manufacturer that the cable is free of any factory-incurred defects.
- B. Replacement if Found Defective: In the event that the cable is found defective in design, material, or workmanship within the warranty period of the cable, remove and replace the defective portion of the cable with another cable meeting the original design specifications. Provide the replacement cable with the same warranty as the replaced cable at no additional cost to the OWNER.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Medium voltage cable
    - a. Prysmian Group
    - b. The Okonite Company
    - c. Kerite by Marmon Utility LLC

#### 2.2 MATERIALS

- A. General: Provide single medium voltage power cable consisting of stranded copper conductors, conductor screen, insulation, insulation screen, metallic shield and outer jacket, suitable for use in wet and dry locations in conduit and underground concrete encased ducts. Provide cables rated 105 degrees C for continuous operation, 140 degrees C for emergency overload operation and 250 degrees C for short circuit

conditions, UL listed as Type MV-105 in accordance with UL 1072 and manufactured in accordance with AEIC CS8.

- B. Conductors: Provide soft drawn, annealed and uncoated copper conductors with 98 percent minimum conductivity in accordance with the requirements of ASTM B 8 with Class B stranding or compact stranding meeting the requirements of ASTM B 496. Provide conductor sizes as scheduled and as required.
- C. Conductor Screen (Shield): Provide conductor screen of an extruded layer of semiconducting, thermosetting compound.
- D. Insulation: Provide conductor insulation other than black or grey in color of a compound based on a thermosetting ethylene-propylene elastomer extruded in tandem with and inseparably bonded to the conductor screen. Provide insulation resistant to heat, moisture, impact, ozone and electrical discharge. Provide the insulation thickness as shown below:
  - 1. For nominal 4160-volt applications
    - a. Voltage rating 5000/8000 volts
    - b. Insulation thickness 140 mils
    - c. Insulation level 133 percent at 5000 volts
- E. Insulation Screen (Shield): Provide insulation screen of an extruded semiconducting compound. Provide insulation screen that is easily removed without requiring the use of heat or special tools.
- F. Metallic Shield: Provide 5-mil thick helically applied coated copper tape shield over insulation screen with a 20 percent minimum overlap.
- G. Outer Jacket: Provide an outer jacket of heavy-duty thermoplastic black polyvinyl chloride (PVC).

## 2.3 COMPONENTS

- A. Splice Kit: Provide splice kits and terminations specifically designed for the application as recommended by the cable manufacturer.
- B. Connections: Provide splice and connections made up with closed end compression connectors and terminal lugs. Provide fittings and compression tools of the circular or hexagonal compression type rated for the voltage of the cable.

## 2.4 SOURCE QUALITY CONTROL

- A. General: Perform the following shop tests in accordance with the requirements of AEIC and furnish certified test reports for all cable lengths shipped.
  - 1. Qualification tests
  - 2. High voltage AC and DC tests

3. Insulation resistance test
  4. Partial discharge test
- B. Test Reports: Furnish certified test report for all cable lengths shipped.

### PART 3 EXECUTION

#### 3.1 PREPARATION

- A. Conduit Preparation: Mandrell all new and existing conduits and duct lines before installation and swab to remove accumulated moisture and debris before cables are pulled.

#### 3.2 INSTALLATION

- A. General: Install all medium voltage cables in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.
- B. Initial Pulls: Use lines of limited stretch to pull wire and cable into conduits. Do not use flat steel tapes and steel cables.
- C. Lubricants: Provide cable lubricants recommended by the manufacturer when pulling the cables into ducts and conduits.
- D. Pull Setup: Provide complete cable pulling setup, including winches, cable reel, support frames, turning sheaves, guides, and the like.
- E. Tension Meters: Connect a pulling tension meter to the pulling setup. Arrange the pulling equipment and apply pulling methods so that pulling tensions do not exceed the manufacturer's permissible limits for the cable furnished.
- F. Cable Groupings: Arrange cables securely tied, neatly bundled, and racked in manholes.
- G. Splices: Do not make splices within the conduit system. Do not make splices within handholes or manholes unless approved.
- H. Fireproofing: Fireproof all medium voltage cables installed in manholes and pullboxes. Provide fireproofing with approximately 30 mils thick by 3 inches wide fireproofing tape and applied tightly around each cable spiral in one-half lapped wrapping or in a butt jointed wrapping with a second wrapping covering joints of the first wrapping. Smooth irregularities in cables, such as at splices, with insulating putty before applying fireproofing tape. Install the tape with coated side toward the cable to extend not less than one inch into conduit. Install a random wrapping of glass cloth electrical tape around installed fireproofing tape to prevent unravelling. Provide fireproofing tape consisting of a flexible, conformable fabric with one side

coated with a flame retardant, flexible, polymeric coating or a chlorinated elastomer. Provide tape that is noncombustive and noncorrosive to the cable sheath.

- I. Terminators: Install medium voltage termination as recommended by the cable manufacturer.
- J. Lug Bolting: Provide connections at terminals, devices and bus bars made up of a flat Belleville or equal washer, and a locknut.
- K. Unacceptable Connections: Do not use indenter type compression fittings. Mechanical splices or lugs are not acceptable.

### 3.3 IDENTIFICATION OF CIRCUITS

- A. General: Identify all cables in accordance with the requirements contained in Section 26 05 53 and as follows.
- B. Color Code: Color code the cables with the following color code scheme.

Phase A	-	Brown, 1 band
Phase B	-	Orange, 2 bands
Phase C	-	Yellow, 3 bands
Neutral	-	White
Ground	-	Green

- C. Coding Tape: When using color coding tape apply the tape with overlapping turns for a minimum length of 2 inches starting 2 inches back from the termination point.

### 3.4 FIELD QUALITY CONTROL

- A. Inspection: Arrange inspection of the cable (including splices and terminations) installation by the manufacturer. Furnish manufacturer's certificate that the cable was installed property.
- B. Field Tests: Arrange the performance of following field tests in presence of the ENGINEER after terminations have been made up, but before final connections are made to equipment terminals.

1. Cable continuity test using a test light or a buzzer.
2. Cable insulation level (high voltage DC) test using approved DC HI-POT equipment in accordance with IEEE 400 for the voltage rating and insulation thicknesses given below; by an independent testing agency:

Voltage Rating	Insulation Thickness	dc Test Voltage	Time of Application
8000 volts	140 mil	44 kV	15 minutes

Voltage Rating	Insulation Thickness	dc Test Voltage	Time of Application
15,000 volts	175 mil	55 kV	15 minutes
15,000 volts	220 mil	65 kV	15 Minutes

END OF SECTION

## SECTION 26 05 19

### WIRES AND CABLES 600 VOLTS AND BELOW

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing all wires and cables rated at 600 volts and below for complete electrical systems as shown.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 26 05 00 – Basic Electrical Materials and Methods
  - 2. Section 26 05 53 – Electrical Identification
  - 3. Section 26 80 00 – Electrical Testing Requirements

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ASTM B3 - Standard Specifications for Soft or Annealed Copper Wire
  - 2. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
  - 3. UL 44 - Thermoset-Insulated Wires and Cables
  - 4. UL 83 - Thermoplastic-insulated Wires and Cables
  - 5. UL 2196 - Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control, and Data Cables
  - 6. NEMA WC-70 / ICEA S-95-658 - Power Cables Rated 2000 Volts Or Less For The Distribution Of Electrical Energy
  - 7. NFPA 70 - National Electrical Code (NEC)
  - 8. TIA/EIA 568-C.2 - Balanced Twisted-Pair Telecommunication Cabling and Components Standard

### 1.3 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01 and Section 26 05 00.
- B. Product Data and Information: Furnish manufacturer's catalog data for each type of wire and cable furnished.

### 1.4 QUALITY ASSURANCE

- A. General: Furnish wire and cable in accordance with applicable IEEE and NEMA standards and meeting the applicable requirements of the NEC and UL.
- B. Tests: Furnish factory tested cables prior to shipment in accordance with ICEA standards for the insulation specified.

### 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle wire and cable in accordance with the manufacturer's instructions and as specified in Division 01.
- B. Storage: Store cable reels on concrete, 2x4 wood lagging, or other hard surface. Do not store reels flat.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Wire and Cable
    - a. Southwire Company
    - b. The Okonite Company
    - c. Prysmian Group/General Cable Corporation
  - 2. Instrumentation Cable
    - a. Belden
    - b. Dekoron Wire and Cable
    - c. The Okonite Company
  - 3. Fire Alarm Cable
    - a. Belden
    - b. General Cable Corporation

4. Multiconductor Cable
  - a. The Okonite Company
  - b. Southwire Company
5. Wire Connectors
  - a. Thomas & Betts/ABB Group
  - b. 3 M/Electrical Products Division
  - c. Ideal Industries
6. Color Coding Marker
  - a. W. H. Brady Company
  - b. Thomas & Betts/ABB Group

## 2.2 MATERIALS

- A. Conductors: Provide soft drawn or annealed copper stranded conductors with 98 percent minimum conductivity, meeting requirements of ASTM B 8. Solid No. 12 and No. 10 AWG meeting requirements of ASTM B 3 may be used in lighting fixture and convenience outlet wiring.
- B. Insulation: Provide wires and cables with insulation as follows:
  1. Power, control and lighting wiring:
    - a. Single Conductor: Provide NEC Type XHHW/XHHW-2 Cross-linked Polyethylene (XLPE)insulation.
    - b. Multiconductor Cables: Insulate individual conductors with 15 mils of polyethylene or PVC and 4-mil nylon jacket. Wrap the conductors with type binder and an outer jacket not less than 45 mils of PVC. Use ICEA Method 1 for color coding wires.
  2. Instrumentation Wiring: The manufacturers' name and catalog number shown below are for the purpose of establishing quality and general configuration.
    - a. Two conductor or single pair: Stranded No. 16 AWG wire, 600 volt polyethylene insulation, twisted conductors, tinned copper drain wire, overlapped metalized tape overall shield providing 100 percent shield coverage and outer jacket of PVC. Dekoron Cat. No. 2X52-69610.
    - b. Three Conductor: Stranded No. 16 wire, 600 volt polyethylene insulation, twisted conductors, tinned copper drain wire, overlapped

metalized tape overall shield providing 100 percent shield coverage and outer jacket of PVC. Okonite Cat. No. 267-38-3401.

- c. Multiple Pairs or Triads: Provide individually shielded pairs or triad of stranded No. 16 AWG wire with overall shield. Insulate each wire for 600 volts with 15 mils of PVC and a 4-mil nylon jacket. Assemble pairs or triads with tinned copper drain wire and metalized tape shield providing 100 percent shield coverage. Cable pairs or triads together with tinned copper drain wire and overall metalized tape shield.
3. Data (Local Area Network) Cable: The manufacturers' name and catalog number shown below are for the purpose of establishing quality and general configuration.
    - a. Category 6: Provide cable having third party verification to TIA/EIA 568-C.2-1 Category 6 requirements and constructed of four pair of solid No. 23 AWG solid copper wire, 300 volt polyolefin insulation, film tape separator and outer jacket of black industrial grade sunlight and oil resistant PVC. Belden Cat. No. 7940A.
  4. Fire Alarm Cable: Provide cables compatible with the fire alarm system specified in Section 28 31 00. The manufacturers' name and catalog numbers shown herein are for the purpose of establishing quality and general configuration.
    - a. Plenum Cable: Provide NEC Type FPLP cable consisting of two solid conductor No. 16 AWG, 300 volt fluorinated ethylene propylene insulation, tinned copper drain wire, overlapping metalized tape overall shield providing 100 percent shield coverage and red Flamarrest outer jacket. Belden Cat. No. 6220FK.
    - b. Riser Cable: Provide NEC Type FPLR-CIC cable consisting of two solid conductor No. 16 AWG, 300 volt silicone rubber insulation with tinned copper drain wire, overlapping metalized tape overall shield providing 100 percent shield coverage and red FRPE outer jacket. Belden Cat. No. 5220FZ.
    - c. General Purpose Cable: Provide NEC Type FPL cable consisting of two or four solid conductor No. 16 AWG, 300 volt foam high density polyethylene insulation with tinned copper drain wire, overlapping metalized tape overall shield providing 100 percent shield coverage and red PVC outer jacket. Belden Cat. No. 5220FJ and 5222FJ.
    - d. Provide cables that are fire resistive rated in accordance with UL 2196.
    - e. Provide wire marking meeting the requirements of NEC Article 760.

- C. Printed Data on Covering: Provide the following information printed on the surface of all wires and cables at regular intervals throughout the entire length.
  - 1. Manufacturer or trade name.
  - 2. Size of conductor.
  - 3. Type of insulation.
  - 4. Voltage classification.

## 2.3 WIRE CONNECTIONS AND CONNECTING DEVICES

- A. Connectors for No. 10 AWG and Smaller: Provide insulated compression type butt connectors.
- B. Connectors for No. 8 AWG and Larger: Provide UL, Inc. listed compression type tube connectors for parallel or butt splices. Provide companion preformed plastic insulating covers or tape to provide insulation equal to conductor insulation.
- C. Miscellaneous Connectors: Provide pre-insulated spring connectors for lighting and receptacle splices and pigtails.
- D. Solderless Lugs: Provide solderless terminal lugs for stranded and multiple solid conductors at connection to terminals or use UL listed crimp tool compression style lugs.
- E. Control Wire Terminations: Provide spade lug or pressure type control conductor connection terminations for control wiring terminations. Provide lug bolting at devices or bus bars with a flat washer, a Belleville washer and a locknut.

## 2.4 COLOR CODING

- A. General: Use a vinyl impregnated tape resistant to oil, dirt and heat for conductor color coding.

# PART 3 EXECUTION

## 3.1 INSTALLATION

- A. General: Swab new and existing conduits to be used to clear debris and remove moisture before conductor installation. Install conductors in raceways with no splices in conduits and between boxes.
- B. Pulling Equipment: Pull conductors using proper equipment without exceeding manufacturer's recommendation for maximum pulling tension. Protect conductor insulation jacket at all times from twists, kinks, scrapes, punctures and other damage. Replace damaged conductors. Pull wires and cables into ducts and conduit without the use of lubricants, except where such use is necessary and approved. Use UL

listed lubricating compound compatible with the conductor insulated jacket and raceway.

Use lines of nylon or polypropylene, propelled by carbon dioxide, or compressed air, to snake or pull wire and cable into conduits. Do not use flat steel tapes or steel cables.

- C. Conductor Support: Support conductors in vertical risers with woven grips to prevent loading on conductor connectors.
- D. Seals: Provide a seal between the conductor and conduit for conduits entering buildings or from areas where the temperature change may cause condensation or moisture. Provide a non-hardening, removable, seal compatible with conductor insulation. Seal the conduits after the conductors are in place.
- E. Identification: Identify all cables as specified in Section 26 05 53.
- F. Color Coded Tape: Apply color coding tape at all terminations and splices with overlapping turns for a minimum length of two inches, starting two inches back from the termination point. Provide color code tape in all boxes and manholes.
- G. Provide color coding throughout the entire network for service, feeder, branch, control and low energy signal circuit conductors. Use the following color code for conductors.

COLOR CODING	
<u>SYSTEM</u>	<u>COLORS</u>
208/120 Three phase	Phase A - Black Phase B - Red Phase C - Blue Neutral - White Ground - Green
480/277 Three phase	Phase A - Brown Phase B - Orange Phase C - Yellow Neutral - White Ground - Green
Control and low- energy signal	Hot - Red Neutral - White Ground - Green
Gas and Fire De- tection Systems	See Specification 28 31 00 – Signaling and Alarm

COLOR CODING	
SYSTEM	COLORS
Instru- mentation	Gray
2-wire grounded dc system (negative grounded)	Positive - Red Negative (Neutral) - White
2-wire grounded dc system (positive grounded)	Positive (Neutral) - White Negative - Black
3-wire grounded dc system	Positive - Red Neutral - White Negative - Black

- H. Terminations: Leave a minimum of six inches of free conductor at each connected outlet and a minimum of nine inches at unconnected outlets.
- I. NEC Requirements: Install wiring in accordance with applicable provisions of National Electrical Code, local codes having jurisdiction, and as indicated.
- J. Conductor Sizing: Size conductors in accordance with the NEC, local codes having jurisdiction and the following:
1. Size for branch lighting circuits so that the greatest voltage drop between lighting panel and center of load does not exceed two percent at rated load.
  2. Size conductors to limit the maximum conductor temperature to less than 75 degrees C, except where specifically stated otherwise.
  3. Use minimum conductor sizes as follows:
    - a. Power and lighting branch circuits, No. 12 AWG.
    - b. 120-volt control circuits, No. 14 AWG.
    - c. Instrumentation and signal wiring, 2 or 3 conductors No. 16 AWG stranded shielded.
  4. Conductor Ampacity Adjustment Factors:
    - a. For installations in ambient temperatures other than 30 degrees C, adjust the conductor ampacity based on NEC Table 310.15(B)(2)(a).

- b. For installations of raceways or cables exposed to sunlight on or above rooftops, utilize ambient temperature adjustment per NEC Table 310.15(B)(3)(c).
- 5. Size conductors as shown or as required by the actual load to be served, whichever is larger.
- K. Splicing: Install continuous cables without splices in all duct systems.
- L. Instrumentation wiring:  
Install instrumentation wiring as follows:
  - 1. Wherever possible provide continuous instrumentation wiring without splices from field device to instrument. Where connections are required, make all connections in terminal boxes.
  - 2. Terminate instrumentation wiring at terminal blocks only.
  - 3. Where instrumentation wire is required to be connected in a terminal box, provide an isolated terminal for each shield.
  - 4. Ground instrumentation shields and drain wires only at the panel end of loop only.
  - 5. Install clear, heat-shrink, seamless tubing over exposed shields and drain wires in all terminal boxes, junction boxes, panels and field devices.
- M. Hazardous Areas: Seal all conduits at boundaries of hazardous areas in accordance with the National Electrical Code, local codes having jurisdiction, and as indicated.
- N. Accuracy of Information: The number and sizes of wires and conduits indicated are for guidance only and are not necessarily the correct number and sizes necessary for actual equipment installed. Install as many wires and conduits of the required size as necessary for a complete electrical system, and provide adequately for the equipment actually installed.

### 3.2 CONDUCTOR IDENTIFICATION

- A. Labeling: Label each wire at both termination points and at each splice point in junction boxes. Carry individual conductor or circuit identification throughout, with circuit numbers or other identification clearly stamped on terminal boards and printed on directory cards in distribution cabinets and panelboards.
- B. Identification: Identify each wire in junction boxes and cabinets by means of plastic slip-on wire marker.

- C. Plastic Tags: In manholes, identify each wire by laminated plastic tag located so it can be easily seen in accordance with Section 26 05 53.
- D. Color Coordination: Connect circuit conductors of the same color to the same phase throughout the installation.

### 3.3 WIRE AND CABLE CONNECTIONS TO EQUIPMENT

- A. General: Provide electrical connections to all equipment in strict accordance with the manufacturer's approved wiring diagrams, the Plans, or as approved. Repair or replace any damaged equipment resulting from erroneous connections.

### 3.4 CONNECTOR AND TERMINAL LUG INSTALLATION

- A. UL Requirements: Install all connectors and terminal lugs in accordance with UL requirements and manufacturer's recommendations.

### 3.5 FIELD QUALITY CONTROL

- A. Insulation Tests: Test all feeders after installation but before final connections are made.
- B. Continuity Tests: Test all power conductors and 20% of all control conductors to demonstrate proper cable connection.
- C. Perform tests in accordance with the requirements of Section 26 08 00.
- D. Test Results: Perform all tests and submit certified test results. Replace and retest any conductors that fail the tests.

END OF SECTION

(NO TEXT ON THIS PAGE)

## SECTION 26 05 26

### GROUNDING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing a complete grounding system and alterations to the existing grounding system as specified and shown. Grounding includes but is not limited to: electric equipment enclosures, raceway systems, transformers, unit substations, switchgears, switchboards, motor control centers, panelboards, ground grid systems, grounding rods, grounding conductors, bonding jumpers, water pipe connections, and structure metal frames as required.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 26 41 00 - Lightning Protection Systems
  - 2. Section 26 05 00 - Basic Electrical Materials and Methods
  - 3. Section 26 05 33 - Electrical Raceway Systems
  - 4. Section 26 05 19 - Wires and Cables - 600 Volts and Below
  - 5. Section 26 08 00 - Electrical Testing Requirements

##### 1.2 REFERENCES

- A. Codes and Standards: The following codes and standards are referred to in this Section:
  - 1. NFPA 70 - National Electrical Code (NEC)

##### 1.3 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01.
- B. Product Data and Information: Furnish manufacturer's catalog data for the following:
  - 1. Grounding and grounded conductors
  - 2. Grounding connectors, clamps and bushings
  - 3. Grounding rods
  - 4. Bonding jumpers
- C. Shop Drawings: Furnish shop drawings showing the locations and length of grounding rods. Denote the size and material used for grounding rods. Furnish details pertaining to the installation of grounding electrode conductors, grounding

and grounded conductors, grounding connections, grounding enhancement materials and the ground grid for buildings, structures, lighting units, manholes and handholes.

- D. Quality Control: Furnish a field report stating the results of the system ground impedance test.

#### 1.4 QUALITY ASSURANCE

- A. Codes and Standards: Construct a complete grounding system in accordance with applicable ANSI, IEEE Standards, the NEC and local codes.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.

##### 1. Grounding and Grounded Conductors

- a. Okonite Company
- b. Southwire Company

##### 2. Ground Plates

- a. Burndy/ Hubbell Incorporated O-Z Gedney/Emerson Industrial Automation
- b. Eritech Grounding Products
- c. Thomas & Betts/ABB Group

##### 3. Grounding Rods

- a. Harger Lightning Protection, Inc.
- b. Thompson Lightning Protection, Inc.
- c. Carolina Galvanizing Utility Products Division
- d. Eritech Grounding Products
- e. Superior Grounding Systems

##### 4. Ground Rod Access and Test Well Box

- a. Hubbell Power Systems – Quazite

- b. Oldcast Precast, Inc.
- c. Thompson Lightning Protection

## Eritech Grounding Products

### 2.2 MATERIALS

- A. General: Provide conductor sizes as shown or required.
- B. Materials: Provide conductors in accordance with the requirements specified in Section 26 05 19.
- C. Bare conductors: Provide bare copper conductor where buried in earth, embedded in concrete or exposed.
- D. Insulated Conductors: Provide copper conductor with green color insulation rated at 600 volts where installed in conduits or other enclosed raceways.

### 2.3 CONNECTORS

- A. Grounding Clamps and Bolted Connectors: Provide grounding clamps and bolted connectors suitable for devices or cables being connected.
- B. Ground Plates: Provide two-hole, cast, copper alloy, ground plates suitable for installation in concrete. Fabricate the ground plates with two ½-inch diameter threaded holes and a 4/0 stud for connection to the grounding system.
- C. Welding: Provide the exothermic welding process for buried, concealed and accessible connections to structural members, ground rods, and case grounds. Clean and paint welds embedded in the ground or encased in concrete with asphalt base paint.
- D. Bolted Connectors: Provide bolted connectors for grounding to ground buses and equipment.
- E. Pipe Grounding: Provide copper, brass, or bronze grounding clamps for grounding pipes. Do not provide strap type clamps.
- F. Grounding Bushings: Provide grounding bushings for conduits where conduits are not effectively grounded by firm contact to the grounded enclosure.

### 2.4 GROUNDING RODS

- A. Length and Size: Provide grounding rods 3/4-inch in diameter and 10 feet long.
- B. Grounding Rod Material: Copper-clad Stainless steel.

## 2.5 GROUND ROD ACCESS AND TEST WELL BOXES

- A. Interior Locations: Cast iron box with open bottom set in concrete floor measuring a minimum of 12 inches in diameter by 18 inches deep with engraved/stamped cover reading "GROUND ELECTRODE".
- B. Exterior Locations: Precast concrete or polymer concrete junction box with open bottom, UL listed, Tier 22 in accordance with ANSI/SCTE 77, with engraved/stamped cover reading "GROUND ELECTRODE".

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General:
  - 1. Install conductors to preclude exposure to physical damage.
  - 2. Install connections firm and tight.
  - 3. Arrange conductors and connectors without placing strain on the connections.
  - 4. Bury equipment grounding conductors as shown, or at a minimum of 12 inches below grade.
  - 5. Bring loops or taps up for connection to equipment or other items to be grounded.
  - 6. Install an insulated grounding conductor in all conduits.
  - 7. When raceways are used to contain and protect grounding conductors, install in accordance with Section 26 05 33 and NEC.
  - 8. Where conductors are installed in nonmetallic raceway, provide the grounding conductor in addition to the neutral wire, sized in accordance with NEC or as scheduled.
  - 9. Perform exothermic welding with properly sized molds.
- B. Grounding Rod Installation:
  - 1. Install grounding rods as shown with the top of the rod a minimum of 12 inches below grade.
  - 2. Drive grounding rods into permanently moist soil.

3. Provide additional ground rod sections as required to reach permanently moist soil.
  4. Provide junction box without bottom for access to grounding rod and conductor where shown.
- C. Equipment Grounding: Ground each piece of electrical equipment using a conductor in the raceway feeding the equipment in accordance with NEC.
1. Unless specified otherwise, connect transformer enclosures and neutrals to the grounding system. Connect the neutral ground connection at the transformer terminal. Make the connection from the ground grid to the ground bus and enclosures of switchboards, switchgears and motor control centers, lighting and distribution panelboards, and control, relay and instrumentation panels.
  2. Provide two separate, independent, diagonally opposite connections for power transformers so removal of one connection will not impair continuity of the ground system. Provide ground plates that are imbedded in the concrete pad so that transformers can be removed without damaging grounding system. Install a copper ground connect between ground plates and the transformers.
- D. Grounding Conductors: Connect the grounding conductor between the equipment and the grounding system. Where a ground bar is furnished with the panelboard, connect the grounding conductor to the bar.
- E. Miscellaneous Grounding: Provide grounding for the following:
1. Ground receptacles and switches and their metal plates through positive ground connection to the yoke/strap, outlet box and grounding system grounding wire installed in the conduit.
  2. Ground racks, supports, frames, covers and metal parts in manholes or handholes, controllers, motor frames, surge capacitors, arrestors, lighting fixtures, metal structures, exposed noncurrent carrying metal, mechanical equipment, hoist beams, cranes and similar items.
  3. Provide ground connections to equipment using ground plates imbedded in the concrete pad so that the equipment can be removed without damaging grounding system. Provide a copper ground connection between ground plates and the equipment.
  4. Ground motor shaft protection for motors operating on adjustable frequency drives where provided.

### 3.2 FIELD QUALITY CONTROL

- A. Tests: Conduct a witnessed test to determine the ground impedance for the entire system using a ground loop impedance tester. Provide a maximum impedance of 2

ohms at any point of the test. Add additional grounding rods if necessary to meet this requirement.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 26 05 33

### ELECTRICAL RACEWAY SYSTEMS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing electrical raceway systems as indicated, in accordance with the Contract Documents.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 09 96 00 – High Performance Coatings
  - 2. Section 26 05 00 - Basic Electrical Materials and Methods
  - 3. Section 26 05 43 - Underground Electrical Distribution System

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ANSI C80.1 - Rigid Steel Conduit
  - 2. ANSI C80.3 - Electrical Metallic Tubing,
  - 3. ANSI C80.5 - Specifications for Aluminum Rigid Conduit
  - 4. ANSI C80.6 - Electrical Intermediate Metal Conduit
  - 5. ANSI/NFPA 70 - National Electrical Code
  - 6. NEMA RN1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
  - 7. NEMA TC2 - Electrical Polyvinyl Chloride (PVC) Conduit
  - 8. UL 1 - Standard for Flexible Metal Conduit
  - 9. UL 6 - Standard for Rigid Metal Conduit-Steel
  - 10. UL 360 - Standard for Liquid-Tight Flexible Steel Conduit
  - 11. UL 651 - Standard for Schedule 40 and 80 Rigid PVC Conduit

- 12. UL 797 - Standard for Electrical Metallic Tubing-Steel
- 13. UL 1242 - Standard for Intermediate Metal Conduit-Steel
- 14. NFPA 70 - National Electrical Code (NEC)
- 15. Federal Specification WW-C-540C - Conduits, Metal, Rigid (Electrical, Aluminum)
- 16. Intertek ETL SEMKO PVC-001 - High Temperature H2O PVC Coating Adhesion Test Procedure

### 1.3 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01 and Section 26 05 00.

### 1.4 QUALITY ASSURANCE

- A. Codes: Provide all materials and workmanship in accordance with the requirements of the National Electrical Code and local codes having jurisdiction.
- B. Regulatory Requirements: Provide UL listed components.
- C. Installers of PVC coated rigid steel conduit are to be factory certified.

### 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Rigid steel and intermediate metal conduits and electrical metallic tubing:
    - a. Allied Tube and Conduit
    - b. Wheatland Tube Company/JMC Steel Group
    - c. Nucor Tublar Products
  - 2. PVC coated steel conduits fitting and boxes:

- a. Plasti-Bond/Perma-Cote/KorKap-Robroy Industries
  - b. Ocal – Thomas & Betts Corp.ABB
  - c. Perma-Cote Industries
3. Aluminum Conduits:
- a. Allied Tube and Conduit
  - b. Wheatland Tube Company/JMC Steel Group
  - c. Sapa Extrusions North America
4. Liquidtight and flexible steel conduit:
- a. Electri-Flex Company
  - b. The International Metal Hose Co.
  - c. Southwire
  - d. Anamet Electrical, Inc.
  - e. Thomas & Betts /ABB Group
5. Conduit Fitting and Connectors
- a. Appleton /Emerson Industrial Automation
  - b. ABB Group
  - c. Eaton’s Cooper Crouse-Hinds
  - d. O-Z Gedney/Emerson Industrial Automation
  - e. Hubbell - Killark
  - f. AdaletPLM/Scott Fetzer Company
6. Boxes and Enclosures:
- a. Appleton /Emerson Industrial Automation
  - b. Raco/A Hubbell Company
  - c. Eaton’s Cooper Crouse-Hinds
  - d. Thomas & Betts/ABB Group
  - e. Hoffman
  - f. Hope Electrical Products Company
  - g. O-Z Gedney/Emerson Industrial Automation
7. Strut Channel and Fittings
- a. Allied Tube and Conduit
  - b. Eaton’s Cooper B-Line Systems, Inc.
  - c. Thomas & Betts /ABB Group-SuperstrutEnduro Composites Inc.
  - d. Strut Tech Systems
  - e. Unistrut

8. Fire Stop System
  - a. 3M/Electrical Products Division
  - b. Acoustical Solutions Inc.
  - c. Nelson Fire Stop Products/Emerson Industrial Automation
9. Terminal Blocks
  - a. Phoenix Contact
  - b. ABB - Entrelec
  - c. Weidmuller

## 2.2 RACEWAYS

- A. General: Provide minimum 3/4-inch raceways.
- B. Raceway Requirements: Provide raceways meeting the following requirements:
  1. Provide rigid steel, heavy wall, hot-dip galvanized in accordance with the requirements of UL-6 and ANSI C80.1.
  2. Provide intermediate metal hot-dip galvanized conduit in accordance with the requirements of UL1242 and ANSI C80.6.
  3. Provide electrical metallic tubing hot dip galvanized conduit in accordance with the requirements of UL 797 and ANSI C80.3.
  4. Provide PVC coated rigid steel in accordance with the requirements for rigid steel raceway herein and with 40 mils bonded PVC exterior coating meeting requirements of UL-6 and NEMA RN1. Provide PVC coated rigid steel conduit that is listed and performance verified to ETL PVC-001 for 200 hours. Provide a nominal 2 mil urethane interior coating and a clear urethane coating over the galvanized threads.
  5. Provide rigid heavy wall aluminum alloy 6063T-1 conduit in accordance with the requirements of UL 6, Federal Specification WW-C-540C and ANSI C80.5.
  6. Provide rigid nonmetallic Schedule 40 PVC in accordance with requirements of NEMA TC2 and UL 651 with solvent cement joints.
  7. Provide rigid nonmetallic Schedule 80 PVC electrical conduit in accordance with the requirements of UL Standard 651 and NEMA Standard TC2 with solvent cement joints.
  8. Provide liquidtight flexible single strip steel, hot-dip galvanized conduit with PVC jacket in accordance with requirements of UL 1. Provide a continuous copper bonding conductor wound spirally between convolutions on the inside

of the conduit meeting requirements of UL 360 for conduit sizes 1-1/4-inch and smaller.

9. Provide flexible steel conduit constructed of continuous interlocked, zinc coated steel strip in accordance with the requirements of UL 1. Provide in a minimum 1/2 inch electrical trade size.

## 2.3 FITTINGS

- A. General: Provide fittings of similar material as raceways.
- B. Fittings Requirements: Provide fittings meeting the following requirements:
  1. Set screw or indenter type fittings are not acceptable. Provide threaded connectors for all rigid or intermediate metal conduits.
  2. Provide gland compression type fittings for all electrical metallic tubing. Provide insulated type connectors.
  3. Provide insulated connectors for liquidtight flexible conduit.
  4. Expansion/Deflection Fittings:
    - a. Provide a deflection and expansion coupling for rigid and intermediate metal conduits that have a 3/4 inch movement in all directions from normal and a 30 degree angular deflection. Provide coupling that includes internal bonding jumper.
  5. Bushings
    - a. Provide insulated nonmetallic bushing rated 105 degrees C for all installations where bonding is not required.
    - b. Provide insulated metallic grounding and bonding bushing rated 150 degrees C where bonding is required.

## 2.4 WALL AND FLOOR PENETRATIONS

- A. Watertight:
  1. For conduit penetrations in new exterior walls or floors provide watertight sealing sleeves consisting of a steel sleeve with pressure ring and clamps.
  2. For conduit penetrations in existing walls or floors, provide watertight sealing bushing consisting of a neoprene sealing ring between two PVC coated steel pressure discs. Provide stainless steel captive screws for sealing ring compression.

B. Fire-proofing Through Fire Rated Construction:

1. Provide a permanent fire stop system for all penetrations through fire-rated walls, partitions and floors.
2. Design fire stop system to maintain the integrity of the wall or floor assembly for its rated time period.
3. Arrange fire stop system to allow normal pipe movement without being displaced.
4. Do not utilize asbestos in fire stop systems.
5. Provide an intumescent fire stop system when exposed to flame or heat.

2.5 BOXES AND CABINETS

A. Outlet Box Requirements:

1. Provide cast aluminum boxes for aluminum conduit systems.
2. Provide galvanized cast iron boxes for galvanized rigid steel and intermediate metal conduit systems.
3. Provide nonmetallic boxes and covers in PVC conduit systems.
4. Provide PVC coated boxes and covers in PVC coated conduit systems.
5. Provide boxes located in Class I, Division 1 hazardous areas meeting NEMA 7 requirements.
6. Provide corrosion-resistant fiberglass reinforced polyester boxes with stainless steel hardware in corrosive areas as defined in Section 26 05 00 or as shown.
7. Provide watertight gasketed covers held with nonferrous screws for all cast metal boxes.

B. Junction and Pull Box Requirements:

1. Provide cast aluminum boxes with mounting lugs, threaded hubs and gasket covers for surface mounted boxes
2. Provide fabricated sheet metal boxes when cast metal box weight exceeds 50 pounds. Construct box from 1/8-inch thick galvanized sheet steel or aluminum with sides return channel flanged around cover opening. Provide angle or channel supporting frame. Provide continuously welded and ground smooth seams. Provide mounting lugs and threaded conduit hubs.

3. Provide cast steel or fabricated 10-gauge Type 316 stainless steel for boxes either partially or fully encased in concrete. For partially encased boxes provide sides return channel flanged around cover opening. For fully encased boxes provide flush covers. Provide continuously welded and ground smooth seams. Provide mounting lugs and threaded conduit hubs.
4. Provide watertight gasketed covers held with stainless-steel captive screw slot bolts.
5. Provide two padlocking hasps for boxes containing medium voltage cables.
6. Provide steel barriers in all boxes that isolates instrumentation wiring from all other wiring systems
7. Provide fabricated boxes located indoors in non-corrosive areas and conditioned spaces -meeting NEMA 12 requirements.
8. Provide all boxes located outdoors, in corrosive areas or where otherwise indicated meeting NEMA 4X, 316 stainless steel requirements.
9. Provide boxes located in Class I, Division 1 hazardous areas meeting NEMA 7 requirements.

C. Terminal Box Requirements:

1. Provide minimum 12 gauge stainless steel fabricated box with mounting lugs, floor stand, and hinged doors.
2. Provide the door with continuous piano hinge and 3 point lockable latch. Provide print pocket on inside of door.
3. Provide back plate fabricated from 12 gauge minimum steel with white enamel finish for mounting terminals and wire troughs.
4. Provide wire troughs consisting of plastic ducts with snap slot design and removable covers. Run all wiring within wire troughs.
5. Furnish a schedule of terminals with the following information
  - a. Source
  - b. Type of Signal
  - c. Function
6. Provide removable jumpers to allow operation of the equipment.
7. Separate analog terminals from all other terminals.

8. Provide number of terminals shown. Where the number of terminals are not shown, provide sufficient terminals for each wire entering the terminal box plus 20 percent but not less than 10 spare terminals.
9. Terminals:
  - a. All catalog numbers refer to Phoenix Contact Type for the purpose of establishing the standard of quality and general configuration desired.
  - b. Provide symmetrical type steel mounting rails, NS-35.
  - c. Analog Signals: Provide terminals in enclosed housing suitable for wires from 22 to 12 AWG rated 600 volts with gray body, knife disconnect and test connection socket on both sides of disconnect, Phoenix Contact Type UK 5-MTK-P/P.
  - d. Control and Alarm Signals: Provide terminals suitable for wires from 24 to 10 AWG rated 18 amperes at 600 volts, blue body, Phoenix Contact Type UK5N BU.
  - e. 120-Volt Power Wiring: Provide terminals suitable for wires from 18 to 10 AWG rated 30 amperes at 600 volts, hot (black body), neutral (white body), ground (green body), Phoenix Contact Type UK5N BK, UK5N WH & UK5N GN, respectively.
10. Enclosures:

Provide enclosures meeting the same NEMA criteria for the various areas as specified under Junction and Pullboxes.

## 2.6 SUPPORTING DEVICES

- A. Raceway Supports: Provide raceway supports meeting the following requirements:
  1. Do not use perforated straps or plumbers tape for conduit supports.
  2. Provide expansion bolts or inserts for fasteners in concrete, toggle bolts for hollow masonry or frame construction, and preset inserts for prestressed concrete.
  3. Conduit Straps and Backs:
    - a. For metallic conduits, provide steel or malleable iron.
    - b. For nonmetallic and PVC coated conduits, provide PVC coated malleable iron with stainless steel anchors and bolts.

4. Conduit Hangers
  - a. For metallic conduits, provide steel adjustable conduit hangers or clevis hangers.
  - b. For nonmetallic and PVC coated conduits, provide PVC coated adjustable conduit hangers with stainless steel hardware.
5. Beam Clamps:
  - a. For metallic conduits, provide malleable iron with steel bolt.
  - b. For nonmetallic and PVC coated conduit, provide PVC coated malleable iron with stainless steel bolt.
6. Trapeze Hangers:
  - a. For metallic conduits provide 12 gauge 1-1/2-inch square steel channels with steel channel straps to secure conduits.
  - b. For nonmetallic or PVC coated conduit, provide either PVC coated 12 gauge 1-1/2-inch square steel channels or 1-5/8-inch square fiberglass channels. Provide PVC coated straps with stainless steel bolts for securing conduits.
  - c. Provide addition channels welded together to limit the deflection to 1/240th of span.
7. Threaded Rod
  - a. Provide threaded rod with the minimum size as follows:
    - (1) Conduit Hangers
      - (a) 3/4-inch to 1-1/2-inch conduit: 1/4-inch thread rod
      - (b) 2-inch to 3-1/2-inch conduit: 3/8-inch thread rod
      - (c) 4-inch and larger: 1/2-inch thread rod
    - (2) Trapeze Hangers: Provide thread rod of sufficient size to support the load. Provide a minimum of 3/8-inch thread rod.
  - b. For Metallic Conduit Systems: Provide continuous threaded galvanized steel rod.

- c. For Nonmetallic or PVC Coated Conduit Systems: Provide continuous threaded stainless steel rod.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. General: Install electrical equipment and material of the size, type and general routing as shown or required.
- B. Coordination with Reinforcing: Install raceway, fittings, boxes and cabinets free from direct contact with reinforcing steel.
- C. Alignment: Provide fasteners, anchor bolts, anchorage items and supports as required to insure proper and rigid alignment. Attach equipment with fasteners sized according to size and weight of the equipment and the thickness of the supporting surface.
- D. Aluminum Coating: Where aluminum is placed in contact with dissimilar metal or concrete, separate contact surfaces with gasket, nonabsorptive tape or coating as specified in Section 09 96 00 to prevent corrosion.
- E. Grounding: Make metallic raceways electrically and mechanically continuous and ground as required. Install conduits continuous between outlets, boxes, cabinets and panels.

### 3.2 INSTALLATION

- A. General: Unless otherwise indicated, install conduits exposed, parallel or perpendicular to building floors, ceilings and walls, to avoid interference with other work. In architecturally finished areas, conceal conduits within finished walls, ceilings and floors. Cut conduits square and deburr the cuts to the same degree as the conduit manufacturer. Fasten conduit securely to outlets, junction, pull and terminal boxes. Provide caps and seals to prevent the entrance of foreign material and moisture during installation and before pulling wire.
  - 1. Where conduit size is not shown, provide conduits one size larger than indicated in Table 4, Chapter 9 of the NEC.
  - 2. Saw cut aluminum conduit to prevent reduction in internal area.
  - 3. Support raceways concealed above suspended ceilings from the slab above suspended ceiling in same manner as exposed raceways. Do not support raceways from suspended ceiling supports.
  - 4. Keep conduit at least six inches away from high temperature piping, ducts, flues and surfaces. For mounting on concrete and masonry surfaces provide

a minimum of 1/4 inch air space between conduit and mounting surface. Support and fasten conduit to building structural members spaced in accordance with electrical codes. Support conduit at least every eight feet or less in accordance with NEC requirements.

5. When two or more exposed conduits are in the same general routing, provide parallel installation with symmetrical bends and for three or more provide trapeze hangers. Size trapeze hangers with space for 25 percent additional conduits.
  6. Make changes in direction with bends or fittings. Use factory-made bends or elbows wherever possible. Make field bends and offsets with a hand bender or conduit-bending machine. Provide a bending radius not less than 36-inches for conduits containing medium voltage cables.
  7. Run conduit in buildings with no more than the equivalent of three 90 degree bends between pull points. Provide no more than 125 feet of conduit runs between pull points. Provide pull boxes where shown, specified or wherever required to install conductors and to meet the above requirement.
  8. Install pull and junction boxes in accessible locations with working space in front of and around the installation. Obtain approval to locate boxes in finished areas.
  9. Install an expansion fitting when a conduit crosses a structural expansion joint.
  10. Unless otherwise approved, install conduits to cross at right angles to building structural expansion joints.
  11. Where approved for encased installation, install conduits in slabs as close to the middle of concrete slabs as practicable without disturbing reinforcement. Do not use conduit with an outside diameter exceeding one-third of the slab thickness. Do not place conduits closer than three diameters on centers, except at cabinet locations where the slab thickness is increased.
  12. Pitch conduits to outlet boxes to avoid trapping moisture. Where dips are unavoidable in exposed conduit runs, install drain fitting at low point.
- B. Conduit Material Types: Provide conduit as follows:
1. Provide aluminum conduit in all exposed indoor and outdoor installations, except as described below.
  2. Provide rigid steel conduits in all installations concealed in structures, concrete encased within structures or under structures.

3. Provide electrical metallic tubing in all installations above suspended ceilings and in partition constructed walls.
  4. Provide rigid steel conduits for all instrumentation, and electronic equipment signal wiring in all exposed or concealed noncorrosive installations.
  5. Provide rigid nonmetallic Schedule 40 conduits underground, concrete encased or direct buried, unless specifically detailed otherwise.
  6. Corrosive and Wet Locations
    - a. Corrosive and Wet locations are defined in Section 26 05 00 or as shown:
    - b. Provide PVC coated rigid steel conduit in all installations in corrosive locations.
- C. Connections to Equipment
1. Provide double locknuts and bushing for all boxes, enclosures and cabinets located in dry areas.
  2. Provide watertight hub fittings for all boxes, enclosures and cabinets located below grade or in wet, damp or corrosive areas.
  3. Provide rigid conduit connection where equipment is fixed and not subject to adjustment, mechanical movement or vibration. Provide union fittings to permit removal of equipment without cutting or breaking conduit.
  4. Provide liquidtight flexible conduit connection where equipment is subject to adjustment, mechanical movement or vibration.
  5. Provide flexible steel conduit connections to lighting fixtures installed in accessible suspended ceilings.
  6. Coat all threads in steel conduit runs with zinc dust in oil or other corrosion-preventive compound before making connections.
  7. Coat all threads in aluminum conduit runs with graphite or other corrosion preventive compound.
- D. Underground Conduits: Provide underground conduits meeting the requirements of Section 26 05 43.
- E. Penetrations: Make concealed penetrations for single conduits not more than 1/4-inch larger than the diameter of the conduit. Make penetrations through walls, ceilings and floors other than concrete for exposed conduits not more than 1/4-inch

larger than the diameter of the conduit. Fill the voids around conduit with caulking compound and finish the surface the same as the wall, ceiling or floor.

1. Where a conduit enters through a concrete roof or membrane waterproofed wall, floor or ceiling, provide a watertight sealing sleeve that can be tightened from one or both sides. If the sealing sleeve is not placed with the concrete, core drill the proper size hole to provide a mechanically watertight installation.
  2. Where a conduit enters through a concrete non-waterproofed wall, floor or ceiling, provide a (Schedule 40), (galvanized steel) sleeve and fill the space between the conduit and sleeve with a plastic expandable compound. If the sleeve is not placed with the concrete, drill the hole not less than 1/2-inch and not more than one inch larger than the sleeve, center the sleeve and grout the sleeve for the total depth of penetrated concrete with non-shrink grout, polyurethane or silicone sealant.
- F. Spare Conduit: Provide spare conduits for future use as shown or required. Provide a minimum 200 pound strength nylon pull line in each spare conduit and identify the origin and termination of the conduit at each end. Terminate spare conduits in equipment, boxes or by couplings plugged flush with the inside of building surfaces.
- G. Boxes: Provide boxes of the proper dimensions for the size and quantity of conductors enclosed.
1. For boxes mounted on steel, concrete and masonry surface, provide a minimum 1/4-inch non-metallic spacer to hold the box away from the surface.
  2. Provide pressed metal boxes in all partition constructed walls.
  3. Provide separate support for boxes and bolt units to buildings with expansion anchors, toggle bolts or appropriate screws. For lighting fixture outlet boxes, provide supports adequate to support the weight of the fixture to be mounted on the box.
  4. Remove debris including dust, dirt, wire clippings and insulation from the interior of boxes. Replace boxes with open conduit holes. Repair or replace damaged boxes as directed.
  5. Unless otherwise indicated, mount outlet boxes flush with the finished wall or ceiling with the long axis vertical. Unless otherwise shown or specified, provide mounting heights measured from the finished floor to centerline of the outlet box as follows:
    - a. For switches: 3'-2". Mount the box for lighting switches on the strike side of the door.

- b. For duplex convenience outlets: Finished areas 12 inches and unfinished areas 2 feet.
- c. For clock receptacles outlets: 8 feet.
- d. For fixtures and equipment: As shown.
- e. For desk telephone outlets: 12 inches.
- f. For wall telephone outlets: 48\* inches.

### 3.3 CLEANING AND PAINTING

- A. Field Painting: Paint conduits meeting the requirements of Section 09 96 00.
- B. Touch Ups: Touch up all PVC coatings on conduit, fittings and boxes where scratched, marred or otherwise compromised during handling and installation per the manufacturer's instructions.

END OF SECTION

## SECTION 26 05 53

### ELECTRICAL IDENTIFICATION

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing materials for the identification of electrical equipment, components, conduits, cables and wiring, and furnishing and installing safety signs.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 09 96 00 – High Performance Coatings
  - 2. Section 26 05 00 - Basic Electrical Materials and Methods

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ANSI C2 - National Electrical Safety Code (NEC)
  - 2. ANSI Z535.1 - Safety Color Code
  - 3. ANSI Z535.2 - Environmental and Facility Safety Signs
  - 4. ANSI Z535.3 - Criteria for Safety Symbols
  - 5. OSHA - Occupational Safety and Health Act

##### 1.3 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01.
- B. Product Data and Information: Furnish manufacturers' catalog data for safety signs, nameplates, labels and markers.
  - 1. Furnish manufacturers' instructions indicating applicable conditions and limitations of use, storage, handling, protection, examination and installation of product.
- C. CONTRACTOR's Record Drawings: Furnish CONTRACTOR's record drawings accurately showing the actual location and elevation of underground ducts, handholes and manholes at the completion of the Project.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01.

#### 1.5 SPARE PARTS

- A. General: Furnish the following spare parts.
  - 1. Ten safety signs of each size and wording.
- B. Packaging: Package spare parts in containers bearing labels clearly identifying the contents. Provide all spare parts with information needed for reordering. Deliver spare parts in original factory packaging.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. W. H. Brady Company
  - 2. Seton
  - 3. Thomas & Betts/ABB Group

#### 2.2 MATERIALS AND COMPONENTS

- A. General: Provide identification materials listed and classified by UL or tested by an acceptable Electrical Testing Company certifying the equivalence of the materials to UL listing requirements and OSHA approved.
- B. Laminated Plastic Nameplates: Provide engraved three layer laminated plastic nameplates with black letters on white background and fastened with corrosion-resistant screws. Do not use mounting cement for fastening nameplates.
  - 1. Provide nameplates with 1-inch high lettering for switchgears, switchboards, motor control centers, control panels, relay panels, contactor panels, panelboards, and similarly grouped equipment, transformers and disconnect switches.
  - 2. Provide nameplates with 1/2-inch high lettering for individual components of a group such as main breakers, switchgear units, switchboard units, motor control center units and similar devices.

3. Provide nameplates with 1/4-inch high lettering for remote motor controllers, control stations, relays and similar equipment.
  4. Provide nameplates for each motor identifying service or function and lettering of an appropriate size to suit each motor.
  5. Provide approved laminated directories of circuits with typewritten designations of each branch circuit in each panelboard.
  6. Provide smaller lettering for a neat, legible nameplate where the amount of lettering causes excessively large nameplates.
- C. Wire Markers: Identify wire bundles and each individual wire.
1. Wire bundles: Provide a brass or rigid fiber identifying tag attached with nylon self locking "Ty-Raps".
  2. Wire identification markers: Provide a printed white, heat-shrink, seamless tubing type with black bold lettering for wires size No. 10 AWG and smaller. Provide a printed self-laminating white, vinyl type with black bold lettering for wires No. 8 AWG and larger.
- D. Conduit Marking Paint: Provide conduit marking paint meeting the requirements of Section 09 90 00.
- E. Safety Signs: Provide safety signs in accordance with OSHA standard meeting the requirements of ANSI C2, ANSI Z535.1, ANSI Z535.2 and ANSI Z535.3.
1. Provide safety signs manufactured from vinyl having a minimum thickness of 60 mils with red and black letters and graphics on a white background.
  2. Size: 10 inches by 14 inches except signs 7-inch by 10-inch may be provided where the larger size cannot be applied.
  3. Mount safety signs using corrosion-resistant screws. Do not use mounting cement.
- F. Working Space Floor Markers
1. Provide paint or tape to mark the working space on the floor at electrical equipment.
    - a. Tape: 2-inch wide, 5-mil pressure-sensitive vinyl tape, black and white stripes with clear vinyl overlay. Manufacturer: 3M Safety Stripe Tape 5700.
    - b. Paint: Black and white to be applied in 2-inch wide stripes or checkers. Refer to Specification Section 09 96 00 – High Performance Coatings.

## G. Working Space Labels

1. Provide labels indicating required working clearance at electrical equipment that is likely to require examination, adjustment, servicing, or maintenance while energized.
  - a. Material: Self-adhesive polyester with pressure-sensitive adhesive back. Outdoor labels shall be suitable for a high-UV environment.
  - b. Dimensions: Approximately 6-3/4 x 2 inches.
  - c. The top line on the label is to read "NOTICE" in a 48 point white italic font letters on a safety blue background.
  - d. Provide message wording in a 24 point black or safety blue font letters on a white background.
    - (1) Message wording for 208Y/120-volt equipment: "KEEP AREA IN FRONT OF THIS ELECTRICAL EQUIPMENT CLEAR FOR 3 FEET. OSHA-NEC REGULATIONS."
    - (2) Message wording for 480-volt and 480Y/277-volt equipment: "KEEP AREA IN FRONT OF THIS ELECTRICAL EQUIPMENT CLEAR FOR 3-1/2 FEET. OSHA-NEC REGULATIONS."
    - (3) Message wording for 4160Y/2400-volt equipment: "KEEP AREA IN FRONT OF THIS ELECTRICAL EQUIPMENT CLEAR FOR 4 FEET. OSHA-NEC REGULATIONS."
  - e. Manufacturer: Brady, Brother, Seton.

## H. Underground Warning Tape

1. Provide underground warning tape for underground cables, conduits and duct banks.
2. Use 6 inch wide, 0.004 inch thick, polyethylene underground warning tape with black lettering and background colors as follows:
  - a. Electric: Red.
  - b. Telephone/Data: Orange.
3. Provide lettering that indicates the type of buried service.
  - a. Electric: "CAUTION ELECTRIC LINE BURIED BELOW"

b. Telephone/data: "CAUTION TELEPHONE LINE BURIED BELOW"

4. Manufacturer: Utility Safeguard, LLC.

### PART 3 EXECUTION

#### 3.1 PREPARATION

A. Surface Preparation: Degrease and clean surfaces to receive nameplates, labels and marking paint.

#### 3.2 INSTALLATION

A. General: Install nameplates on the front of equipment, parallel to the equipment lines and secured with corrosion resistant screws. Caulk all screw holes with clear silicone caulk prior to attaching nameplates on NEMA 4X enclosures.

1. Install laminated nameplates identifying:

- a. Each electrical equipment enclosure
- b. Individual equipment and devices

B. Wire Markers: Identify wire bundles and each individual wire with identification tags as follows:

1. Wire Bundles: Install an identifying tag engraved with the conduit number where conduits enter motor control centers, switchgear, switchboards, control panels, terminal boxes and the like.
2. Wire identification markers: Provide wire identification markers on each wire at all termination points.
  - a. On power and lighting circuits: The branch circuit or feeder number as indicated on drawings
  - b. On control circuits terminated in motor control centers, switchgears, control panels and alike: The field device and terminal number of the opposite end connection.
  - c. On control circuits at each field device: The panel or compartment number and terminal number of the opposite end connection.
3. Oversize wire markers so that after heat shrinking the wire marker can be rotated on the wire. Rotate wire markers so that wire identification number is visible.

C. Conduit Markers: Paint colored marking bands on each conduit that is longer than 6 feet at intervals of 20 feet on centers to identify the wiring voltage system contained in the conduit or for identifying the different conduit systems as follows:

1. 4,160-Volt System
2. 480-Volt System
3. 208/120-Volt System
4. 240/120-Volt System
5. 24/48/125-Volt dc System
6. SCADA Network
7. Fire Alarm System
8. Telephone System
9. Paging System
10. Security System

D. Safety Signs: Provide safety signs as follows or as shown including existing locations and equipment not signed per current industry standards and being modified or reused under this Contract:

1. Type DS-1
  - a. Wording: "DANGER - BATTERY CHARGING AREA, NO SMOKING"
  - b. Location: Within 3 feet of all station battery racks.
2. Type DS-2
  - a. Wording: "DANGER - ELECTRICAL EQUIPMENT, AUTHORIZED PERSONNEL ONLY"
  - b. Location: At each entrance to electrical rooms, and enclosed outdoor electrical equipment.
3. Type DS-3
  - a. Wording: "DANGER - HIGH VOLTAGE, KEEP OUT"

- b. Location: At each entrance to electrical rooms, and enclosed outdoor electrical equipment operating at over 600 Volts. Also, on the sides of fences or walls which enclose outdoor equipment operating at over 600 Volts.

4. Type DS-4

- a. Wording: "DANGER - HIGH VOLTAGE"
- b. Location: Outside all equipment operating at over 600 Volts.

5. Type DS-5

- a. Wording: "DANGER - POWERED FROM MORE THAN ONE SOURCE"
- b. Location: Outside all equipment that operates from more than one power source.

6. Type DS-6

- a. Wording: "NOTICE - KEEP DOOR CLOSED"
- b. Location: On all doors with another safety sign installed.

7. Type DS-7

- a. Wording: "CAUTION - CONTROLS & INTERLOCKS POWERED FROM MULTIPLE SOURCES"
- b. Location: On all control panel doors.

E. Working Space Floor Markers

- 1. Install floor marking tape or paint on the floor at the locations listed below to indicate working space required by the NEC.
  - a. Front and rear of each medium-voltage switchgear.
  - b. Front of each medium-voltage transformer.
  - c. Front and rear of each free-standing low-voltage switchgear or switchboard section.
  - d. Front of each low-voltage transformer, switchboard, panelboard, industrial control panel, motor control center, enclosed circuit breaker, safety switch, and motor controller enclosure including those furnished with mechanical equipment.

- e. Any other equipment likely to require examination, adjustment, servicing, or maintenance while energized.
2. Dimensions of working space area are to be as follows:
    - a. Width: the greater of the width of the equipment or 30 inches.
    - b. Depth:
      - (1) Systems 600V and Below: In accordance with NEC Table 110.26(A)(1)
      - (2) Systems Over 600V: In accordance with NEC Table 110.31
3. Thoroughly prepare floor surface to receive tape or paint.
  4. Where marking tape is used, outline working space with tape then infill with diagonal tape stripes placed 6 inches on center.
  5. Where paint is used, cover working space area with alternating 3 to 6 inch wide black and white diagonal stripes.

#### F. Working Space Labels

1. Provide working space labels at the following locations positioned at the optimal height for reading when standing facing the equipment:
  - a. Front and rear of each medium-voltage switchgear.
  - b. Front of each medium-voltage transformer.
  - c. Front and rear of each freestanding low-voltage switchgear or switchboard section.
  - d. Front of each low-voltage transformer, panelboard, industrial control panel, motor control center, enclosed circuit breaker, safety switch, and motor controller enclosure, including those furnished with mechanical equipment.
  - e. Any other equipment likely to require examination, adjustment, servicing, or maintenance while energized

#### G. Underground Warning Tape

1. Install underground warning tape in the trench above underground conduit(s), 1 foot below the finish grade.

END OF SECTION

## SECTION 26 05 60

### ELECTRICAL REQUIREMENTS FOR SHOP-ASSEMBLED EQUIPMENT

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing, installing and testing shop-assembled equipment as indicated, in accordance with the Contract Documents. Shop-assembled equipment panels and other items may be specified under the driven equipment sections and/or on the contract drawings and may require external field connection to ancillary devices and other system components for interlocks and alarms. Provide all field wiring as required by the system and equipment specified under the driven equipment sections. This field wiring may not be specified or shown. This equipment includes but is not limited to the following:

1. Air conditioning units
2. Heat pumps
3. Miscellaneous control equipment
4. Overhead doors
5. Pump and fan equipment
6. Sump pump and sewage ejector pump equipment
7. Temperature control systems

- B. Related Work Specified in Other Sections, But is Not Limited to, the Following:

1. Section 03 31 00 - Cast-in-Place Concrete
2. Section 09 96 00 - High Performance Coatings
3. Section 26 05 00 - Basic Electrical Materials and Methods
4. Section 26 05 19 - Wires and Cables - 600 Volts and Below
5. Section 26 05 26 - Grounding
6. Section 26 05 33 - Electrical Raceway Systems
7. Section 26 05 53 - Electrical Identification
8. Section 26 05 73 - Short Circuit and Coordination Study
9. Section 26 05 80 - Electric Motors
10. Section 26 27 26 - Wiring Devices
11. Section 26 29 23 - Adjustable Frequency Drives
12. Section 26 29 53 - Control Components and Devices

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

2. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.
3. UL 508A - Industrial Control Panels
4. NEC Article 409 - Industrial Control Panels
5. NFPA-70E - Standard for Electrical Safety in the Workplace

### 1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Provide the Shop Assembled equipment using Components and Appurtenances meeting the requirements specified in Division 26. Provide shop assembled equipment constructed and labeled to meet the requirements of all referenced and otherwise applicable codes and standards.

### 1.4 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01.
- B. Product Data and Information: Furnish manufacturer's data on all equipment and devices in the assembly, including voltages, number of phases, current ratings, capacities and other relevant data.
- C. Shop Drawings: Furnish shop drawings for the shop-assembled equipment, including the following:
  1. Layout drawings of the assembly showing accurately scaled basic equipment sections, auxiliary compartments and combination sections. Show special relationships of assemblies to associated equipment, including plan and front views of the equipment. Furnish a device summary.
  2. Furnish wiring diagrams for assemblies that show connections to electrical power. Clearly differentiate between shop-installed and field installed wiring.
  3. Furnish construction drawings for equipment requiring field assembly. Clearly differentiate between shop-assembled and field assembled elements of the assembly.
  4. A manufacturer's standard connection diagram or schematic showing more than one method of connection is not acceptable unless, the intended method is clearly identified.
  5. Furnish short circuit ratings on control panels and data demonstrating the rating is appropriate for the available fault current in accordance with NEC Article 409 and UL 508A.

- D. Quality Control: Furnish manufacturer's test reports and certified performance records of all equipment installed. Furnish field test reports after equipment is installed.

## 1.5 QUALITY ASSURANCE

- A. Codes: Comply with local codes and all other applicable codes.
- B. Regulatory Requirements: Comply with applicable Regulatory Agency requirements.
- C. Certification: Certify that the panels' construction complies with the following:
  - 1. List and label panel in compliance with UL-508A.
  - 2. Label panel with its' designed and constructed Short Circuit Current Rating (SCCR) indicating compliance with UL 508.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01.

## PART 2 PRODUCTS

### 2.1 FABRICATION

- A. General: Provide shop-assembled equipment as standard products manufactured by companies regularly engaged in the manufacture of such equipment.
- B. Provide panels constructed as follows:
  - 1. Minimum of #12 AWG copper control wires at 120V.
  - 2. Minimum of #14 AWG copper control wires at 24V.
  - 3. Where main terminal and/or intermediate distribution blocks are used, provide blocks suitable for copper cables with ampere ratings at the rated voltage and related UL Short Circuit Current Rating (SCCR)/Ampere Interrupting Current Rating (AIC) as specified herein.
  - 4. Isolate or barrier 120/24V(LV) controls from 208 through 600V (HV) line voltage equipment and wiring.
  - 5. Isolate all HV equipment and wiring in the main control panel using wireways and internal sub-enclosures so as to allow the opening of the main control

panel under “Work Permit” conditions to access low voltage component enclosures without being exposed to the (HV) equipment and wiring.

6. Provided a main control panel main breaker listed per UL-489.
    - a. Less than 400A: thermal magnetic fixed trip or adjustable where available for the particular size furnished.
    - b. 400A and larger: electronic solid state adjustable trip.
  7. Where 3-phase magnetic motor starters are included, provide in combination with a motor circuit protector sized for the applicable horsepower.
  8. Provide a warning label to read “WARNING-CONTROL VOLTAGE MAY BE PRESENT AFTER OPENING MAIN DISCONNECT” where control voltages are present from an external source.
  9. Provide minimum Short Circuit Current Ratings (SCCR) as follows:
    - a. LV control enclosures – 5KAIC
    - b. HV enclosures as follows:
      - (1) 208V, 3-phase – 22KAIC
      - (2) 480V, 3-phase – 35KAIC
  10. Increase minimum SCCR ratings to satisfy the requirements of the Projects Power System Study at no additional cost.
- C. Factory Assembled Requirements: Provide control panels for shop-assembled equipment as complete factory assembled units that require only external connections for installation including main disconnect and all electrical features necessary for the proper operation of the units.
- D. Controls:
1. Motors 1/2 Hp and Larger:
    - a. Provide motors suitable for 480-volt, 3-phase, 60-hertz operation, with all controls at 115 volts or less.
    - b. Provide a combination circuit breaker along with all required control transformers, relays, timers, heaters and other necessary incidentals to form a complete functioning unit.
    - c. Provide NEMA Size 1 or larger starters.

2. Motors less than 1/2 Hp:
    - a. Provide motors suitable for 120-volt, single phase operation.
    - b. Provide manual motor starter with neon pilot light.
  3. Provide all controls and equipment as specified in Section 26 30 00.
- E. Control Components: Install principal control components in NEMA 250 rated enclosures as follows:

AREA	ENCLOSURE
Above grade indoor	NEMA 12 - Industrial
Outdoor and below grade elevation indoor	NEMA 4 - Watertight
Corrosive areas as defined in Section 26 05 00 or as shown.	NEMA 4X - Watertight and corrosion-resistant (stainless steel) (fiberglass-reinforced thermal setting polyester formulation) with stainless steel external hardware. Provide all external operators made of the same materials as that of the enclosures

- F. Miscellaneous Controls:
1. Provide float switches, pressure switches, limit switches, thermostats and other auxiliary control devices to satisfy the intended service.
  2. Provide contacts rated at 10-amperes, 120 volts, 60-hertz ac, unless otherwise specified.
  3. Provide limit switches that function in accordance with contact development charts.
- G. Panel Accessories:
1. Provide panels with auxiliary heaters, fans or integral air conditioners as specified for specific equipment.
  2. Provide corrosion inhibitors and breather assemblies to prevent corrosion and condensation within NEMA 4 and 4X rated panels.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install shop-assembled equipment as indicated, in accordance with manufacturer's written instructions.
- B. Coordination: Coordinate cabling and wiring as necessary to interface installation of shop-assembled equipment.
- C. Torque Requirements: Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals in accordance with UL Standard 486A.
- D. Grounding Connections: Make equipment grounding connections for the shop-assembled equipment as specified and shown. Tighten connections in accordance with UL Standard 486A to assure permanent and effective grounding.
- E. Adjustments: Make all necessary adjustments to the equipment to provide complete and satisfactory operation upon completion of the Contract.
- F. Power Supplies: Provide an external power supply where required for panel integral air conditioners.

### 3.2 CLEANING AND PAINTING

- A. Shop Painting: Paint the shop-assembled equipment enclosures as specified in Section 09 96 00.
- B. Field Painting: Clean and touch up scratched and marred surfaces to match original finish.

END OF SECTION

## SECTION 26 05 73

### SHORT CIRCUIT, COORDINATION, AND ARC FLASH STUDY

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements outlining the parameters of the short circuit, coordination, and arc flash study being performed by the Engineer and the Contractor's responsibilities relating to furnishing of information, implementation of protective device settings.
- B. Related work specified in other sections includes, but is not limited to, the following:
  - 1. Section 26 08 00 - Electrical Testing Requirements
  - 2. Section 26 12 16 - Substation Medium-Voltage Transformers
  - 3. Section 26 12 00 - Pad-Mounted Transformers
  - 4. Section 26 13 00 - Medium Voltage Switchgear
  - 5. Section 26 23 00 - 480 Volt Switchgear
  - 6. Section 26 24 13 - 480 Volt Switchboards

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. IEEE 242, "IEEE Recommended Practices for Protection and Coordination of Industrial and Commercial Power Systems"
  - 2. IEEE 399, "IEEE Recommended Practices for Industrial and Commercial Power Systems Analysis"
  - 3. IEEE 1584 – "IEEE Guide for Arc Flash Hazard Calculations"
  - 4. NFPA 70 - National Electrical Code (NEC)
  - 5. NFPA 70E – Standard for Electrical Safety in the Workplace
  - 6. OSHA 29 CFR 1910 – "OSHA General Industry Book"

##### 1.3 SYSTEM DESCRIPTION

- A. Final Conditions: The software model used for the performance of the study will be developed based on the approved equipment data and shop drawings and final information of the cable lengths for this project.

B. Responsibilities:

1. Performance of the short circuit, coordination, and arc flash study for the distribution system will be the responsibility of the Engineer.
2. The Contractor will be responsible for providing the necessary data relating to electrical apparatus provided or otherwise modified under this Contract that is needed to build the model.
  - a. Provide to the Engineer the following data to complete the studies including:
    - (1) Final, approved shop drawings for all new equipment
    - (2) Cable sizes and lengths for each circuit installed under the scope of work.
3. The Engineer will provide the Contractor the recommended settings for overcurrent devices and protective relays.
4. The Contractor will implement all recommended adjustments and settings per the recommendations of the study
5. The Engineer will be responsible for furnishing required arc flash hazard warning labels based upon the outcome of the arc flash study and install arc flash hazard warning labels prior to equipment start-up and testing.
6. The Engineer will provide the recommended settings and arc flash hazard warning labels within 31 consecutive calendar days following receipt of complete data submittal.
7. Contractor is responsible to coordinate timing of submittal required under this Section to ensure recommended settings and arc flash hazard warning labels are received prior to start-up and testing.

1.4 SUBMITTALS

A. General: Furnish all submittals, including the following, as specified in Division 01.

1. Provide all the necessary data to the Engineer relating to electrical apparatus provided or otherwise modified under this Contract that is needed to build the study model.
2. Following Approved (or Approved Subject to Corrections Noted) status of all new equipment and raceway routing shop drawings, compile data necessary for input to the model into a single informational submittal.
  - a. Table indicating cable sizes and lengths.

b. List of where to find applicable information in approved submittals. Provide submittal number and page number for reference to required data. Required data is listed below.

- (1) Medium Voltage Switchgears
  - (a) Relays
  - (b) Circuit Breaker
  - (c) Fuses
  - (d) Bus Ratings
- (2) Low Voltage Switchgears
  - (a) Circuit Breakers
  - (b) Bus Ratings
- (3) Medium Voltage Motor Control Centers
  - (a) Relays
  - (b) Circuit Breakers
  - (c) Fuses
  - (d) Bus Ratings
- (4) Low Voltage Motor Control Centers
  - (a) Circuit Breakers
  - (b) Bus Ratings
- (5) Panelboards
  - (a) Circuit Breakers
  - (b) Bus Ratings
- (6) Transformers
  - (a) kVA
  - (b) Impedance (%Z)
- (7) Automatic Transfer Switches
  - (a) Device Ratings
- (8) Generators
  - (a) Power Factor
  - (b) kVA/kW
  - (c) Subtransient Impedance

- (9) Motors (Over 50HP)
  - (a) Subtransient Impedance
  - (b) Power Factor
  - (c) Efficiency
  - (d) Horsepower
  
- (10) Cables
  - (a) Sizes
  - (b) Lengths
  - (c) Sets
  - (d) Insulation Type

## PART 2 PRODUCTS

Not used

## PART 3 EXECUTION

### 3.1 PROTECTIVE DEVICE SETTINGS

- A. Receive from the Engineer a copy of the Coordination Study and implement all recommended settings for overcurrent devices and protective relays prior to equipment start-up and testing.

### 3.2 ARC FLASH HAZARD STUDY

- A. The Engineer will furnish arc flash hazard warning labels and install labels prior to equipment startup and testing.

END OF SECTION

SECTION 26 05 80  
ELECTRIC MOTORS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Requirements for electric motors as specified.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 09 96 00 – High Performance Coatings
  - 2. Section 26 05 00 - Basic Electrical Materials and Methods
  - 3. Section 26 05 33 - Electrical Raceway Systems
  - 4. Section 26 05 53 - Electrical Identification
  - 5. Section 26 35 33 - Power Factor Correcting Capacitors
  - 6. Section 26 05 26 - Grounding

1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. AFBMA 10 - Metal Balls
  - 2. NEMA CP1 - Shunt Capacitors
  - 3. NEMA MG1 - Motors and Generators
  - 4. NFPA 70 - National Electrical Code (NEC)

1.3 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01 and Section 26 05 00.
- B. Product Data and Information: Furnish manufacturer's catalog data for each motor.
- C. Shop Drawings: Furnish shop drawings for each motor detailing arrangement, wiring, conduit boxes, and motor application.
- D. Certificate of Compatibility: For each motor controlled by an adjustable frequency drive, furnish a certificate that the motor is compatible with the adjustable frequency drive and the driven equipment load.
- E. Quality Control: Furnish test reports for motors as follows:
  - 1. Certified standard commercial test reports for motors 5 hp through 200 hp.

2. Actual shop test reports for motors over 200 hp.
  3. Witnessed test reports as specified.
- F. Operations and Maintenance Manuals: Furnish operation and maintenance manuals for all motors as specified in Division 1.
- 1.4 QUALITY ASSURANCE
- A. Codes: Comply with all local and applicable codes.
  - B. Regulatory Requirements: Comply with the requirements of the Regulatory Agencies having jurisdiction over this Project.
- 1.5 DELIVERY, STORAGE AND HANDLING
- A. General: Deliver, store and handle all products and materials as specified in Division 01.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  1. General Electric Company
  2. Magnetek
  3. Baldor/ABB Group
  4. Siemens
  5. U.S. Motors
  6. TECO/Westinghouse Motor Company
  7. Hyundai Ideal Electric Co.
  8. Aegis/ElectroStatic Technology Inc. (Bearing Protection Ring)

### 2.2 MATERIALS

- A. General: Provide motors and accessories with the equipment as specified under the equipment sections.

- B. Motor Requirements: Unless otherwise specified, provide motors as follows:
1. Polyphase motors of the high energy efficiency and high power factor type.
  2. Motor nameplate horsepower as specified for the driven equipment.
  3. Motors that operate continuously over the entire load range of the driven equipment without loading motor in excess of nameplate rating and its specified temperature limit.
  4. For motors rated ½ hp to 200 hp operating at 460 volts, 3-phase, 60-hertz, provide squirrel cage induction type.
  5. For motors less than ½ hp, provide 115-volt, single phase, 60-hertz type.
  6. Motors that are suitable for continuous operation with a line voltage variation within ± 10-percent of rated voltage.
  7. Motors that operate continuously in a 40 degrees C ambient.
  8. Inverter duty motors when powered from an adjustable frequency drive.
  9. Provide a certificate of compatibility signed by both the motor and ground ring manufacturer confirming the ground ring being installed per the manufacturer's requirements with no detriment to proper motor operation.
- C. Frequent Start Requirements: Provide motors for frequent starting as specified.

## 2.3 MECHANICAL PROTECTION

- A. Indoor Locations:
1. For motors located in dry, clean and well-ventilated areas provide open drip-proof type.
- B. Outdoor Locations: For motors located outdoors, provide a totally-enclosed, fan-cooled type with removable drain plug.
- C. Submersible Locations: For motors that operate submerged or operation in a location for the potential to be submerged, provide a completely sealed submersible motor.

## 2.4 BOXES

- A. General: Provide oversized conduit boxes on motors to facilitate conductor installation and auxiliary components as required.
1. Provide separate boxes for motor power leads, accessory terminals and RTD leads.

2. Make conduit box NEMA enclosure ratings compatible with motor enclosures.
3. Where shown, provide additional space in the power terminal box for the mounting and wiring of the current transformers furnished under the motor protection system.

## 2.5 NEMA DESIGN AND INSULATION

- A. Design Classification: Provide NEMA Design B, unless otherwise specified with NEMA Class F moisture resistant insulation and NEMA Class B, 80 degrees C temperature rise at rated nameplate load.
- B. Variable Speed Operation: Provide insulation to protect against adverse effects of a nonsinusoidal waveform.

## 2.6 WINDINGS

- A. General: Provide copper windings unless otherwise specified.

## 2.7 BEARINGS

- A. Ball and Roller Bearings: Use antifriction ball or roller type bearings at manufacturer's option, unless otherwise specified.
- B. Regreasable Bearings: Use regreasable bearings with support side thrust loadings, with an AFBMA B-10 bearing life rated at least 100,000 hours, based on a reliability of 90 percent.

## 2.8 SERVICE FACTOR AND LOADINGS

- A. Service Factor: Provide 1.15 service factor for sinusoidal voltage waveforms and 1.0 for nonsinusoidal voltage waveforms unless otherwise specified. Where motors with a 1.0 service factor are furnished, provide motors rated at least 15 percent greater than required brake horsepower.
- B. Shaft Loading: Provide steady state shaft loading not to exceed 100 percent of full load rating under maximum load, excluding the service factor, unless otherwise specified.

## 2.9 SPEED

- A. General: Provide motor speed as specified or as shown for the driven equipment.
- B. Multispeed: Provide multispeed motors as specified for the driven equipment.

- C. Adjustable Speed: Provide inverter duty motors specifically designed and rated for use with the adjustable speed device furnished.

2.10 TORQUE

- A. General: Provide breakdown torque of 200 percent or more of motor full load torque.
- B. Locked Rotor: Provide locked rotor torque of 80 percent or more of motor full load torque.
- C. Inertia: Provide necessary WK<sup>2</sup> data for special loads to coordinate with motors.
- D. Special Motors: Supply special motors where torque requirements exceed standard design.

2.11 SLIDE RAILS AND SOLE PLATES

- A. General: Provide slide rails and sole plates as required for proper installation.

2.12 SINGLE PHASE FRACTIONAL HORSEPOWER MOTORS

- A. Small Motor Requirements: Provide capacitor or open split phase start, for smaller than 1/2 hp motors unless otherwise specified.

2.13 THREE-PHASE MOTORS

- A. Induction Motors: Provide horizontal or vertical squirrel cage induction motors for continuous duty with full voltage starting except as otherwise specified.

2.14 EFFICIENCY

- A. General: Provide motors one horsepower and larger meeting the requirements as stated in Table 12-12, Full Load Efficiency for NEMA Premium Efficiency Electric Motors, in NEMA MG 1, Part 12.

2.15 POWER FACTOR

- A. General: Provide motors having the following minimum power factor ratings:

Motor Power Factor - Minimum		
	Percent	
Horsepower	At 1800 RPM Power Factor	At 1200 RPM Power Factor
1	74.3	69.7
1-1/2	76.5	62.0
2	70.3	70.1

Motor Power Factor - Minimum		
Horsepower	Percent	
	At 1800 RPM Power Factor	At 1200 RPM Power Factor
3	79.9	73.7
5	83.8	75.8
7-1/2	82.4	78.2
10	85.0	76.4
15	85.0	81.1
20	84.6	81.9
25	84.5	82.0
30	84.2	82.5
40	84.2	83.3
50	85.0	84.9
60	86.8	85.7
75	86.6	86.0
100	88.3	86.4
125	89.3	85.8
150	88.5	87.5
200	88.5	87.9

- B. Power Factor Correction: Provide motors 75-hp and larger with capacitors to correct the no-load power factor to unity in accordance with Section 26 35 33. Do not provide capacitors for motors controlled by adjustable frequency drives or started by solid-state reduced voltage starters.

Provide capacitors in accordance with the latest NEMA CP-1.

2.16 NOISE

- A. General: Limit motor machine noise to sound power levels listed in NEMA MG 1-12.

2.17 ACCESSORIES

- A. Identification: Provide identification meeting the requirements with Section 26 05 53.
- B. Space Heaters: Where specified or shown, provide motor space heaters to prevent moisture condensation when the motor is not operating. Provide space heaters suitable for 115-volt, single phase, 60-hertz operation.
- C. Resistance Temperature Detectors (RTDs): Where specified or shown, provide motor bearing and winding RTDs of the 100-ohm platinum, three-wire type.

- D. Thermal Detectors: Where specified or shown, provide motor winding temperature switches or thermal devices.

## 2.18 SOURCE QUALITY CONTROL

- A. Shop Tests: Perform actual job motor shop tests for motors over 200 hp. Include standard commercial and additional tests listed below, and special tests listed in other sections.
- B. Standard Commercial Tests: Perform the following tests in accordance with NEMA standards.
  - 1. No load running current and speed
  - 2. Locked rotor current
  - 3. Dielectric routine tests
  - 4. Motor efficiency tests
  - 5. Motor power factor tests
- C. Additional Testing: Perform the following additional tests in accordance with NEMA standards.
  - 1. Winding resistance
  - 2. Bearing inspection
  - 3. Power factor at full, 3/4 and 1/2 load
  - 4. Efficiency at full, 3/4 and 1/2 load
  - 5. Motor starting torque
  - 6. Bearing currents testing per manufacturer's specifications
  - 7. Motor frame grounding

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install motors in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1. Make all necessary adjustments to equipment to provide a complete operational system.

- B. Install additional grounding connections where shaft grounding protection is applied.

### 3.2 FIELD QUALITY CONTROL

- A. Inspections and Tests: Perform field preliminary and final inspection and testing for motors as specified in Division 01 and as follows:

- 1. Preliminary Inspection:

- a. Demonstrate that each motor has been properly connected.
- b. Check for proper rotation by bumping prior to connecting motor to driven equipment.

- 2. Final Test:

- a. Measure motor applied voltage and current with equipment operating at full load.
- b. Operate equipment as specified.

### 3.3 CLEANING AND PAINTING

- A. Shop Painting: Paint the motors in accordance with the requirements of Section 09 96 00.
- B. Field Painting: Clean and touch up marred surfaces to match the original finish.

END OF SECTION

## SECTION 26 08 00

### ELECTRICAL TESTING REQUIREMENTS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for field acceptance testing of materials and equipment provided under various other sections to determine suitability for installation and energization. Requirements of field testing and certification of electrical equipment and materials provided under various other sections to assess their equivalence to UL Inc. listing/labeling.
  
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 26 05 13 - Medium Voltage Cables
  - 2. Section 26 05 26 - Grounding
  - 3. Section 26 05 60 - Electrical Requirements for Shop-Assembled Equipment
  - 4. Section 26 13 00 - Medium Voltage Switchgear
  - 5. Section 26 22 00 - General Purpose Dry Type Transformers
  - 6. Section 26 24 16 - Panelboards
  - 7. Section 26 29 23 - Adjustable Frequency Drives
  - 8. Section 26 12 16 - Medium Voltage Transformers
  - 9. Section 26 05 19 - Wires and Cables – 600V and Below
  - 10. Section 26 23 00 - 480 Volt Switchgear

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ANSI/NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
  - 2. ANSI/NETA MTS - Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems
  - 3. NIST - National Institute of Standards and Technology

##### 1.3 SUBMITTALS

- A. General: Furnish all submittals including the following, as specified in Division 01 and Section 26 05 00.
  - 1. Acceptance Testing Reports: Furnish acceptance testing reports for all equipment and materials. Include the following information:

- a. Summary of the test
  - b. Description of material or equipment tested
  - c. Description of test including acceptable test values
  - d. Test results
  - e. Analysis of test results with recommendations
2. UL Testing: Furnish standard test parameters in accordance with the acceptable codes and standards for all the equipment and materials tested for equivalence to UL listing.
  3. UL Test Reports and Certificates: Submit for approval test reports and certificates for all equipment and materials tested for equivalence to UL listing.

## PART 2 PRODUCTS

### 2.1 TESTING COMPANIES

- A. Acceptable Testing Companies: Acceptable testing companies are as listed below:
  1. MET Electrical Testing Co. Inc.
  2. ASET Power Systems Services Inc.
  3. Electric Power Systems Inc.
  4. Electro-Test and Maintenance Inc.
  5. High Voltage Maintenance Corp.
  6. UL Underwriters Laboratories Inc.
  7. Other OSHA and NETA approved testing facilities

### 2.2 SOURCE QUALITY CONTROL

- A. Tests: Furnish all testing and certification in accordance with the latest NETA, ANSI, IEEE and NEMA Standards to meet the UL requirements, NFPA Standards and NEC.
- B. Test Equipment: Furnish all testing equipment, cables and appurtenances required to perform all tests and certifications in accordance with the following:
  1. Use instruments that have been calibrated, to assure that they are within rated accuracy in accordance with NIST.

2. Select test instruments that are appropriate for the variable being measured.

### PART 3 EXECUTION

#### 3.1 UL TESTING AND CERTIFICATION

- A. General: Furnish the test reports and certifications for UL equivalence prior to acceptance of all materials and equipment requiring such tests and certifications.

#### 3.2 ACCEPTANCE TESTING

- A. General: Furnish acceptance test reports prior to acceptance of all materials, equipment and installations requiring such tests.

END OF SECTION

(NO TEXT ON THIS PAGE)

## SECTION 26 09 13

### ELECTRICAL MONITORING SYSTEM

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing and installing a electrical monitoring system that interfaces with the plant SCADA ethernet system as specified and shown. The system consists of installing all intercommunication wiring, programming, remote monitoring and protecting devices, ethernet bridge and startup services.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 01 79 00 - Training
  - 2. Section 26 13 00 - Medium Voltage Switchgear
  - 3. Section 26 23 00 - 480 Volt Switchgears
  - 4. Section 26 24 16 - Panelboards
  - 5. Section 26 14 00 - Medium Voltage Motor Controllers
  - 6. Section 26 33 00 - Battery Systems
  - 7. Section 26 32 13 - Packaged Engine Generator Systems
  - 8. Section 26 05 00 - Basic Electrical Materials and Methods
  - 9. Section 26 12 16 - Medium Voltage Transformers
  - 10. Section 26 05 19 - Wire and Cable - 600 Volts and Below

##### 1.2 SYSTEM DESCRIPTION DESIGN REQUIREMENTS:

- A. Were required, provide systems consisting of bridges to translate communications received from electrical equipment into ethernet compatible communications. This equipment includes but is not limited to the following:
  - 1. 480 Volt Switchgears
  - 2. Battery Systems
  - 3. Generator Systems
  - 4. Medium Voltage Motor Controllers
  - 5. Medium Voltage Switchgears
  - 6. Panelboards
  - 7. Transformers

##### 1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 01 and Section 26 05 00.

- B. Product Data and Information: Provide catalog data for all associated equipment and devices.
- C. Shop Drawings: Provide shop drawings customized for the project to include the following:
  - 1. Drawings showing dimensions, arrangement, elevations, identification of components.
  - 2. Bill of materials including manufacturer's name and catalog number.
  - 3. System description including an overview of the system provided with detailed description of system architecture. A customized system diagram showing location of all gateways and assemblies/devices to be connected to the system and types of wiring required.
  - 4. Interconnecting wiring diagrams
  - 5. Ethernet bridge system addresses, memory map and instruction booklets.
- D. Operation and Maintenance Manuals: Provide operation and maintenance manuals as specified in Division 1.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, and handle all products and materials as specified in Division 01.
- B. Storage and Protection: Store all equipment and materials in a dry, covered, heated and ventilated location. Provide any additional measures in accordance with manufacturer's instructions.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Ethernet Bridge
    - a. Eaton/Cutler-Hammer
    - b. General Electric Company
    - c. Allen Bradley

## 2.2 ETHERNET BRIDGE

- A. Enclosure: Provide rigid, NEMA 12, gasketed enclosure.
- B. Description of Operation: The ethernet bridge provides the necessary modules to translate status and/or control information from microprocessor based metering systems, microprocessor based overload protection, microprocessor based protective relays and internal solid state control logic located in various items assembled equipment such as motor control centers, adjustable frequency drives and switchgears into an Ethernet compatible signal.

## 2.3 SOURCE QUALITY CONTROL

- A. Tests: Shop test each bridge in accordance with IEEE standards.
  - 1. Operational Tests: After the equipment has been completely assembled, perform operational tests to determine the general operating conditions and circuit continuity.
- B. Device Address: Factory set the address of each device.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install the ethernet bridge adjacent to the RTU panel in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 01.

### 3.2 OPERATION DEMONSTRATION

Manufacturer's Service Representative: Provide the services of a qualified factory-trained service engineer to assist in installation, start-up, field testing, calibration, placing into operation and provide training, as specified in Section 01 79 00.

- 1. Provide service engineer when the equipment is placed into operation.
- 2. Provide service engineer at job site as often as necessary until all problems are corrected and the equipment installation and operation are satisfactory.
- 3. Following completion of installation and field testing provide training for 12 employees of the OWNER in the proper operation, troubleshooting and maintenance of the equipment as outlined below. All training will be at the OWNER'S facilities at a time agreeable to the OWNER:
  - a. Operational Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.

- b. Maintenance Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.
- B. Provide a service engineer at the job site as often as necessary to assist in the programming of the SCADA system in accessing the memory map of each device.
- C. Operation and Maintenance: Provide operation and maintenance instructions as specified in Division 01.

END OF SECTION

## SECTION 26 11 13

### MEDIUM-VOLTAGE TRANSFORMERS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing and testing substation transformers complete and ready for operation, including all accessories and appurtenances with shop and field tests necessary for a complete installation.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 09 96 00 - High Performance Coatings
  - 2. Section 26 05 00 - Basic Electrical Materials and Methods
  - 3. Section 26 05 26 - Grounding
  - 4. Section 26 05 53 - Electrical Identification
  - 5. Section 26 08 00 - Electrical Testing Requirements
  - 6. Section 26 23 00 - 480 Volt Switchgear

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. IEEE C57.12.00 - General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformer
  - 2. IEEE C57.12.91 - Test Code for Dry-Type Distribution and Power Transformers
  - 3. NFPA 70 - National Electrical Code (NEC)
  - 4. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors
  - 5. IEEE C57.12.01 - General Requirements for Distribution, Power and Regulating Transformers
  - 6. ANSI C57.12.28 - Switchgear and Transformers, Pad-Mounted Equipment - Enclosure Integrity
  - 7. ANSI C57.12.50 - Requirements for Ventilated Dry-Type Distribution Transformers, 1-500 kVA Single-Phase and 15-500 kVA Three-Phase, with High Voltage 601-34,500 Volts, Low Voltage 120-600 Volts

8. ANSI C57.12.51 - Requirements for Ventilated Dry-Type Power Transformers, 501 kVA and Larger Three-Phase, with High Voltage 601-34,500 Volts, Low Voltage 208Y/120-4160 Volts
9. ANSI C57.12.55 - Conformance Standard for Transformers - Dry-Type Transformers Used in Unit Installations, Including Unit Substations
10. IEEE C57.12.56 - Standard Test Procedure for Thermal Evaluation of Insulation Systems for Ventilated Dry-Type Power and Distribution Transformers
11. IEEE C57.12.58 - Guide for Conducting a Transient Voltage Analysis of a Dry-Type Transformer Coil
12. IEEE C57.12.59 - Guide for Dry-Type Transformer Through-Fault Current Duration
13. IEEE C57.12.70 - Terminal Markings and Connections for Distribution and Power Transformers
14. IEEE C57.12.80 - Standard Terminology for Power and Distribution Transformers
15. IEEE C57.12.91 - Standard Test Code for Dry-Type Distribution and Power Transformers,
16. IEEE C57.94 - Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type General Purpose Distribution and Power Transformers
17. IEEE C57.96 - Guide for Loading Dry-Type Distribution and Power Transformers (ANSI).
18. IEEE C57.105 - Guide for Application of Transformer Connections in Three-Phase Distribution Systems
19. IEEE C57.124 - Recommended Practice for the Detection of Partial Discharges and the Measurement of Apparent Charge in Dry-Type Transformers
20. UL 1562 - Transformers, Distribution, Dry-Type - Over 600 Volts
21. DOE 2016 - DOE 10 CFR Part 431 Efficiency Standards; published in the Federal Register on April 18, 2013
22. Natural Resources Canada, Canada Energy Efficiency Act, Energy Efficiency

- 23. NEMA 210 - Secondary Unit Substations
- 24. NEMA ST 20 - Dry-Type Transformers for General Applications

1.3 SYSTEM DESCRIPTION

A. General: Provide substation transformers made up of factory-built standardized units, dry type, self-cooled, completely dead front, totally enclosed and freestanding, with side wall mounted primary and secondary terminations, including accessories, controls and metering with auxiliary compartments and interconnections as shown.

B. Rating: Provide Transformers with the following ratings:

- 1. Primary Voltage 4.16 kV
- 2. Primary Connection Delta
- 3. Secondary Voltage 480/277 volts
- 4. Secondary Connection Wye 4 wire (with insulated ground)
- 5. Insulation Class 155°C or higher
- 6. kVA 1,000/1,333 kVA OA/FA
- 7. BIL 60 kV
- 8. Impedance 5.75 ± 7-1/2 percent
- 9. Phase(s) 3
- 10. Hertz 60

1.4 SUBMITTALS

A. General: Furnish all submittals including the following, as specified in Division 01 and Section 26 05 00.

B. CONTRACTOR's Drawings: Furnish working drawings customized for the project transformers including the following:

- 1. Manufacturer's data showing service voltages, number of phases, kVA ratings, inrush factor, voltage taps, temperature rise, BIL, weight, support points and standard accessories.
- 2. Layout drawings showing accurately scaled basic equipment sections and openings for cable and conduit. Include plan and front views.
- 3. Interconnection diagrams with equipment external to the transformer clearly shown.
- 4. Wiring diagrams showing voltage taps and high and low voltage connections.
- 5. Bill of Materials.
- 6. Catalog data for all accessories and appurtenances.

7. Shop test procedures complete with instrument calibration data.
  8. Spare parts list.
- C. Operation and Maintenance: Furnish transformer operation and maintenance manuals as specified in Division 1.
- D. Source Quality Control: Furnish the following:
1. Manufacturers certificates for insulation rating, temperature rise, impedance and high potential tests of the primary and secondary connections.
  2. Certified copies of the factory and shop test results.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 and as follows:
- B. Packing: Suitable pack all structures and equipment to be rigidly braced and protected against weather, damage and undue strain during shipment.

#### 1.6 SPARE PARTS

- A. General: Furnish the following spare parts:
1. Any other parts or material that may be necessary for the proper maintenance and operation of the transformers.
  2. Three 12-ounce spray cans of the final finish for touch-up
- B. Special Tools: Provide a set of special wrenches as required for each transformer.
- C. Packaging: Plainly tag and mark spare parts for identification and reordering. Properly box and wrap spare parts to prevent deterioration. Completely identify the contents of the box on the outside with suitable labels.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
1. Substation Transformer
    - a. Hammond Power Solutions

- b. Eaton's Cooper Power Systems
- c. ABB Power T&D Company Inc.
- d. Square D /Schneider Electric

## 2.2 SUBSTATION TRANSFORMER

- A. General: Provide transformers and accessories and appurtenances designed, assembled and tested in accordance with applicable IEEE, ANSI and NEMA standards. Provide all electrical equipment suitable for operation at their standard nameplate ratings in accordance with applicable IEEE and ANSI standards.
- B. Provide suitable structural base members to permit plumb and level installation of the substation transformer on its concrete pad.

## 2.3 CAST COIL TYPE DRY TRANSFORMER

- A. General: Provide the transformer with top mounted primary and secondary terminations.
- B. Construction: Provide transformers of a solid-cast, dry-type, mounted in a suitable, ventilated indoor enclosure.
- C. Temperature Rise: Provide average temperature rise of the transformer windings not to exceed 80 degrees C when the transformer is operated at full nameplate rating. Furnish a transformer capable of carrying 100 percent of nameplate kVA rating in a 40 degrees maximum, 30 degrees C average ambient as defined by IEEE C57.12.01.
- D. Taps: Provide two 2-1/2 percent full-capacity above normal and two 2-1/2 percent full-capacity below normal primary taps.
- E. Windings: Provide copper conductors for both the high voltage (HV) and low voltage (LV) windings. Separately cast each HV and LV windings as one rigid tubular coil, arranged coaxially. Fully reinforce each coil with glass cloth and cast under vacuum to provide complete, void-free resin impregnation throughout the entire insulation system. Reinforcement with suspended particulate matter (filled-resin) is not acceptable. Support coils by cast epoxy bottom supports and space blocks and spring loaded top blocks in order to absorb thermal expansion and contraction of the coils. Rigid mechanical connection between HV and LV coils will not be accepted.
- F. Windings Absorption and Storage: Provide windings to not absorb moisture, and suitable for both storage and operation in adverse environments, including prolonged storage in 100 percent humidity at temperature from -40 degrees C to +40 degrees C. Provide the transformer that are capable of immediately being switched on after such storage periods without requiring predrying.
- G. Ventilation: Provide all ventilating openings in accordance with NEMA and NEC standards for ventilated enclosures.

- H. Enclosure Base: Provide transformer base that permits rolling or skidding in any direction, and equip with jacking pads designed to be flush with the transformer enclosure.
- I. Forced Air Cooling: Include provisions for future fan cooling system automatically controlled by sensors placed in the LV air ducts to increase the transformer capacity by 33 percent. Provide cooling system that consists of fans, control wiring, controller with test switch, current limiting fuses, indication lights, alarm silencing relay, and necessary push buttons to properly control the system. Derive the power for the fan cooling system from a 240 volt, single phase control power transformer located in the primary termination compartment.
- J. Monitoring: Provide High temperature alarm thermostats in each phase, with normally-open contacts, wired in series and connected to the plant SCADA system. Alarm setpoint shall be 130 degrees C.
- K. Sound Level: Not exceeding the allowable values in NEMA ST 20.
- L. Testing: Conduct the following tests in accordance with IEEE C57.12.91:
  - 1. Ratio
  - 2. Polarity
  - 3. No-Load Loss
  - 4. Excitation Current
  - 5. Impedance
  - 6. Full Load Loss
  - 7. Applied Potential
  - 8. Induced Potential

## 2.4 WIRING

- A. General: Provide completely assembled transformers, wired, and tested at the factory, including buses, connections, insulators, cleats, terminals, and terminal blocks. Insulate all current carrying parts. Run all low voltage wiring in high voltage compartments in conduit or in metal wiring troughs. Provide terminal blocks with approved covers and mounted so that the wires to them can be grouped and laced together in a neat and workmanlike manner. Provide cup washers for wires No. 12 and smaller and solderless lugs for larger sizes. Provide a sufficient number of terminal connections, including 15 percent of spare terminals, for all control and instrument wiring. Provide No. 14 AWG stranded copper or larger, insulated with NEC Type SIS for 600 volts for all low voltage wiring.
- B. Multi-Voltage Primary Tap Connections: Where specified to be provided, confirm that the factory installed conductors used for internal winding connections are sized for the voltage shown to be used initially on the Contract Drawings.

## 2.5 TEMPERATURE RISE

- A. General: Do not exceed the temperature rise of switching devices within the enclosure as permitted by the standards for such devices and measured over the average ambient. Provide temperature rise of buses and connections not exceeding 35 degrees C over the average air temperature inside the enclosure.

## 2.6 IDENTIFICATION

- A. General: Provide the substation transformer with a nameplate identifying the circuit or unit controlled. Identify all switches, meters, instruments, and other features as specified in Section 26 05 53.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Arrange the transformer equipment as shown, and suitable for installation in the spaces as shown without appreciable revision to other equipment, foundation arrangements and structures.
- B. Conformance: Install transformer assembly as indicated, in accordance with manufacturer's written instructions and with recognized industry practices; comply with NEMA Standards, NEC, applicable ANSI Publications and local codes.
- C. Coordination: Coordinate with other work including cabling/wiring work to interface installation of transformer assembly.
- D. Torque Requirements: Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening requirements for equipment connectors. Where manufacturers' torquing requirements are not included, tighten connectors and terminals in accordance with UL Standard 486A.
- E. Grounding Connections: Make equipment grounding connections for the transformers and appurtenances. Tighten connections in accordance with UL Standard 486A for permanent and effective grounding.
- F. Adjustments: Make all necessary adjustments to the equipment to provide complete and satisfactory operation upon completion of the Contract.
- G. Neutral Connections: Make suitable provisions for connections to the neutral cables from the transformer secondary and to the ground cables from the grounding system.

### 3.2 FACTORY TESTING

- A. The following factory tests shall be performed on each transformer provided under this section. All tests shall be in accordance with the latest version of ANSI, NEMA and IEEE standards including IEEE C57.12.90:
1. Polarity
  2. Resistance measurements of all windings on the rated voltage connection of each unit and at the tap extremes
  3. Ratio tests on the rated voltage connection and on all tap connections
  4. Polarity and phase-relation tests on the rated voltage connections
  5. No-load loss at rated voltage on the rated voltage connection
  6. Exciting current at rated voltage on the rated voltage connection
  7. Impedance and full load loss at rated current on the rated voltage connection of each unit and on the tap extremes
  8. Applied potential test
  9. Induced potential tests
  10. Full wave and reduced wave impulse tests
  11. Temperature test(s) shall be made on all units.
  12. Final inspections and quality checks
- B. In addition, the manufacturer shall provide certification for all design and other tests listed in C57.12.00, including verification that the design has passed short circuit criteria per ANSI C57.12.00 and C57.12.90.
- C. The manufacturer shall provide three (3) certified copies of factory test reports.
- D. Factory tests as outlined above shall be witnessed by the Owner's representative:
1. The Contractor shall notify the Owner's representative two (2) weeks prior to the date the tests are to be performed.
  2. The Contractor shall be responsible for all associated costs including but, not limited to all transportation, lodging, meals and miscellaneous expenses for three Owner representatives.

### 3.3 FIELD QUALITY CONTROL

- A. **Manufacturer's Representative:** Provide a factory-trained, authorized representative of the manufacturer as specified in Division 1. Provide all instruments necessary to conduct required tests and adjustments. Have the manufacturer's representative utilize prepared comprehensive check sheets covering inspections, checks and tests required for the assembly of the product. Submit copies of these documents executed and signed by the manufacturer's representative. Have the representative present when the equipment is placed in operation. Provide representative service as often as necessary until all problems are corrected and the equipment is installed and operating satisfactorily.
- B. **Certified Report:** Furnish a written report certifying that the equipment (1) has been properly installed, (2) is in accurate alignment, (3) is free from any undue stress imposed by connecting piping or anchor bolts, and (4) has been operated under full load conditions and that it operated satisfactorily.
- C. **Testing:** Furnish an AC or DC 5-minute high potential test applied after the installation is complete for all substation equipment. Provide test voltages in accordance with the IEEE and NEMA Standards for the voltage class of equipment and components to be tested. Provide tests for all bus, cable, wire, switches, breakers, transformer, and control devices.
- D. **Test dielectric inhibited oil to ASTM D 877, using 25,000 minimum breakdown voltage, after installation and before energization from system.**

### 3.4 CLEANING AND PAINTING

- A. **Shop Painting:** Paint the substation transformers as specified in Section 09 96 00.
- B. **Field Painting:** Touch-up scratched and marred surfaces to meet the requirements of Section 09 90 00.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 26 13 00

### MEDIUM VOLTAGE SWITCHGEAR

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing 5 kV class, metal-clad, indoor switchgear as indicated, in accordance with the Contract Documents.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 01 79 00 - Training
  - 2. Section 09 96 00 - High Performance Coatings
  - 3. Section 26 05 00 - Basic Electrical Materials and Methods
  - 4. Section 26 05 26 - Grounding
  - 5. Section 26 05 53 - Electrical Identification
  - 6. Section 26 08 00 - Electrical Testing Requirements
  - 7. Section 26 05 73 - Short Circuit and Coordination Study
  - 8. Section 26 05 13 - Medium Voltage Cables
  - 9. Section 26 05 33 - Electrical Raceway Systems
  - 10. Section 26 05 43 - Underground Electrical Distribution System
  - 11. Section 26 05 10 - Utility Coordination and Requirements
  - 12. Section 26 33 00 - Battery Systems
  - 13. Section 26 09 13 - Electrical Monitoring System
  - 14. Section 26 29 53 - Control Components and Devices

##### 1.2 REFERENCES

- A. General: Codes and standards referred to in this Section are:
  - 1. IEEE C37.90 - IEEE Standard Surge Withstand Capabilities Tests for Relays and Relay Systems Associated with Electric Power Apparatus
  - 2. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors
  - 3. CSA C22.2 #31 - Switchgear Assemblies
- B. Material and Installation Workmanship Requirements: Provide all materials and workmanship meeting the requirements of NFPA standards and codes.

- C. Design and Testing Requirements: Provide all switchgear components designed, manufactured and tested in accordance with the latest NEMA, IEEE and ANSI standards; and be UL or CSA listed.
- D. Installation Requirements: Install the switchgear assemblies meeting the requirements of NEC and local Electrical Codes.

### 1.3 SUBMITTALS

- A. General: Provide all submittals customized for the project, including the following, as specified in Division 01 and Section 26 05 00.
- B. Product Data and Information: Provide manufacturer's catalog data and bill of material for the switchgear assemblies, identifying major components and accessories of the system. Provide rating data, type, model, service voltages, number of phases, current ratings, interrupting capacities as well as function and sequence of operation of the control, protection and sensing equipment.
- C. Provide manufacturers' one line diagrams schematic control diagrams and interconnection diagrams with terminals for connection to equipment external to the switchgear assemblies.
- D. Shop Drawings:
  - 1. Provide manufacturers' layout drawings of the switchgear assemblies showing accurately scaled stationary structures and the basic equipment sections in Plan View, Elevations and Sections.
  - 2. Provide manufacturers' wiring diagrams for switchgear assemblies showing the space allocated for connections to incoming power feeders and outgoing distribution feeders. Clearly indicate the portion of wiring and cabling to be manufacturer installed and the portions to be field installed.
  - 3. Provide instruction booklets and time-current curves for each protective relay supplied.
  - 4. Provide microprocessor-based metering system and overload protection systems address, memory map and instruction booklets.

### 1.4 QUALITY CONTROL

- A. Test Reports: Provide the manufacturer's certified shop test report for the switchgear.

### 1.5 OPERATIONS AND MAINTENANCE MANUALS

- A. General: Provide operation and maintenance manuals including spare parts list for the switchgear assembly as specified in Division 01.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 and Section 26 05 00 (and as follows:)
- B. Storage and Protection: Store all equipment and materials in a dry, covered, heated and ventilated location. Provide any additional measures in accordance with manufacturer's instructions.

## 1.7 SPARE PARTS

- A. General: Provide the following spare parts:
  - 1. All parts recommended by the manufacturer in published literature as spare parts. As a minimum, provide the following:
    - a. Six replacement lenses for each color of indicating lights
    - b. Three current transformers of each type and rating
    - c. Two potential transformers of each type and rating
    - d. Twelve potential transformer primary fuses
    - e. Twelve potential transformer secondary fuses
    - f. One microprocessor three-phase protective relay of each type furnished.
    - g. One ANSI 86 relay
    - h. One ANSI 87 relay complete in a protective case of each style furnished
    - i. One circuit breaker control switch
    - j. One ammeter switch
    - k. One voltmeter switch
    - l. Twelve dc control power fuses for each size required
    - m. One transfer truck with arrangement for lifting and removing circuit breakers from the switchgear
    - n. Three manual circuit breaker closing devices
    - o. Two pairs of fuse tongs for potential fuses

- p. Two sets of control jumpers
  - q. One test cabinet complete with secondary disconnecting contacts, control relay, breaker control station
  - r. One neon tube test stick with neon tubes and ground cable and clamp
  - s. One ground test device as specified herein
  - t. One hand crank for breaker withdrawal and insertion
  - u. Three 12-ounce spray cans of the final finish for touch-up
- B. Packaging: Pack spare parts in containers bearing labels clearly indicating contents and related pieces of equipment. Deliver spare parts in original factory packages. Identify all spare parts with information needed for reordering.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
- 1. Medium Voltage Switchgear
    - a. Eaton/Cutler-Hammer Type Vac Clad-W
    - b. Square D/Schneider Electric Type Masterclad
    - c. ABB Type Advance
  - 2. Protective Relays
    - a. Schweitzer Engineering Laboratories
    - b. GE Grid Solutions/Multilin
    - c. ABB Power T&D Company Inc.
    - d. Basler
  - 3. Microprocessor Based Protective Relays and Metering Systems
    - a. Eaton/Cutler-Hammer IQ DP-4000
    - b. Square D/Schneider Electric Powerlogic
    - c. GE Grid Solutions/ Multilin
  - 4. Power Transducers
    - a. Ametek Power Instruments/Scientific Columbus Type Exceltronic
    - b. Ametek Power Instruments/Rochester Instrument Systems

## 2.2 ELECTRICAL CONDITIONS

### A. Design

1. Provide all components required for complete functioning units as specified and as shown using factory built standardized type, completely dead front, totally enclosed and freestanding units. Each unit comprises a stationary structure and a removable element.
2. Design, manufacture, and test in accordance with the latest NEMA, IEEE and ANSI Standards.
3. Furnish the required number of units to provide the necessary controls and metering as shown and specified.

B. Distribution System: The switchgear will be connected to a 4160-volt, 3-phase, 60-hertz, 3-wire, solidly grounded power system.

## 2.3 COMPONENTS

### A. Stationary Structure: Fabricate the stationary structure of the switchgear as follows:

1. Fabricate the unit out of welded structural steel members, together with formed or fitted sections of smooth 11-gauge sheet steel for front and rear hinged panels. Fabricate side panels from a minimum of smooth 13-gauge sheet steel.
2. Dimensions: Approximately 26h inches wide, 96 inches deep, and 95 inches high.
3. Form completely enclosed compartments for various combinations of vacuum circuit breaker and auxiliary equipment.
4. Provide sufficient structural strength supporting all the equipment mounted within, withstand the handling and shipment of the units, maintaining the proper alignment, and be rigid and freestanding.
5. Provide a formed front door panel for each compartment consisting of concealed type hinges or pins and two or three point latch with cylinder locks with common keying. Furnish four keys.
6. Provide bolted covers for rear access to cable terminals.
7. Reinforce panels as required to retain alignment and to support instruments, relays, and control equipment mounted thereon.
8. Provide removable plates to permit access to all compartments individually.

9. Isolate circuit breaker, buses, instrument transformers and incoming or outgoing cables with separate compartments formed by sheet steel barriers.
10. Seal all openings in the barriers between compartments.
11. Provide suitable ventilation for the individual compartments to keep the temperature of devices and buses within the permissible temperature limits as specified by the Standards.
12. The stationary structure includes the insulated buses, the fixed portion of primary disconnect devices, insulated connections, instrument transformers, control devices and fuses.
13. Provide grounded automatic safety shutters to close the high voltage openings when the circuit breaker is moved to the disconnected position.
14. Furnish a positioning mechanism for moving the removable circuit breaker to or from the connected position.
15. Install guides for proper alignment of all engaging parts during movement of the circuit breaker between the connected or disconnected position.
16. Insulate and isolate the control equipment and wiring from primary conductors and devices.
17. Design the stationary structure and circuit breakers to be interchangeable with every other circuit breaker of the same rating.
18. Extend the dc control wiring across all units of the switchgear.
19. Fully isolate the main bus compartment from the breaker compartment and from the compartment enclosing instrument transformers, cable terminations, and accessories.
20. Provide main buses rated not less than 1200 amperes rms consisting of rigidly supported insulated copper bars of suitable design and cross-sectional area to satisfactorily carry the rated current without exceeding the temperature rise as specified in the IEEE and NEMA standards.
21. Base current-carrying capacity of the bus on the actual service conditions, including skin and proximity effect, insulation, steel enclosure, and ambient temperature of 40 degrees C.
22. Insulate the bus using a flame-retardant, track-resistant fluidized bed epoxy material, designed for 5 kV service, over the entire length and able to withstand the ANSI 60-hertz standard production test voltage of 19 kV and

impulse test of 60 kV. Install the epoxy insulation with a high resistance conducting surface in contact with the bus to give a void free system to eliminate corona damage to the bus insulations.

23. Connect the bus with suitable bus clamps or bolts with lock washers.
24. Silver plate the copper bars at current-carrying connections.
25. Insulate all standard bus joints with preformed insulating boots secured by nylon hardware. Insulate nonstandard joints with tape and insulating compound.
26. Equip each switchgear unit with a 1/4-inch by 2-inch bare copper ground bus with a momentary rating at least equal to the highest momentary rating of the circuit breaker. Extend the ground bus the entire length of the structure and comply with all applicable codes and regulations.
27. Ground each stationary unit directly to the ground bus.
28. Provide suitable lug terminals on the ground bus for connections to the station grounding system.
29. Construct and arrange the stationary structure so that circuit breakers, main buses, instrument transformers, and control are completely isolated from each other within the same section and that sections are isolated from adjoining sections.
30. Furnish steel floor channels suitable for embedding into the concrete floor for leveling and anchoring the switchgear. Drill and tap the floor channels as required. Provide bolts, nuts, and washers for anchoring the switchgear to the channel.
31. Provide key interlocks where noted on the Contract Drawings. Where multiply lineups of like equipment are provided, interlock keys are to be keyed unique to each lineup. Where multiple interlock functions are to be provided in a common lineup, the interlock keys for each function are to be uniquely keyed.
32. Provide viewing windows for infrared inspection of terminations and bus connections without removal of covers. Coordinate window size and placement with internal components to be imaged and obstacles such as barriers.

B. Switchgear Enclosure:

1. Design the switchgear for installation indoors.

- C. Removable Element: Design the removable element as follows.
1. Horizontal-drawout type designed for use with metal-clad switchgear.
  2. Manufactured by the switchgear manufacturer.
  3. Vacuum break type circuit breaker complete with operating mechanism, removable portion of primary and secondary disconnecting devices, mechanical interlocks and local control wiring.
  4. Install control wiring in conduit or other suitable enclosure.
  5. Design circuit breakers to be freestanding when removed with suitable casters or wheels for moving.
  6. Isolate circuit breakers from all other primary equipment.
  7. Arrange circuit breakers so that they may be completely disconnected from the line and bus for test and inspection.
  8. Equip the circuit breaker assembly with mechanical interlocks to prevent moving the circuit breaker in the stationary structure without tripping open.
  9. Arrange the circuit breaker so it is not possible to close it either electrically or manually when the circuit breaker is at any point between the operating and the test position, or while the interlock is engaged.
  10. Isolate the breaker by moving it to the disconnected position.
  11. Allow the breaker to be removed from the structure.
  12. Provide provisions for padlocking the circuit breaker in the open, disconnect or test position.
  13. Manufacture the removable element in jigs which will accurately locate the contacts, holding devices and interlocks. Use similar jigs in the construction of the stationary structure. Check each removable element for complete interchangeability.
  14. Provide self-aligning female and male multicontact devices for the control connections between the stationary equipment and the removable breaker.
  15. Furnish a polarized plug and receptacle on a control cable to permit test operation of the breaker when in the disconnected position, unless the switchgear design provides a test position which permits the breaker to be operated with the primary disconnecting contacts open and the secondary contacts in the normal position.

16. Provide cell switches to allow testing of the breaker in the test position without affecting or tripping any other breaker.
17. Design the removable element to operate with a test cabinet specified hereinafter.

D. Power Circuit Breakers: Provide power circuit breakers as follows:

1. Rate at 1200 amperes symmetrical continuous, at 4.76 rms kV.
2. Provide a 3-phase interrupting rating of 40 kA at a nominal 4.16 kV on a standard Close-Open 15-second Close-Open duty cycle.
3. Provide an interrupting time not to exceed 5 cycles on a 60-cycle basis for all values of fault interrupting currents.
4. Provide breaker contacts composed of silver-to-silver or equivalent.
5. Provide circuit breakers that are capable of carrying the rated full load current continuously without exceeding the temperature rise, as specified in the latest IEEE and ANSI standards.
6. Provide circuit breakers that successfully withstand the 60-hertz production test voltage of 19 kV, and an impulse test voltage of 60 kV.
7. Coordinate circuit breaker insulation with the switchgear insulation, suitable for service on a nominal 5 kV system.
8. Provide each breaker with a mechanically and electrically trip-free stored energy operating mechanism, pump-free control relay, operation counter, trip coil, position indicator, and multistage auxiliary switch with three sets of spare normally-open and normally-closed contacts.
9. Closing Voltage: 100 to 140 volts on 125-volt dc system
10. Tripping Voltage: 70 to 140 volts on a 125-volt dc system
11. Arrange each breaker to allow manual operation for maintenance purposes only.

E. Switchgear Insulation Classes and Dielectric Test:

1. Provide the switchgear equipment that conforms to the 5 kV insulation class.
2. After assembly, subject the equipment and the secondary and control wiring to demonstrate the capability of withstanding the ac high potential tests as

specified by the IEEE and NEMA standards for the specific system insulation classes.

F. Mechanical and Thermal Limits:

1. Provide equipment capable of withstanding mechanically and thermally short circuit currents equivalent to the corresponding interrupting ratings of the breakers.

G. Switchgear Connections and Terminals:

1. Construct all current-carrying connections to the main buses of copper with suitable capacity and conform to the requirements of the main bus insofar as bracing, insulation, temperature limits and the like are concerned.
2. Connect current transformers in such a way that the transformers may be removed and changed without damaging the connection.
3. Use flexible cable insulated for 5 kV service for potential transformer leads.

H. Instrument Transformers:

1. Current Transformers

- a. Dry type current transformers, designed for indoor service in metal-clad switchgear, and rated as shown.
- b. Provide sufficient thermal and mechanical capacity to withstand the maximum momentary current rating of the circuit breaker.
- c. Use solderless clamp type shorting terminal blocks for secondary connections.
- d. Properly identify the polarity of all current transformers with standard marking symbols.
- e. Use window-type current transformers for ground-sensing where shown.
- f. Provide the accuracy of current transformers suitable for the instruments and meters specified using the normal burdens of the various devices, and not less than ANSI Standard requirements.

2. Potential Transformers

- a. A dry type, suitable for indoor service in metal-clad switchgear, single-phase, 60-hertz, 120 volts.

- b. Provide potential transformers that fit into and coordinate with the complete switchgear units, and with the instruments, relays, meters, and devices specified.
- c. Rate the potential transformers not less than 150-volt-amp on an accuracy basis and 700-volt-amp on a thermal basis.
- d. Provide the potential transformers that withstand a secondary short circuit for at least one second.
- e. Provide the transformers meeting the requirements of the ANSI Standard accuracy classifications.
- f. Withstand an impulse test voltage of 60 kV.
- g. Provide two primary bushings with full insulation.
- h. Install potential transformers on a suitably designed drawout carriage with primary and secondary disconnect device, grounding device, and accessories in conformance with IEEE and NEMA standards.
- i. Provide current-limiting type primary fuses.
- j. Provide secondary fuses for the protection of potential transformers.

I. Grounding:

- 1. Ground current and potential transformer secondaries with a copper conductor not smaller than No. 10 and connecting to the ground bus.
- 2. Ground potential transformer primaries, where shown or required with a copper conductor not smaller than No. 6 insulated for line-to-line voltage, and terminated at the ground bus.
- 3. Provide connections to the bus so that it can be easily disconnected and isolated for proof testing.
- 4. Install each ground wire as a continuous run without intervening splices or terminal blocks.
- 5. Ground secondary circuits of metering and relaying transformers at one point only.
- 6. Effectively ground meter, relay and instrument transformer cases.

J. Protective Relays:

1. Provide multi-functional microprocessor based three-phase protective relays that provide protection functions as described on the drawings.
2. Provide relays with true RMS sensing that operates from the 5-ampere secondary output of current transformers.
3. Provide relays with ANSI 50/51N protective functions for each of the three (3) phases, and ANSI 50/51N or 50/51G ground fault protection functions as shown. Provide ground elements that utilizes residual, zero sequence, or ground source connection schemes, or be deactivated.
4. Provide relays with separate programmable setting for phase and ground current transformers with primary current ratings from 5 through 5,000 amperes.
5. Provide relays with phase and ground protection curves that are independently field selectable and programmable with or without load from the following type of curves:
  - a. IEEE: Moderately inverse, very inverse, extremely inverse
  - b. IEC: A, B, C, or D
  - c. Thermal: Flat,  $I_t$ ,  $I_t^2$ ,  $I_t^4$
  - d. Selectable short delay pick-up and short delay time settings
  - e. Instantaneous phase over-current trip - field programmable pick-up points from 1.0 to 25 times current transformer primary rating or set to NONE.
  - f. Provide a field selectable (ON or OFF) discriminator circuit that operates when phase instantaneous over-current trip has been set to NONE, to protect against currents exceeding 11 times current transformer primary rating, only when the breaker is closed.
6. Provide a relay with two field configurable type "a" contacts.
7. Provide a built-in alphanumeric display capable of displaying the following information:
  - a. Individual phase currents
  - b. Ground current
  - c. Cause of trip
  - d. Magnitude and phase of current causing trip
  - e. Peak current demand for each phase and ground since last reset
  - f. Current transformer primary rating
  - g. Programmed phase and ground set-points.
8. Provide a relay having integral manual testing capability for both phase and ground

9. Provide an addressable communication card capable of transmitting all data over a two-wire network to the Plant SCADA System as specified in Section 26 09 13.
  10. Provide a relay with Alarm and/or Trip contacts do not change state if power is lost or an under-voltage occurs. Provide contacts that only cause a trip upon detection of an over-current or fault condition based upon programmed settings.
  11. Provide a relay suitable for operating on control power with a nominal input voltage of 125 volts dc
  12. Provide Relays of the following types
    - a. Type FPR – Feeder Protection Relay: Schweitzer SEL-751 or equal.
    - b. Type BDR – Bus Differential Relay: Schweitzer SEL-487B-1 or equal
    - c. Type GPR – Generator Protection Relay: Schweitzer SEL-700G or equal.
    - d. Type TPR – Transformer Protection Relay: Schweitzer SEL-787-2 or equal.
- K. Lockout Relays: Provide hand reset type lockout relays (IEEE/ANSI Device 86) where indicated on the drawings. Provide, Electroswitch Type WL, GE Grid Solutions Type HEA, or equal.
- L. Lightning Arresters and Surge Capacitors:
1. Provide each incoming service with lightning arresters and surge capacitors.
  2. Provide Intermediate type lightning arresters of the metal oxide varistor (MOV) type rated 4.5 kV designed for 3-phase switchgear applications.
  3. Provide 3-pole surge capacitors designed for switchgear applications.
- M. Control Devices:
1. Provide control switches of the standard rotary, multistage type suitable for the use specified.
  2. Provide circuit breaker control switches suitable for use with red and green indicating lamps, and provide with indicating targets.
  3. Provide rectangular or round miniature LED type indicating lamps with resistors designed for 125-volt dc.

4. Provide the following:
  - a. Other controls which may be required for moving the breaker to and from the operating position
  - b. Auxiliary relays, switches and mechanisms required for the particular manufacture of the breaker
  - c. Operation counter
  - d. Manually operated trip bar or lever
  - e. Provision for manual closing
  
- N. Microprocessor-Based Metering and Protection System: Provide a microprocessor-based metering and protection system having the following features:
  1. UL recognized component meeting IEEE C37.90.
  2. Housed in an enclosure suitable for door mounting.
  3. Derive control power from metered line.
  4. Auto ranging metering of the following values:
    - a. Ac amperes in each phase, 0.5 percent accuracy
    - b. Ac voltage, phase-to-phase, phase-to-neutral, 0.5 percent accuracy
    - c. Watts, 1 percent accuracy
    - d. Vars, 1 percent accuracy
    - e. Power factor, 2 percent accuracy
    - f. Frequency, 0.5 percent accuracy
    - g. Watt demand, 1 percent accuracy with programmable 5-, 10-, 15-, 30-minute intervals
    - h. Watt-hours, 1 percent accuracy
    - i. Percent total harmonic distortion through the 31st harmonic
  5. Protection system of the following functions:
    - a. Voltage phase loss, less than 50% nominal line voltage

- b. Current phase loss, less than 1/16 of the largest phase
  - c. Voltage phase unbalance, 5 to 40% in 5% increments
  - d. Phase voltage reversal
  - e. Overvoltage, 105 to 140% in 5% increments
  - f. Undervoltage, 95 to 60% in 5% increments
  - g. Time delay for overvoltage, undervoltage, and phase unbalance, zero to twenty seconds in one second intervals.
- 6. Separate Form C (NO/NC) trip and alarm outputs contacts rated 10 amperes at 115-volt ac or 30-volt dc resistive.
  - 7. Addressable communications card capable of transmitting all data over a two-wire network to the Plant SCADA System as specified in Section 26 09 13.
- O. Power Transducers:
- 1. Provide voltage, current, watt, var, frequency and power factor transducer in accordance with the following:
    - a. Solid state devices.
    - b. Output: 4-20 ma into a 750 ohm load.
    - c. Provisions for zero and span adjustment with 0.25 percent accuracy.
    - d. Input power: Operate on external 125 volts dc, or derive their power supply from input signals.
    - e. Calibrate power factor transducer between 50 percent lag and 50 percent lead.
    - f. Provide watt and var transducers designed for 3-phase, 3 wire system.
- P. Wiring
- 1. Completely assemble, wire and test each switchgear section at the factory, including buses, connections, insulators, cleats, terminals, and terminal blocks.
  - 2. Insulate all current-carrying parts.

3. Route all secondary wiring in high voltage compartments in conduit or metal-covered wiring troughs.
4. Route all secondary wiring in the front of secondary compartments in wiring troughs and terminate at approved molded type terminal blocks with numbered marking strips, conveniently located with respect to the control conduits.
5. Provide terminal blocks mounted so that the wires on them can be grouped and laced together.
6. Mark and identify all wiring in accordance with the manufacturer's wiring diagrams.
7. Label control wiring with an identification tag that indicates the terminal number of the opposite end connection.
8. Include wire labels on schematic control and wiring diagrams.
9. Provide spade connectors for wires No. 12 and smaller and solderless lugs for larger sizes. Provide full ring lugs on all current transformer circuits.
10. Provide sufficient number of terminal connections, including 15 percent spare terminals, for all control and instrument wiring.
11. Provide No. 10 AWG stranded copper or larger with NEC Type SIS insulation for all current transformer secondary wiring.
12. Provide No. 14 AWG stranded copper or larger with NEC Type SIS insulation for all secondary wiring.
13. Provide a fused switch or circuit breaker for the control power supply in each breaker compartment.

Q. Identification:

1. Provide identification of the switchgear and its components as specified in Section 26 05 53.
2. Install nameplates for devices located on doors so they are readable to a person 5'-8" tall standing 3'-0" in front of the equipment.
3. Locate nameplates so that they are readily associated with items labeled.
4. Where nameplates are installed on removable relay or device doors, install a nameplate within the relay or device.

5. Where nameplates are located on other compartments than those served, add additional engraving to identify units served.
- R. Automatic Transfer Controller:
1. Provide a PLC-based automatic transfer controller in a separate vertical section of the switchgear to perform open-transition transfer between the two utility power sources.
  2. Coordinate the operation of the Switchgear and Automatic Transfer Controller with the Generator Master Control Panel:
    - a. Provide output contacts from the Automatic Transfer Controller to the Generator Master Control Panel to call the generator system to start or stop.
    - b. Accept input signals from the Generator Master Control Panel to monitor running status of the generators.
    - c. Accept input signals from the Generator Master Control Panel input circuit breakers to allow the Generator Master Control panel to synchronize the generators onto the bus and close the generator input circuit breakers at the switchgear.
  3. Provide automatic sequencing between the following normal operation modes:
    - a. Both Utility Sources energized (Normal Operating Condition)
    - b. Utility Source A energized, Utility Source B de-energized, ties closed to power all buses.
    - c. Utility Source A energized, Utility Source B de-energized, Bus 2 de-energized. (Service on Bus 2 or Tie Breaker)
    - d. Utility Source B energized, Utility Source A de-energized, ties closed to power all buses.
    - e. Utility Source B energized, Utility Source A de-energized, Bus 1 de-energized. (Service on Bus A or Tie Breaker)
    - f. Utility Source A energized, Utility Source B de-energized, Generators powering Bus 2.
    - g. Utility Source B energized, Utility Source A de-energized, Generators powering Bus 1.
    - h. Both Utility Sources de-energized, Generators powering Bus 1 and Bus 2.

- i. Both Utility Sources de-energized, Generators powering Bus 1, Bus 2 de-energized.
  - j. Both Utility Sources de-energized, Generators powering Bus 1, Bus 2 de-energized.
  - k. All sources de-energized.
4. Manual Operation
- a. Provide hardwired interlocks between circuit breakers to allow safe manual operation through all normal modes and required intermediate steps.

#### 2.4 REMOTE CONTROL PANEL (MIMIC PANEL)

- A. Provide a remote mounted control panel for monitoring and control of the switchgear. Panel shall have the following features:
  - 1. Floor or wall mounted painted steel enclosure
  - 2. Open/close selector switch for each circuit breaker
  - 3. Open, close and tripped indicating lights for each circuit breaker
  - 4. Mimic (one-line) diagram of the switchgear integrating the above selector switches and indicating lights
  - 5. Powered from switchgear control power source(s)
- B. Provide all interconnecting wiring between switchgear and remote control panel.

#### 2.5 SOURCE QUALITY CONTROL

- A. Tests: Provide the following tests and installation procedures in accordance with Section 26 08 00.
  - 1. Relay Testing: Perform the manufacturer's standard protective relay production and test procedures. The tests may be witnessed by the ENGINEER at the option of the OWNER.
  - 2. Shop Tests and Inspection. Completely assemble switchgear equipment in the manufacturer's plant for inspection and witness tests. Test the switchgear in accordance with the IEEE and ANSI standards for this class of equipment. Include shop tests to determine general operating condition and circuit continuity, high potential test and other standard tests for that particular class of equipment.

Notify the ENGINEER of the proposed date of testing a minimum of ten working days prior to the test.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install all medium voltage switchgear in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 01.
- B. Conformance: Install switchgears as indicated, in accordance with manufacturer's written instructions and with recognized industry practices. Comply with requirements of NEMA standards, NEC, and applicable ANSI Publications.
- C. Leveling and Anchoring: Provide steel channels in the concrete floor for leveling and anchoring the switchgear. Anchor the switchgear to steel channels bolts, nuts and washers.
- D. Coordination: Coordinate with other work, including cabling/wiring, as necessary to interface switchgear installation.
- E. Torque Requirements: Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals in accordance with UL Std 486A.
- F. Fuses: Provide fuses in each switchgear as required.
- G. Protective Relay Parameters: Set the protective relays in accordance with the protective coordination study specified in Section 26 08 00
- H. Ground Connections: Make equipment grounding connections for the switchgears as indicated on the drawings. Tighten connections in accordance with UL Standard 486A for permanent and effective grounding.
- I. Adjustments: Make all necessary adjustments to the equipment to provide complete and satisfactory operation.

### 3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Representative: Provide a factory-trained experienced, competent, and authorized representative of the switchgear manufacturer to visit the site of the work; inspect, check, adjust if necessary, and approve the equipment installation and provide training as specified in Section 01 79 00. Provide all instruments necessary to conduct required tests and adjustments. Have the manufacturer's representative

utilize prepared comprehensive check sheets covering inspections, checks and tests required for the assembly of the switchgear. Submit copies of these documents executed and signed by the manufacturer's representative. Have the representative present when the equipment is placed in operation. Provide representative services as often as necessary until all problems are corrected and the equipment is installed and operating satisfactorily.

- B. Certified Report: Furnish a written report certifying that the equipment
  - 1. Has been properly installed
  - 2. Is in accurate alignment
  - 3. Is free from any undue stress imposed by connections or anchor bolts, and
  - 4. Has been operated under full load conditions and that it operated satisfactorily
- C. SCADA Programming: Provide service engineer at the job site as often as necessary to assist in the programming of the SCADA system for accessing the memory map of each device.
- D. Field Tests: Perform the following tests and inspections. Record all tests and submit a written report for approval. Retest as necessary.
  - 1. Check all breakers, relays, meters, power and control fuses and auxiliaries for proper size, rating, and location. Clean control panels, cubicles, and aisles and remove all shipping materials.
  - 2. Inspect equipment and each breaker and report installation or shipping damage, loose materials, shipping blocks or contamination.
  - 3. Inspect installation location and report any unfavorable environmental conditions that require correction.
  - 4. Torque test bus connections where field joints are made.
  - 5. Test key interlock systems to demonstrate proper function.
  - 6. Check that all panel circuits are numbered and tagged: Panel door legends are engraved and installed as per drawings.
  - 7. Check equipment to determine that it is level, secured to foundations and that doors operate properly.

8. Test insulation of all control and relay circuits to ground with a suitable megohmmeter. Take suitable precautions where electronic devices, instruments and instrument transformers are involved.
  9. Field Proof Test. After installation, but before any external connections are made to the switchgear, subject the switchgear to a 10-minute high potential test applied on the stationary gear and breakers. Use a test voltage of 75 percent of the standard factory production tests.
  10. Test all bus, cable, wire and other equipment operating at the service voltage that is energized by closing the incoming main line breakers. Perform test witnessed by the ENGINEER.
  11. Test protective relays to verify settings and determine proper operation.
- E. Training: Following completion of installation and field testing provide training for 12 employees of the OWNER in the proper operation, troubleshooting and maintenance of the equipment as outlined below. All training will be at the OWNER'S facilities at a time agreeable to the OWNER:
1. Operational Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.
  2. Maintenance Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.

### 3.3 GROUNDING

- A. General: Inspect ground system for compliance with the latest drawings.
- B. Connections: Inspect all ground connections for evidence of looseness and/or corrosion.

### 3.4 CLEANING AND PAINTING

- A. Shop Painting: Paint the switchgear as specified in Section 09 96 00.
- B. Field Painting: Touch up scratched and marred surfaces to match with original finishes.

### 3.5 IDENTIFICATION

- A. General: Provide identifications meeting the requirements of Section 26 05 53.
- B. Component Identification: Identify all system components, cables and wires by labels indicating unit numbers, circuit numbers and date of installation.

- C. Work Mats: Thoroughly clean the floor in front of the switchgear and install the rubber work mats.

END OF SECTION

## SECTION 26 14 00

### MEDIUM VOLTAGE MOTOR CONTROLLERS

#### PART 1 GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Requirements for providing medium voltage motor controllers.
2. Requirements for modifications to existing medium voltage motor control center.
3. Requirement for performing maintenance activities on existing medium voltage motor control centers at the Water Plant.
  - a. Main Switchgear - Westinghouse AmpGard
  - b. Low Lift Pumping Station MCC - Westinghouse AmpGard
  - c. High Lift Pumping Station MCC - Westinghouse AmpGard

###### B. Related Work Specified in Other Sections Includes, But is Not Limited to the Following:

1. Section 01 79 00 - Training
2. Section 09 96 00 - High Performance Coatings
3. Section 26 05 00 - Basic Electrical Materials and Methods
4. Section 26 05 19 - Wire and Cables - 600 Volts and Below
5. Section 26 05 13 - Medium Voltage Cables
6. Section 26 05 53 - Electrical Identification
7. Section 26 05 26 - Grounding
8. Section 26 30 00 - Control Components and Devices
9. Section 26 09 13 - Electrical Monitoring System
10. Section 26 08 00 - Electrical Testing Requirements
11. Section 26 05 73 - Short Circuit and Coordination Study

##### 1.2 REFERENCES

###### A. General: Codes and standards referred to in this Section are:

1. IEEE C37.90 - IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus
2. IEEE C37.46 - American National Standard Specifications for Power Fuses and Fuse Disconnecting Switches

3. ANSI/NEMA ICS6 - Enclosures for Industrial Controls and Systems
4. NEMA ICS 1 - General Standards for Industrial Control Systems
5. NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies
6. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors
7. UL 347 - High Voltage Industrial Control Equipment
8. ANSI/NETA MTS - Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems
9. NFPA 70B - Standard for Electrical Equipment Maintenance

### 1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Provide equipment capable of operating in an ambient temperature range of 0 to 40 degrees C and humidity of up to 90 percent noncondensing.
  1. Provide medium voltage motor controllers of the 5-kV class designed for operation on a 4160-volt, 3-phase, 60-Hertz, 3-wire, grounded neutral power system.
  2. Provide motor controllers with current limiting fuses for control and protection of 4000-volt, 3-phase, 60-Hertz induction motors.
  3. Provide control devices suitable for operation at 120-volts, 60-Hertz, unless specifically noted otherwise.
  4. Arrange the equipment for convenient and ready accessibility from the front for inspection and maintenance of devices, terminals, and wiring.

### 1.4 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Section 26 05 00.
- B. Product Data and Information: Provide manufacturers' catalog data and bill of material for the medium voltage motor control center assemblies. Identify major components and accessories of the system including rating data, type, model, service voltages, number of phases, current ratings and interrupting capacities.

- C. Shop Drawings: Provide shop drawings customized to the project for medium voltage motor controllers that include the following:
1. Outline drawings showing dimensions, arrangement, elevations, identification of components and a nameplate schedule for all units.
  2. Interconnecting wiring diagrams, where required.
  3. Individual schematic and wiring diagrams for each compartment.
  4. One-line diagrams.
  5. Obtain and enter full performance details on all motors and other equipment being served on the shop drawings.
  6. Provide instruction booklets and time-current curves for each circuit breaker supplied.
- D. Maintenance and Testing Plan: Provide detailed list of planned maintenance and testing activities for each motor control center listed in 1.1 A.3:
1. Checklist of all systems and components receiving maintenance service, demonstrating compliance with the requirements of referenced standards.
  2. Where test results consist of numerical measured values, indicate expected range for each test.
- E. Quality Control: Provide the following test reports and certificates as specified in Division 01:
1. Qualifications of Third-Party Testing Firm performing Maintenance Testing
  2. Certified shop test reports for medium voltage motor controllers and related components. Provide a written notice a minimum of 15 days prior to shop tests for inspection and witnessing by the ENGINEER.
  3. Detailed field test reports of all tests indicating specified test performed, discrepancies found, and corrective actions taken.
  4. Furnish manufacturer's certificates for medium voltage motor controllers.
  5. Detailed list of Proposed Corrective Maintenance Work, with itemized costs.
- F. Operation and Maintenance Manuals: Furnish operation and maintenance manuals as specified in Division 1.

## 1.5 QUALITY ASSURANCE

- A. Codes: Manufacture all motor controllers in accordance with NEMA ICS 2 and UL Standard No. 347.
  - 1. Manufacture and install each motor control center in accordance with the NEC and local codes.
- B. Provide a UL Label on each vertical section of each motor control center.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, and handle all products and materials as specified in Division 01.
- B. Shipping and Packing: Provide all structures, equipment and materials rigidly braced and protected against weather, damage, and undue strain during shipment.
- C. Storage and Protection: Store all equipment and materials in a dry, covered, heated and ventilated location. Provide any additional measures in accordance with manufacturer's instructions.

## 1.7 SPARE PARTS

- A. General: Provide the following spare parts:
  - 1. Two complete sets of replacement power fuses for each size and rating
  - 2. Complete set of replacement fuses for all control power transformers
  - 3. Complete set of replacement fuses for low voltage circuits
  - 4. One current transformer of each type and rating
  - 5. Two of each type of control or latching relay
  - 6. Two complete replacements of all LED type indicating lamps used in the installation
  - 7. Two sets of replacement indicating light lenses of each color provided
  - 8. One control station of each type provided
  - 9. Two insulated handle fuse pulling tools
  - 10. One each of each type of printed circuit board
  - 11. One complete spare power cell of each type and size used

12. One keypad of each type used
  13. Three 12-ounce spray cans of the final finish for touch-up
- B. Packaging: Pack spare parts in containers bearing labels clearly identifying the contents. Deliver spare parts in original factory packages. Identify all spare parts with information needed for reordering.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
1. Solid State Reduced Voltage Starters
    - a. Benshaw
    - b. Eaton/Cutler Hammer
    - c. Motortronics
  2. Modifications to Medium Voltage Motor Control Center
    - a. Eaton
  3. Motor Protection Systems
    - a. Eaton/Cutler Hammer MP-3000
    - b. GE Grid Solutions Multilin
    - c. Schweitzer Engineering Laboratories
  4. Microprocessor Based Protective Relays
    - a. Eaton/Cutler Hammer IQ-4000
    - b. Square D/Schneider Electric Power logic
    - c. GE Grid Solutions/ Multilin
    - d. Schweitzer Engineering Laboratories
  5. Power Transducers
    - a. Ametek Power Instruments/Scientific Columbus Type Exceltronic
    - b. Ametek Power Instruments/Rochester Instrument Systems

## 2.2 MODIFICATIONS TO EXISTING MEDIUM VOLTAGE MOTOR CONTROL CENTER

### A. Description:

1. Modify existing spare motor starter unit as required for use as input breaker for mobile generator connections, including new latching contactor, protective relay, and servicing.
2. Modify two existing feeder units as required to accommodate increased capacity requirements.

## 2.3 MAINTENANCE SERVICES

### A. Perform maintenance services at the main motor control centers serving the following locations:

1. North Standpipe, 2536 Gross Point Rd, Evanston
2. South Standpipe, 640 Hartrey Ave, Evanston

### B. Perform all periodic maintenance and testing described in NFPA 70B for the following:

1. Motor Control Center Assembly, according to NFPA 70B, Chapter 12.
2. Fuses, according to NFPA 70B, Chapter 16.
3. Grounding and Bonding, according to NFPA 70B, Chapter 20.
4. Motor Control Equipment, according to NFPA 70B, Chapter 28.
5. Protective Relays, according to NFPA 70B, Chapter 35.

### C. Maintenance testing shall be performed by a third party testing firm, and shall meet the requirements of Section 26 08 00 and ANSI/NETA MTS.

### D. Submit a list of proposed corrective work for approval.

### E. Upon approval, perform corrective work under the allowances described in Section 01 29 00.

## 2.4 MEDIUM VOLTAGE MOTOR CONTROLLERS

### A. Basic Construction: Provide totally enclosed, dead-front, rigid, NEMA 12 self-supporting and freestanding structures, arranged for front mounting as shown.

1. Construct the units from welded structural steel and full finished sheet steel with a minimum thickness of 12 gauge.

2. Form, reinforce and arc-weld together to provide rigid, self-supporting structures giving a complete dead front assembly.
  3. Provide structures with a bottom design that permits tack-welding or bolting to the supporting floor channels. Provide steel floor channels suitable for embedding into the concrete floor for leveling and anchoring of motor control center.
  4. Provide controller enclosures with separate low voltage and high voltage compartments.
  5. Arrange and barrier the compartments to allow personnel entry to the low voltage compartment without being exposed to high voltage.
  6. Rigidly support the primary buses with insulating material of high dielectric and mechanical strength.
  7. Provide silver plated and bolted connections to the primary buses.
  8. Brace the primary buses to mechanically and thermally withstand the full effect of short circuit currents equivalent to the interrupting ratings of the interrupter switches furnished with the switchgear.
  9. Provide a 1/4-inch by 2-inch, bare-copper ground bus extending the full width of the complete assembly.
  10. Provide lugs on the ground bus for terminating copper ground cables.
  11. Provide buses in the end units of the completed assembly, capable of being easily extended in the future.
  12. Provide individual flanged doors on the compartments with latches and hinges capable of holding the door closed during maximum fault conditions.
  13. Provide access to cable compartments via removable steel plates.
  14. Provide cable compartments of sufficient size to terminate medium voltage cables of the type specified under Section 26 05 13.
  15. Provide solderless, high-voltage terminal lugs.
- B. Solid State Reduced Voltage Starter: Provide solid-state, reduced-voltage starters consisting of an isolation switch, current limiting fuses, main contactor, bypass contactor, solid state power assembly and microprocessor control logic providing closed-loop current ramp for smooth and stepless motor acceleration and deceleration.
1. Rating:

- a. Input Power: 4160 volts, 3-phase  $\pm 10$  percent, 60 Hz.
  - b. Overload Rating: 500 percent of starter FLA for 30 seconds and 125% continuous.
  - c. Short Circuit Amps: 50,000 amperes rms symmetrical
  - d. Efficiency: greater than 99 percent with or without bypass
2. Provide door interlocks to keep doors from being opened with power applied.
  3. Design the electrical components for front accessibility only.
  4. Provide main and bypass contactors of the vacuum type, fixed-mounted style rated as required for the load served.
  5. Design the bypass contactor to bypass the SCRs after starting and while the starter is operating at full voltage.
  6. Provide a manually-operated isolation switch that is electrically and mechanically interlocked with the contactor so it can only be operated when the contactor is open.
    - a. Provide a switch with the following ratings:
      - (1) Maximum Voltage: 5.5 kV
      - (2) BIL Rating: 60 kV
      - (3) Continuous Current: 600 amperes
  7. Provide a mechanical interlock to prevent opening the medium voltage door when the isolating switch is in the closed position and to prevent closing of the isolating switch when the medium voltage door of the starter is open.
  8. Provide a digital operator keypad with LCD display located on the front door to allow setting of all programmable parameters and the following control functions:
    - a. Power ON
    - b. Start push button
    - c. Stop push button
    - d. "Local-Remote" control selection
    - e. Line current, voltage and frequency
    - f. Elapsed time meter
    - g. Diagnostics package with fault indication.
  9. Include the capability to test the power and adjust microprocessor control when the isolating switch is in open position.

10. Provide a microprocessor-based control logic required to drive the power semiconductors and provide motor and starter monitoring functions having the following features:
  - a. Adjustable ramp time (0-120 seconds)
  - b. Adjustable initial current (50-400 % of motor FLA)
  - c. Adjustable max current (200-600% of motor FLA)
  - d. Kick start (adjustable 0.1 - 10 seconds)
  - e. Adjustable deceleration profile
  - f. Over/under current fault protection
  - g. Line phase loss detection
  - h. Adjustable line current imbalance detection (10-40%)
  - i. Adjustable over/under line voltage protection (10-30%)
  - j. Up to speed indication
  - k. Line phase sequence sensitivity or insensitivity
  - l. Selectable solid state overload class (10, 20, 30)
  - m. Adjustable motor full load amperes
  - n. Real-time clock
  - o. Selectable passcode protection of set starter parameters
  - p. Over/under line frequency protection
  - q. Instantaneous overcurrent detection
  - r. Shorted SCR detection
  - s. Machine ground fault protection
  - t. Time between starts limiter
  - u. Power factor monitor
  - v. Event recorder with time and date stamp (99 most recent events)
  
11. Provide an addressable communication card capable of transmitting the following data over a two-wire network to the Plant SCADA system as specified in Section 26 09 13:
  - a. Status (ON, OFF, TRIPPED)
  - b. Input and output current in each phase
  - c. Input and output kW
  - d. Cause of trip
  
12. Provide dry contacts rated at 10 amperes at 120 volts ac and that indicate the following functions:
  - a. Running
  - b. Up To Speed
  - c. SCR failure
  - d. Motor Overload Trip
  - e. General fault alarm
  
13. Provide line reactors where required, installed within the starter enclosure.

C. Wiring:

1. Provide internal wiring runs for interconnecting units with stranded switchboard wire having 600-volt rated, flame-resistant, type SIS insulation. Provide No. 14 AWG wire for control interconnections and No. 10 AWG wire for current transformer connections. Provide power connections as required for the service.
2. Provide wire markers at each end of all wires.
3. Where wiring connections are made to equipment mounted on hinged doors, provide connections with extra flexible wires suitably cabled together and cleated.
4. Provide wiring of all control connections to individual terminal blocks at each motor starter and contactor. Locate terminal blocks for front access.
5. Provide sufficient terminals for all devices external to the motor control center.
6. Construct all current-carrying connections to the main buses of copper with suitable capacity and conform to the requirements of the main bus insofar as bracing, insulation, temperature limits and the like are concerned.
7. Connect current transformers in such a way that the transformers may be removed and changed without damaging the connection.
8. Provide flexible cable insulated for 5 kV service for control power transformer leads.
9. Wire the communication cable for the microprocessor-based metering system to a single terminal block located in the incoming line structure.

D. Instrument Transformers:

1. Current Transformers
  - a. Provide dry type current transformers, suitable for indoor service and rated as shown.
  - b. Provide sufficient thermal and mechanical capacity to withstand the maximum momentary current rating of the equipment.
  - c. Provide solderless, clamp-type, shorting terminal blocks for secondary connections.
  - d. Properly identify the polarity of all current transformers with standard marking symbols.

- e. Provide window-type current transformers for ground-sensing where shown.
- f. Provide current transformer with accuracy suitable for the instruments and meters specified using the normal burdens of the various devices, and not less than ANSI Standard requirements.

2. Potential Transformers

- a. Provide a dry type, suitable for indoor service, rated single-phase, 60-hertz, 120 volts.
- b. Provide control power transformers that fit into the motor control center unit.
- c. Rate the control power transformers as required for operation and control of the starters, contactors, and auxiliary loads, including motor heating element.
- d. Provide transformers that can withstand a secondary short circuit for at least one second.
- e. Provide transformers meeting the requirements of the ANSI Standard accuracy classifications.
- f. Provide transformers that can withstand an impulse test voltage of 60 kV.
- g. Provide two primary bushings with full insulation.
- h. Provide current-limiting type, primary fuses.
- i. Provide secondary fuses for the protection of potential transformers.

E. Grounding:

- 1. Ground current and control power transformer secondaries with a copper conductor not smaller than No. 10 and connecting to the ground bus.
- 2. Provide connections to the bus that can be easily disconnected and isolated for proof testing.
- 3. Provide each ground wire as a continuous run without intervening splices or terminal blocks.

4. Ground secondary circuits of metering and relaying transformers at one point only.
  5. Effectively ground meter, relay and instrument transformer cases.
- F. Power Transducers: Provide watt transducers in accordance with the following:
1. Solid-state devices.
  2. Output: 4-20 mA into a 750-ohm load.
  3. Provisions for zero and span adjustment with 0.25 percent accuracy.
  4. Input Power: Operate on external 120-volt ac, single-phase, 60-hertz or derive their power supply from input signals.
- G. Push Buttons, Selector Switches and Indicating Lights: Provide push buttons, selector switches and indicating lights including legend plates having the same type, appearance, shape and catalog number throughout each motor control center meeting the requirements of Section 26 30 00.
- H. Control Components: Provide control components including elapsed time meters, control relays, latching relays, time-delay relays, reset timers, repeat-cycle timers, alternators, phase-failure and undervoltage relays and ground-fault protection relays meeting the requirements of Section 26 30 00.
- I. Wiring Schematic: Provide a schematic wiring diagram of each unit and affix it to the inside of the door of that unit.
- J. Identification:
1. Provide identification of the switchgear and its components as specified in Section 26 05 53.
  2. Install nameplates for devices located on doors so they are readable to a person 5'-8" tall standing 3'-0" in front of the equipment.
  3. Locate nameplates so that they are readily associated with items labeled.
  4. Where nameplates are installed on removable relay or device doors, install a nameplate within the relay or device.
  5. Where nameplates are located on other compartments than those served, add additional engraving to identify units served.

## 2.5 SOURCE QUALITY CONTROL

- A. Tests: Provide the following tests and installation procedures in accordance with Section 26 08 00.
  - 1. Shop Tests and Inspection: Completely assemble medium voltage motor control center equipment in the manufacturer's plant for inspection and witness tests. Test the motor control center in accordance with the IEEE and ANSI standards for this class of equipment. Include shop tests to determine general operating condition and circuit continuity, high potential test and other standard tests for that particular class of equipment.
  - 2. Notify the ENGINEER of the proposed date of testing a minimum of ten working days prior to the test.
  - 3. Device Address: Factory set the address of each device.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install medium voltage motor controllers in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 01.
- B. Conformance: Install medium voltage motor controllers as indicated, in accordance with manufacturer's written instructions and in accordance with recognized industry practices; comply with requirements of NEMA standards, NEC, and applicable ANSI Publications.
- C. Coordination: Coordinate with other work, including cabling and wiring, as necessary.
- D. Torque Requirements: Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals in accordance with UL Std 486A.
- E. Fuses: Provide fuses in each unit as required.
- F. Grounding Connections: Make equipment grounding connections for the motor controllers as indicated. Tighten connections in accordance with UL Standard 486A for permanent and effective grounding.
- G. Adjustments: Make all necessary adjustments to the equipment to provide complete and satisfactory operation.

### 3.2 FIELD QUALITY CONTROL

- A. Inspections: Inspect, adjust and check the installation for physical alignment, cable terminations and ventilation.
- B. Tests: Perform the following field tests:
  - 1. Close and open each isolation switch, starter and disconnect switch to test operation.
  - 2. Energize the motor control center and test for hot spots.
  - 3. When site conditions permit, energize and de-energize each equipment item served by each motor control center, testing the complete control sequence of each item.

### 3.3 OPERATION DEMONSTRATION

- A. Manufacturer's Representative: Provide the services of a factory-trained service engineer, specifically trained on the medium voltage motor control center equipment to assist in installation, start-up, testing, calibration, placing into operation and provide training, as specified in Section 01 79 00.
  - 1. Provide a service engineer when the equipment is placed into operation.
  - 2. Provide a service engineer at the jobsite as often as necessary until all problems are corrected and the equipment installation and operation are satisfactory.
  - 3. Following completion of installation and field testing, provide training for 12 employees of the OWNER in the proper operation, troubleshooting and maintenance of the equipment as outlined below. All training will be at the OWNER'S facilities at a time agreeable to the OWNER:
    - a. Operational Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.
    - b. Maintenance Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.
  - 4. Provide a service engineer at the job site as often as necessary to assist in the programming of the SCADA system for accessing the memory map of each device.

### 3.4 CLEANING AND PAINTING

- A. Shop Painting: Paint medium voltage motor controllers in accordance with Section 09 96 00.

- B. Field Painting: Clean and touch up any scratched or marred surface to match original finish.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 26 18 16

### MEDIUM VOLTAGE FUSES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing medium voltage fuses for medium voltage interrupter switches.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 26 05 00 - Basic Electrical Materials and Methods
  - 2. Section 26 14 00 - Medium Voltage Motor Controllers

##### 1.2 SYSTEM DESCRIPTION

- A. Provide medium voltage fuses for use with medium voltage interrupter switches.

##### 1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1 and Section 26 05 00.
- B. Shop Drawings: Provide catalog data and time-current curves for the medium voltage fuses.

##### 1.4 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 (and as follows:)

#### PART 2 PRODUCTS

##### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Current Limiting
    - a. ABB Power T&D Company Inc.
    - b. General Electric Company
    - c. Eaton's Cooper Power Systems

B. Current Limiting Type Fuse:

1. Provide current limiting fuses having an interrupting capacity of 50,000 rms symmetrical amperes. Use fuses that operate with no expulsion of gases or vapors. Provide fuse with the voltage class corresponding to the intended service.

PART 3 EXECUTION

3.1 INSTALLATION

- A. General: Install all fuses in accordance with manufacturer's recommendations and approved shop drawings and as specified in Division 01.

END OF SECTION

## SECTION 26 22 00

### GENERAL PURPOSE DRY TYPE TRANSFORMERS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for furnishing and installing ventilated, dry-type transformers.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 09 96 00 – High Performance Coatings
  - 2. Section 26 05 00 – Basic Electrical Materials and Methods
  - 3. Section 26 05 26 – Grounding

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ASTM D 635 - Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
  - 2. 78 FR 23335 - Energy Conservation Program: Energy Conservation Standards for Distribution Transformers
  - 3. NEMA ST 20 - Dry Type Transformers for General Applications
  - 4. NFPA 70 - National Electrical Code (NEC)
  - 5. UL 1561 - Standard for Dry-Type General Purpose & Power Transformers

##### 1.3 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01 and Section 26 05 00.
- B. Product Data and Information: Furnish manufacturer's data including:
  - 1. KVA ratings
  - 2. Service voltages
  - 3. Impedance and X/R ratio
  - 4. Number of phases
  - 5. Taps

6. Insulation class
7. Sound level
8. Dimensions
9. Weights
10. Mounting details

C. Quality Control: Furnish the following as specified in Division 01.

1. Test Reports:

- a. Certified production reports for sound-level and temperature in accordance with NEMA ST 20

2. Manufacturer's Installation Instructions

D. Operations and Maintenance Manuals: Furnish 6 copies of manufacturer's operations and maintenance manuals.

#### 1.4 QUALITY ASSURANCE

A. UL Label: Provide UL listing label or mark showing compliance with UL 1561.

B. Provide all transformers rated 15 kVA or larger in accordance with 78 FR 23335.

#### 1.5 DELIVERY, STORAGE AND HANDLING

A. General: Deliver, store and handle all products and materials as specified in Division 01 (and as follows:)

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.

1. Hammond Power Systems
2. ABB
3. Eaton/Cutler-Hammer
4. Square D/Schneider Electric
5. Siemens

#### 2.2 MATERIALS

A. General: Provide dry-type transformers suitable for indoor use.

- B. Insulation: Provide transformers above 15 kVA with 220-degree C temperature insulation class. Provide transformers 15 kVA and below with a minimum of 180-degree C temperature insulation class.
- C. Flame Retardant Materials: Provide transformers with flame retardant materials that will not support combustion as defined in ASTM D 635.

2.3 FABRICATION

- A. Transformer Taps: Provide transformers rated over 15 kVA with at least two 2-1/2 percent full capacity taps above and below nominal in the primary winding. Provide transformers rated 15 kVA and below with two 5 percent taps or with four 2-1/2 percent taps below rated voltage on the primary winding.
- B. Windings: Provide primary and secondary windings fabricated from copper conductors.
- C. Voltage and KVA Ratings: Provide three-phase or single-phase transformers with primary and secondary voltages and kVA ratings as specified.
- D. Connections:
  - 1. Three phase: Primary – 3-wire Delta; Secondary – 4-wire, solidly-grounded wye.
  - 2. Single Phase: Primary – 2-wire; Secondary – 3-wire with mid-point solidly-grounded.
- E. Continuous Operations: Provide transformers suitable for continuous operation at the rated kVA with a normal life expectancy as defined in NEMA ST 20 and the performance obtained without exceeding 115 degrees C average temperature rise by resistance or 145 degrees C hot spot temperature rise in 40-degree C maximum ambient and 30-degree C average ambient. Provide transformers that do not exceed 150-degree C maximum operating temperature.
- F. Electrostatic Shields: Provide electrostatic shields between windings.
- G. Construction: Provide transformers with core mounting frames and enclosures of welded and bolted construction with sufficient mechanical rigidity and strength to withstand shipping, erection and short circuit stresses.
- H. Sound Levels: Provide transformers that do not exceed the following sound levels, when measured in accordance with NEMA ST 20:

Transformer kVA	Average Sound Level in dB
0 – 9	40
10 – 30	45

Transformer kVA	Average Sound Level in dB
31 – 50	48
51 – 150	53

- I. Lifting Lugs and Jacking Plates: Provide lifting lugs and jacking plates as required on the transformer.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. General: Install all transformers and provide guards as specified by the latest NEC and ANSI standards, and in accordance with manufacturer's instructions.
- B. Clearances: Provide clearance around the transformer meeting the manufacturer's recommendation.
- C. Supports: Provide suitable supports for all transformers. Mount transformers on one inch of elastomeric pad sound-absorbent material.
- D. Primary Disconnect: Provide primary disconnect circuit breaker or disconnect switch as shown or required.
- E. Grounding: Connect transformers to grounding system in accordance with Section 26 05 26.

#### 3.2 CLEANING AND PAINTING

- A. Shop Painting: Paint transformers meeting the requirements of Section 09 96 00.
- B. Field Painting: Clean and touch up scratched and marred surfaces to match the original finish.

END OF SECTION

## SECTION 26 23 00

### 480 VOLT SWITCHGEAR

#### PART 1 GENERAL

##### 1.1 SUMMARY

A. Section Includes: Requirements for providing, installing and testing 480-volt front accessible switchgear including the following major components:

1. Stationary structure including bus bars
2. Main and tie power air circuit breakers
3. Distribution power air circuit breakers
4. Control, protection, monitoring and metering equipment

B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:

1. Section 01 79 00 - Training
2. Section 09 96 00 – High Performance Coatings
3. Section 26 05 00 - Basic Electrical Materials and Methods
4. Section 26 05 26 - Grounding
5. Section 26 05 53 - Electrical Identification
6. Section 26 08 00 - Electrical Testing Requirements
7. Section 26 05 73 - Short Circuit and Coordination Study
8. Section 26 05 19 - Wires and Cables - 600 Volts and Below
9. Section 26 05 10 - Utility Coordination and Requirements
10. Section 26 33 00 - Battery Systems
11. Section 26 09 13 - Electrical Monitoring System
12. Section 26 29 53 – Control Components and Devices

##### 1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ANSI C37.51 - Conformance Testing of Metal-Enclosed Low-Voltage AC Power Circuit Breaker Switchgear Assemblies.
2. IEC 61557-12 - Equipment for testing, measuring or monitoring of protective measures - Part 12: Power metering and monitoring devices (PMD)
3. IEEE C37.13 - Low-Voltage AC Power Circuit Breakers Used in Enclosures
4. IEEE C37.20.1 - Metal-Enclosed Low Voltage Power Circuit Breaker

5. IEEE C37.90 - IEEE Standard for Relays and Relay-Systems Associated with Electric Power Apparatus
6. IEEE C62.41 - IEEE Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits
7. IEEE C62.45 - IEEE Guide on Surge Testing for Equipment Connected to Low Voltage AC Power Circuits
8. MIL-STD-220A- Method of Insertion-loss Measurement 12/1/59; with N1 and N2 (Fed/mil H-q)
9. NEMA SG3 - Low-Voltage Power Circuit Breakers.
10. NEMA SG5 - Power Switchgear Assemblies.
11. NFPA 70 - National Electrical Code (NEC).
12. UL 1283 - Electromagnetic Interference Filters
13. UL 1449 - Transient voltage surge suppressors
14. UL 1558 - Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear  
UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors

- B. Material Workmanship Requirements: Provide all materials and workmanship meeting the requirements of NFPA Standards and Codes.
- C. Design and Testing Requirements: Provide all switchgear components designed, manufactured and tested in accordance with the latest NEMA, IEEE and ANSI Standards; and UL listed.
- D. Installation Requirements: Install the switchgear assemblies meeting the requirements of NEC and local Electrical Codes.

### 1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 01.
- B. Product Data and Information: Furnish the following.
  1. Manufacturers catalog data on switchgear assemblies and on each component detailing materials, ratings, type, model and reference number.
  2. Layout drawings customized for the project including physical details, dimensions, clearances, mounting, elevations, sections, and nameplates.

3. Electrical control schematics, wiring diagrams, internal interconnection diagrams and interconnection diagrams, including equipment external to the switchgear.
  4. Terminal lists for all connections.
  5. Provide instruction booklets and time-current curves for each circuit breaker supplied.
  6. Provide microprocessor-based metering system and overload protection systems address, memory map and instruction booklets.
  7. Furnish the following information on transient voltage surge suppressors (TVSS):
    - a. Verification that TVSS devices comply with UL 1449 and UL 1283 SVR.
    - b. Actual let through voltage test data in the form of oscillograph results for both the ANSI/IEEE C62.41 Category C3 (combination wave) and B3 (ringwave) tests in accordance with ANSI/IEEE C62.45.
    - c. Spectrum analysis of each unit based on MIL-STD-220A test procedures between 50 kHz and 200 kHz verifying that the device's noise attenuation exceeds 50 dB at 100 kHz.
    - d. Test reports from a recognized independent testing laboratory verifying the suppressor components can survive published surge current ratings on both a per mode and per phase basis using the IEEE C62.41, 8 x 20 microsecond current wave. Note: Test data on individual modules are not acceptable.
- C. Contractors Drawings: Furnish switchgear installation details including concrete pad details, mounting details, conduit and cable termination details and shipping section split field connection details.

#### 1.4 QUALITY CONTROL

- A. Test Reports: Furnish the manufacturer's certified shop test report and field test report for each 480-volt switchgear.

#### 1.5 OPERATIONS AND MAINTENANCE MANUALS

- A. Provide operation and maintenance manuals, including spare parts lists, as specified in Division 01.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 (and as follows:)
- B. Storage and Protection: Store all equipment in a dry, covered, heated and ventilated location. Provide any additional measures in accordance with manufacturer's instructions.
- C. Provide low voltage breakers with the means of power metering and communications via ethernet.

## 1.7 SPARE PARTS

- A. General: Provide the following spare parts:
  - 1. One transfer truck with fixed and swivel wheels and rubber tires suitable for moving the largest circuit breakers.
  - 2. One portable circuit breaker test kit.
  - 3. Two auxiliary power modules to power breaker trip units when breaker is not in the "connected" position.
  - 4. One complete solid-state sensor unit for each size furnished.
  - 5. Six replacement indicating light color lens for each color furnished.
  - 6. Three current transformers of each type and rating.
  - 7. Two potential transformers of each type and rating.
  - 8. Twelve potential transformer primary fuses.
  - 9. Twelve potential transformer secondary fuses.
  - 10. Two sets of control jumpers.
  - 11. One hand crank per switchgear for circuit breaker withdrawal and insertion.
  - 12. Three 12-ounce spray cans of the final finish for touch-up
- B. Packaging: Pack spare parts in containers bearing labels clearly designating contents and related pieces of equipment. Deliver spare parts in original factory packages. Identify all spare parts with information needed for reordering.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.

1. 480-Volt Front Accessible Switchgear
  - a. Eaton/Cutler-Hammer Magnum DS Low Voltage Metal Enclosed Switchgear with Magnum DS drawout power circuit breakers with Digitrip 1150 RMS solid state tripping units.
  - b. Square D/Schneider Electric (Power-Zone III Series 2 Low Voltage Metal Enclosed Switchgear with DSII drawout power circuit breakers with Powerlogic RMS solid state tripping units.) (Power-Zone 4 Low Voltage Metal Enclosed Switchgear with Masterpact drawout power circuit breakers with Micrologic RMS solid state tripping units.)
  - c. Siemens Type WL with RL drawout power circuit breakers with Static Trip III solid state tripping units and power metering option.
2. Microprocessor based Metering Systems
  - a. Eaton/Cutler-Hammer IQ DP-4000
  - b. General Electric Company Multilin
  - c. Square D/Schneider Electric Powerlogic
3. Transient Voltage Surge Suppression (TVSS):
  - a. Eaton/Cutler-Hammer
  - b. Advanced Protection Technologies Inc.

### 2.2 ELECTRICAL CONDITIONS

A. Stationary Structure: The power supply to the switchgear will be from the substation transformers fed from a medium voltage switchgear. Coordinate the circuit breaker trip units with the incoming feeder protection.

B. Switchgear:

1. Provide switchgear with the following features:
  - a. Individually mounted, drawout power air circuit breakers
  - b. Full insulated and isolated bus
  - c. Insulated run back bus

- d. Circuit breakers rated for 100 percent continuous ampere when installed in the switchgear enclosure
  - e. Interrupting rating of 42,000 rms symmetrical amperes at rated voltage
2. Label the switchgear suitable for use as service entrance equipment where appropriate.
  3. Provide all components required for complete functioning units as specified and as shown using factory built standardized units, completely dead front, totally enclosed and freestanding. Each unit comprises a stationary structure and a drawout circuit breaker.
  4. Design, manufacture and test all equipment in accordance with the NFPA 70, NEMA SG3, and SG5; IEEE C37.13, C37.20.1 and C37.51 and UL 1558 Standards.
  5. Provide the required number of units based on the necessary controls and metering as shown and specified.
- C. Distribution System: Connect the switchgear to 480-volt, 3-phase, 60-hertz, 3 wire, solidly grounded neutral power system.

## 2.3 COMPONENTS

- A. Stationary Structure: Construct the stationary structure of the switchgear as follows:
1. Build each unit out of bolted structural steel members, together with formed or fitted sections of smooth sheet steel approximately 90 inches high.
  2. Form completely enclosed compartments for various combinations of circuit breakers and auxiliary equipment.
  3. Provide sufficient structural strength to support all the equipment mounted within, withstand the handling and shipment of the units, maintaining the proper alignment, and be rigid and freestanding.
  4. Provide a formed front door panel for each compartment consisting of concealed type hinges.
  5. Reinforce panels as required to retain alignment and to support instruments, relays, and control equipment mounted thereon.
  6. Provide removable plates to permit access to all compartments individually.
  7. Isolate circuit breaker, buses, and incoming or outgoing cables with separate compartments formed by sheet steel barriers.

8. Provide a circuit breaker cubicle that allows the front face of the circuit breaker to extend to the front of the switchgear enclosure or be enclosed behind the circuit breaker compartment door.
9. Provide suitable ventilation for the individual compartments to keep the temperature of devices and buses within the permissible temperature limits as specified by the Standards.
10. Include insulated buses, fixed portion of primary disconnect devices, insulated connections, instrument transformers, control devices and fuses in the stationary structure. Provide removable boots to give access to bus joint for inspection and maintenance.
11. Provide a positioning mechanism for moving the removable circuit breaker to or from the connected position.
12. Provide guides for proper alignment of all engaging parts during movement of circuit breakers between the connected or disconnected position.
13. Provide stationary structure and circuit breakers that are interchangeable with every other circuit breaker of the same rating.
14. Extend the control and potential buses across all units of the switchgear.
15. Fully isolate the main bus compartment from the circuit breaker compartment and front access cable terminations.
16. Provide main buses rated not less than shown, consisting of rigidly supported insulated copper bars of suitable design and cross-sectional area to satisfactorily carry the rated current without exceeding the temperature rise as specified in the IEEE and NEMA standards.
17. Connect the bus with bolts having Belleville type lock washers.
18. Silver plate the copper bars at current-carrying connections.
19. Insulate all standard bus joints with preformed insulating boots secured by nylon hardware. Insulate nonstandard joints with tape and insulating compound.
20. Equip each switchgear unit with a 1/4-inch by 2-inch bare copper ground bus with a momentary rating at least equal to the highest momentary rating of the unit's circuit breakers. Extend the ground bus the entire length of the structure and comply with all applicable codes and regulations.
21. Ground each stationary unit directly to the ground bus.

22. Provide suitable lug terminals on the ground bus for connections to the station grounding system.
  23. Construct and arrange the stationary structure so that circuit breakers are completely isolated from each other within the same section and that sections are isolated from adjoining sections and front access cable sections.
  24. Provide steel floor channels suitable for embedding into the concrete floor for leveling and anchoring the switchgear. Drill and tap the floor channels as required. Provide bolts, nuts, and washers for anchoring the switchgear to the channel.
  25. Provide electronic interlocks where noted on the Contract Drawings. Where multiply lineups of like equipment are provided, interlock keys are to be keyed unique to each lineup. Where multiple interlock functions are to be provided in a common lineup, the interlock keys for each function are to be uniquely keyed.
- B. Switchgear Enclosure:
1. Provide front accessible switchgear with separate sections for cable compartments and power circuit breakers suitable for installation indoors with
- C. Drawout Circuit Breakers and Tripping Units:
1. Provide 480 volt, 3-pole, 600-volt class, drawout-type, power air circuit breakers with solid-state trip units rated as shown, having 42,000 rms amperes interrupting rating without current limiting fuses. Provide breakers having a 100 percent ampere rating when installed in the switchgear enclosure. Breakers with interrupting ratings of 85,000 rms amperes and below shall have a 30 cycle short time rating equal to the interrupting rating regardless of whether the breaker is equipped with instantaneous trip protection or not to ensure a fully selective system.
  2. Provide circuit breakers with trip free, manual-operating handles, stored-energy type trip mechanism and push-to-trip button; rated for 40 degrees C ambient operation. Provide main and tie circuit breakers with electronic interlocks as shown.
  3. Equip circuit breakers rated for 1200A or higher with means of arc energy reduction using an energy-reducing maintenance switch indicator. The energy reduction method shall be set to operate at less than available arcing current. Proof of effectiveness will be shown through a visual indication on the breakers showing the arc flash mitigation is engaged.

4. Equip the circuit breaker with mechanical interlocks to prevent moving the circuit breaker to and from the connected position without the circuit breaker open.
5. Provide circuit breakers that cannot be closed at any point between the operating and test positions or when the interlock is engaged.
6. Provide means to padlock the circuit breaker in the disconnect position.
7. Provide (electrically operated distribution, main, and tie circuit breakers).
8. Provide electrically operated circuit breakers suitable for 125 volts dc operation. Provide all auxiliary relays, electrical interlocks and cell position switches to accomplish the operation shown or specified.
9. Provide control connections between the stationary structure and removable circuit breaker that have floating terminals mounted in the stationary structure and engaging mating contacts on the breaker that are engaged when the breaker is in either the connected or test position.
10. Provide all circuit breakers with true rms sensing and microprocessor-based logic circuitry having the following protection features for tripping the circuit breaker.
  - a. Trip Indicators
  - b. Long time setting and time delay
  - c. Short time setting, time delay and  $I^2t$  response.
  - d. Instantaneous setting (distribution circuit breakers only).
  - e. Ground fault setting, time delay and  $I^2t$  response.
  - f. Short time and ground fault zone interlocking.
11. Provide all circuit breakers with digital, networked metering capabilities. Include measurement of the following parameters, at standard precision as defined by IEC 61557-12:T:
  - a. Current (RMS), Amps
  - b. Ground Fault Current (RMS), Amps
  - c. Phase-to-Phase Voltages (RMS), Volts
  - d. Active Power, kW
  - e. Reactive Power, kVAR
  - f. Apparent Power, kVA
  - g. Power Factor
  - h. Energy (kWh)
  - i. Reactive Energy (kVARh)
  - j. Apparent Energy (kVAh)

- D. Switchgear Connections and Terminals:
  - 1. Construct all current-carrying connections of copper having suitable capacity, bracing, insulation, temperature rating as the main bus.
  - 2. Connect current transformers in such a way that the transformers may be removed and changed without damaging the connection.
- E. Instrument Transformers:
  - 1. Current Transformers
    - a. Provide dry type current transformers, suitable for indoor service and rated as shown.
    - b. Provide sufficient thermal and mechanical capacity to withstand the maximum momentary current rating of the circuit breaker.
    - c. Provide solderless, clamp type shorting terminal blocks for secondary connections.
    - d. Properly identify the polarity of all current transformers with standard marking symbols.
    - e. Provide current transformers having an accuracy suitable for the instruments and meters specified using the normal burdens of the various devices, and not less than ANSI Standard requirements.
  - 2. Potential Transformers
    - a. Provide dry type potential transformers, suitable for indoor service, single-phase, 60 hertz, 120 volts.
    - b. Provide potential transformers that fit into and coordinate with the complete switchgear units, and with the instruments, relays, meters, and devices specified.
    - c. Rate the potential transformers not less than 100-volt-amperes at 55 degrees C ambient or 150-volt-amperes at 30 degrees C ambient thermal rating.
    - d. Provide potential transformers that can withstand a secondary short circuit for at least one second.
    - e. Provide the transformers meeting the requirements of the ANSI Standard accuracy classifications.
    - f. Provide current-limiting type primary fuses.

- g. Provide secondary fuses sized for the protection of potential transformers.

3. Grounding

- a. Ground current and potential transformer secondaries with copper conductors not smaller than No. 10 AWG and connecting to the ground bus.
- b. Ground potential transformer neutrals, where shown or required with a 600-volt green insulated copper conductor not smaller than No. 10 AWG.
- c. Provide connections to the bus that can be easily disconnected and isolated for field testing individually.
- d. Install each ground wire as a continuous run without intervening splices or terminal blocks.
- e. Ground secondary circuits of metering and relaying transformers at one point only.
- f. Effectively ground meter, relay and instrument transformer cases.

F. Lightning Arresters and Surge Capacitors:

- 1. Provide lightning arresters and surge capacitors for each incoming service.

G. Control Devices:

- 1. Provide provisions for manual closing of each circuit breaker.

H. Power Transducers:

- 1. Provide voltage, current, watt, var, frequency and power factor transducer as shown or required in accordance with the following:
  - a. Solid state devices.
  - b. Output: 4-20 ma into a 750 ohm load.
  - c. Provisions for zero and span adjustment with 0.25 percent accuracy.
  - d. Operate on external 120 volts ac, single phase, 60-hertz or derive their power supply from input signals.

- e. Calibrate power factor transducer between 50 percent lag and 50 percent lead.
  - f. Use watt and var transducers designed for 3-phase, 3 wire system.
- I. Microprocessor-Based Metering and Protection System: Provide a microprocessor-based metering and protection system having the following features:
- 1. UL recognized component meeting IEEE C37.90.
  - 2. Housed in an enclosure suitable for door mounting.
  - 3. Derive control power from metered line.
  - 4. Auto ranging metering of the following values:
    - a. AC amperes in each phase, 0.5 percent accuracy
    - b. AC voltage, phase-to-phase, phase-to-neutral, 0.5 percent accuracy
    - c. Watts, 1 percent accuracy
    - d. Vars, 1 percent accuracy
    - e. Power factor, 2 percent accuracy
    - f. Frequency, 0.5 percent accuracy
    - g. Watt demand, 1 percent accuracy with programmable 5-, 10-, 15-, 30-minute intervals
    - h. Watt-hours, 1 percent accuracy
    - i. Percent total harmonic distortion through the 31st harmonic
  - 5. Protection system with the following functions:
    - a. Voltage phase loss, less than 50% nominal line voltage
    - b. Current phase loss, less than 1/16 of the largest phase
    - c. Voltage phase unbalance, 5 to 40% in 5% increments
    - d. Phase voltage reversal
    - e. Overvoltage, 105 to 140% in 5% increments

- f. Undervoltage, 95 to 60% in 5% increments
  - g. Time delay for overvoltage, undervoltage, and phase unbalance, zero to twenty seconds in one second intervals.
6. Separate Form C (NO/NC) trip and alarm outputs contacts rated 10 amperes at 115-volt ac or 30-volt dc resistive.
  7. Addressable communications card capable of transmitting all data over a two-wire network to the Plant SCADA system as specified in Section 26 09 13.
- J. Transient Voltage Surge Suppression (TVSS):
1. Provide transient voltage surge suppression (TVSS) equipment that complies with UL 1449 and UL 1283.
  2. Provide units with a maximum continuous operating voltage that exceeds 115 percent of the nominal system operating voltage.
  3. Provide TVSS equipment suitable for wye-configured systems.
  4. Provide TVSS equipment having directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G).
  5. Provide TVSS equipment that distributes the surge current to all MOV components to ensure equal stressing and maximum performance and provides equal impedance paths to each matched MOV.
  6. Provide high-performance EMI/RFI noise rejection filters that attenuate the electric line noise at least 55 dB at 100 kHz using the MIL-STD-220A insertion loss test method.
  7. Wire internal components with connections utilizing low impedance conductors and compression fittings.
  8. Provide a monitoring panel for each system that incorporates the following features:
    - a. Green/red solid state indicator light to indicate which phase(s) have been damaged.
    - b. A flashing trouble light to indicate fault detection
    - c. Transient event counter
    - d. Audible alarm
    - e. Form C dry contacts for remote indication of the unit status.

9. Provide each TVSS for service entrance or branch location application with a minimum total surge current capable of withstanding 250kA or 160kA per phase respectively or as shown.

K. Wiring:

1. Completely assemble, wire and test each switchgear section at the factory, including buses, phase, neutral and ground connections, insulators, cleats, terminals, and terminal blocks.
2. Insulate all current-carrying parts.
3. Route all secondary wiring in the front of secondary compartments in wiring troughs and terminate at approved, molded-type terminal blocks with numbered marking strips, conveniently located with respect to the control conduits.
4. Provide terminal blocks with covers mounted so that the wires can be grouped and laced together.
5. Mark and identify all wiring in accordance with the manufacturer's wiring diagrams.
6. Label control wiring with an identification tag that indicates the terminal number of the opposite end connection.
7. Include wire labels and terminal numbers on schematic control and wiring diagrams.
8. Provide spade connectors for wires No. 12 and smaller and solderless lugs for larger sizes.
9. Provide terminals for all connections and an additional 15 percent spare terminals for all control and instrument wiring.
10. Provide No. 10 AWG stranded copper or larger with NEC Type SIS insulation for all current transformer secondary wiring.
11. Provide No. 14 AWG stranded copper or larger with NEC Type SIS insulation for all other control wiring.
12. Provide a fused switch or circuit breaker for the control power supply in each breaker compartment.

L. Identification:

1. Provide identification of the switchgear and its components as specified in Section 26 05 53.
2. Install nameplates for devices located on doors so they are readable to a person 5'-8" tall standing 3'-0" in front of the equipment.
3. Locate nameplates so that they are readily associated with the items labeled.
4. Where nameplates are installed on removable relays or removable device doors, install a nameplate within the relay or device.
5. Where nameplates are located on other compartments than those served, add additional engraving to identify units served.

2.4 ACCESSORIES

- A. Circuit Breaker Lifting Device: Provide a traveling type circuit breaker lifting device rail mounted on the top of each switchgear assembly. Provide all accessories required for lifting and lowering circuit breakers.
- B. Rubber Work Mats: Provide rubber work mats meeting the requirements of Section 26 29 53.

2.5 COMMUNICATIONS

- A. Provide communications accessories as required to interface all metering and protection devices, including circuit breakers to the plant controls system specified in Division 40, including:
  1. Power Supplies
  2. Gateways
  3. Interconnecting wiring and terminations.
  4. Barriers separating power wiring from communications wiring
- B. Provide a single fiber optic connection from the switchgear to the plant SCADA system.

2.6 OPERATION SEQUENCE

1. Provide (IEEE/ANSI Device 86) LOR that locks out main if tie is closed
2. Provide cell-switches that functionally indicate when a breaker is in either the operating or test position. Incorporate cell switch contacts into the breaker

control circuit to allow testing a breaker in the test position without affecting or tripping any other breaker.

## 2.7 SOURCE QUALITY CONTROL

### A. Tests:

1. Conduct shop tests after the switchgear has been assembled to determine general operating condition and circuit continuity, high voltage withstand and other safety standards.
2. Witness Tests: Carry out inspection and witness test of the completed switchgear assembly to assess its state of workmanship and standard of performance.
3. Notify the ENGINEER of the proposed date of testing a minimum of ten working days prior to the test.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install the switchgears in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.
- B. Conformance: Install the switchgears as shown, in conformance with manufacturers written instruction and recognized industry practices. Comply with requirements of NEMA standards, and applicable ANSI publications.
- C. Coordination: Coordinate with other work including cabling and wiring work as necessary to interface installation of switchgears with other work.
- D. Torque Requirements: Tighten electrical connectors and terminals including screws and bolts, in accordance with equipment manufacturer's published torque tightening values of equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals in accordance with UL Standard 486A.
- E. Fuses: Provide fuses in switchgear assemblies as required.
- F. Circuit Breaker Parameters: Set the circuit breaker protection parameters in accordance with the protective coordination study specified in Section 26 05 73.
- G. Grounding Connections: Make equipment grounding connections for the switchgear as shown. Tighten connections in accordance with UL standard 486A for permanent and effective grounding.

- H. Adjustments: Make all necessary adjustments to the equipment to provide complete and satisfactory operation of the system.
- I. Main and Feeder Cable Connections: Train and support cables to limit movement under fault conditions.
- J. Conduit Terminations: Conduits for power conductors are to be physically terminated in the structure where the associated power cables are intended to be terminated. Cabling between structures is only allowed where required for metering, control and monitoring.

### 3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Representative: Provide a factory-trained experienced, competent, and authorized representative of the switchgear manufacturer to visit the site of the Work and inspect, check, adjust if necessary, approve the equipment installation and provide training as specified in Section 01 79 00. Provide all instruments and equipment necessary to conduct required tests, adjustments and training. Have the manufacturer's representative utilize prepared comprehensive check sheets covering inspections, checks and tests required for the assembly of the switchgear. Submit copies of these documents executed and signed by the manufacturer's representative. Have the representative present when each equipment item is placed in operation. Provide representative service as often as necessary until all problems are corrected and each equipment item is installed and operating satisfactorily.
- B. Certified Report: Furnish a written report certifying that the equipment:
  - 1. Has been properly installed
  - 2. Is in accurate alignment
  - 3. Is free from any undue stress imposed by connections or anchor bolts, and
  - 4. Has been operated under full load conditions and that it operated satisfactorily
- C. SCADA Programming: Provide manufacturers representative at the job site as often as necessary to assist in the programming of the SCADA system for accessing the memory map of each device.
- D. Tests and Inspections: Perform the following tests and inspections. Record all tests and submit a written report for approval. Retest as necessary.
  - 1. Check all breakers, relays, meters, power and control fuses and auxiliaries for proper size, rating, and location. Clean control panels and cubicles. Remove all shipping materials.
  - 2. Inspect equipment and each breaker and report installation or shipping damage, loose materials, shipping blocks or contamination.

3. Torque test bus connections where field joints are made.
  4. Test key interlock systems to demonstrate proper function.
  5. Check that all control and panel circuits are numbered and tagged and panel door legends are engraved and installed as per drawings.
  6. Check equipment to determine that it is level, secured to foundations and that doors operate properly.
  7. Test insulation of all control and relay circuits to ground with a suitable megohmmeter. Take suitable precautions where electronic devices, instruments and instrument transformers are involved.
  8. After installation, but before any external connections are made to the switchgear, subject the switchgear to a 10-minute high potential test applied on the stationary structure and breakers. Use a test voltage of 75 percent of the standard factory production tests.
  9. Test all bus, cable, wire and other equipment operating at the service voltage that is energized by closing the incoming main line breakers. This test may be witnessed by the ENGINEER.
  10. Test protective relays to verify settings and determine proper operation.
- E. Training: Following completion of installation and field testing provide training for 12 employees of the OWNER in the proper operation, troubleshooting and maintenance of the equipment as outlined below. All training will be at the OWNER'S facilities at a time agreeable to the OWNER:
1. Operational Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.
  2. Maintenance Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.

### 3.3 GROUNDING

- A. System Inspections: Inspect ground system for compliance with the latest approved drawings.
- B. Connection Inspections: Inspect all ground connections for evidence of looseness and/or corrosion.

### 3.4 CLEANING AND PAINTING

- A. Shop Painting: Paint the switchgear as specified in Section 09 96 00.

- B. Field Painting: Touch up scratched and marred surfaces to match with original finishes.
- C. Work Mats: Thoroughly clean the floor in front of the switchgear and install the rubber work mats.

### 3.5 IDENTIFICATION

- A. General: Provide identification meeting the requirements of Section 26 05 53.
- B. Component Identification: Identify all system components, cables and wires by labels indicating unit numbers, circuit numbers and date of installation.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 26 24 13

### 480V MOBILE GENERATOR TERMINATION CABINET

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing a low voltage, front accessible, freestanding, termination cabinet for use as an intermediate termination point between the trailer mounted portable generator and the disconnecting means feeding the designated emergency loads as shown on the Contract drawings. The cabinet is to include the following major components:
1. Stationary structure including phase, neutral and ground bus bars
  2. Mechanical line and load cable lugs.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to the Following:
1. Section 26 05 00 - Basic Electrical Materials and Methods
  2. Section 26 05 26 - Grounding
  3. Section 26 05 53 - Electrical Identification
  4. Section 26 08 00 - Electrical Testing Requirements
  5. Section 26 05 73 - Short Circuit and Coordination Study
  6. Section 26 05 19 - Wires and Cables - 600 Volts and Below

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
1. NEC - National Electrical Code
  2. UL 1008 - Transfer Switch Equipment
  3. UL 1773 - Standard for Safety Termination Boxes
  4. NEMA 250 - Enclosure Types
- B. Material Workmanship Requirements: Provide all materials and workmanship meeting the requirements of NFPA Standards and Codes.
- C. Design and Testing Requirements: Provide all cabinet components designed, manufactured and tested in accordance with the latest applicable standards and UL listed.
- D. Installation Requirements: Install the cabinet assemblies meeting the requirements of NEC and local Electrical Codes.

### 1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 01.
- B. Product Data and Information: Furnish the following:
  - 1. Manufacturers' catalog data on cabinet assemblies and on each component detailing materials, ratings, type, model and reference number.
  - 2. Layout drawings customized for the project including physical details, dimensions, clearances, mounting, elevations, sections, and nameplates.
  - 3. Assembly ratings including short circuit rating, voltage, continuous current rating and cable termination sizes.
- C. CONTRACTOR's Drawings: Provide cabinet installation details including concrete pad details, mounting details and conduit and cable termination details.

### 1.4 QUALITY CONTROL

- A. Regulatory Requirements: Provide UL listed components and assemblies.
- B. Test Reports: Provide the manufacturer's certified factory test reports for each cabinet.

### 1.5 OPERATIONS AND MAINTENANCE MANUALS

- A. General: Provide operation and maintenance manuals, including spare parts lists, as specified in Division 01.

### 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 and as follows:
- B. Storage and Protection: Store all equipment in a dry, covered, heated and ventilated location. Provide any additional measures in accordance with manufacturer's instructions.

### 1.7 SPARE PARTS

- A. General: Provide the following spare parts:
  - 1. Two 12-ounce spray cans per cabinet of the final finish for touch-up.

- B. Packaging: Pack spare parts in containers bearing labels clearly designating contents and related pieces of equipment. Deliver spare parts in original factory packages. Identify all spare parts with information needed for reordering.

## 1.8 EQUIPMENT WARRANTY

- A. Warrant the equipment to be free from defects in materials and workmanship for a period of twelve (12) months after the Date of Substantial Completion. The warranty shall cover all repairs for all systems furnished by the manufacturer. The Manufacturer will repair or replace, at its option, any such equipment found to be defective, provided written notice of the alleged defect is received within twelve (12) months after the Date of Substantial Completion.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Berthold Electric
  - 2. ESL
  - 3. Eaton/Cutler-Hammer
  - 4. Square D/ASCO Power Technologies/Schneider Electric

### 2.2 RATINGS

- A. Provide an assembly rated to withstand mechanical forces exerted during short-circuit conditions when connected to a power source with an available fault current not exceeding 35,000 symmetrical amperes at rated voltage.
- B. Rated Voltage: Provide the system operating voltage not to exceed 600V.
- C. Ampere Rating: 1600A

### 2.3 CONSTRUCTION

- A. Construct the cabinet as follows:
  - 1. Freestanding, pad mounted or wall mounted design.
  - 2. Top and bottom accessible for cabling. front accessible for maintenance.
  - 3. Provide sufficient structural strength to support all the equipment mounted within, withstand the handling and shipment of the assembly, maintaining the proper alignment, and be rigid and freestanding.

4. Provide all terminations accessible from the front of the enclosure.
5. Provide the assembly with adequate lifting means.
6. Provide with a padlockable front hinged door.
7. Provide interlocking to breaker in the corresponding switchgear to prevent the cabinet from being open when the generator is active.
8. Provide an enclosure that is indoor NEMA 12 rated.

B. Bus Terminations:

1. Provide cable terminations consisting of copper horizontal landing bars with the phases arranged in a staggered vertical plane to accommodate wire terminations. Size bars based on a 65 degrees C temperature rise over a 40 degrees C ambient.
2. Provide a full capacity copper neutral bus.
3. Provide a copper ground bus.

C. Cable Terminations:

1. Provide generator (line side) terminations based upon the bus ampacity and wiring as shown, scheduled, or otherwise noted on the Contract drawings.
2. Provide standard 400A, single-pole cam-style receptacles, with phases color-coded as defined in Section 26 05 53 - Electrical Identification.
3. Provide 4 connections per phase for 1600 A ampacity.
4. Provide Eaton Cam-Lok series E1016 or equal.

D. Finish:

1. Provide all exterior and interior surfaces with a rust inhibiting, phosphatized finish of polyester powder coat paint.
2. Stainless steel cabinets: #4 brushed finish.

E. Identification:

1. Provide identification of the cabinet and its components as specified in Section 26 05 53.

## 2.4 SOURCE QUALITY CONTROL

- A. Conduct standard production shop tests.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install the assembly in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 01.
- B. Compliance: Install the assembly as shown, in accordance with manufacturer's written instruction and recognized industry practices. Comply with referenced standards and codes.
- C. Coordination: Coordinate with other work including cabling and wiring work.
- D. Torque Requirements: Tighten electrical connectors and terminals including screws and bolts, in accordance with equipment manufacturer's published torque tightening values of equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals in accordance with UL Standard 486A.
- E. Ground Connections: Make equipment grounding connections for the assembly as required. Tighten connections in accordance with UL standard 486A for permanent and effective grounding.

### 3.2 FIELD QUALITY CONTROL

- A. Provide certified factory test reports of all standard production tests.
- B. Test and Inspect as follows:
  - 1. Inspect for shipping damage, loose materials, shipping blocks or contamination.
  - 2. Check the assembly to determine that it is level, secured to foundations and that door operate properly.
  - 3. Correct all deficiencies.

### 3.3 GROUNDING

- A. System: Inspect ground system for compliance with the latest approved drawings.
- B. Connections: Inspect all ground connections for evidence of looseness and/or corrosion.

3.4 CLEANING AND PAINTING

- A. Field Painting: Touch up scratched and marred surfaces to match with original finishes.

3.5 IDENTIFICATION

- A. General: Provide identification meeting the requirements of Section 26 05 53.
- B. Component Identification: Clearly identify all phase, neutral and ground bussing for termination of portable generator cables.

END OF SECTION

## SECTION 26 24 14

### 4,160V MOBILE GENERATOR TERMINATION CABINET

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing a medium voltage, front and rear accessible, freestanding, termination cabinet for use as an intermediate termination point between the trailer mounted temporary generator and the disconnecting means feeding the designated emergency loads as shown on the Contract drawings. The cabinet is to include the following major components:

1. Stationary structure
2. Copper phase, neutral, and ground bus bars for elbow connections
3. Alternative bus bar for hard wire connections
4. Rear phase barriers
5. Air-insulated bushing wells
6. Interlocking capabilities
7. Surge protection, phase rotation monitoring, CTs, PTs, and power quality metering

- B. Related Work Specified in Other Sections Includes, But is Not Limited to the Following:

1. Section 09 96 00 - High Performance Coatings
2. Section 26 05 00 - Basic Electrical Materials and Methods
3. Section 26 05 26 - Grounding
4. Section 26 05 53 - Electrical Identification
5. Section 26 08 00 - Electrical Testing Requirements
6. Section 26 05 73 - Short Circuit and Coordination Study
7. Section 26 05 13 - Medium Voltage Cables

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:

1. NEC - National Electrical Code
2. ANSI C12.20 - ANSI Standard for Electricity Meters
3. ANSI/IEEE 386- Standard for Insulated Connectors

- B. Material Workmanship Requirements: Provide all materials and workmanship meeting the requirements of NFPA Standards and Codes.

- C. Design and Testing Requirements: Provide all cabinet components designed, manufactured and tested in accordance with the latest applicable standards and UL listed.
- D. Installation Requirements: Install the cabinet assemblies meeting the requirements of NEC and local Electrical Codes.

### 1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 01.
- B. Product Data and Information: Furnish the following:
  - 1. Manufacturers' catalog data on cabinet assemblies and on each component detailing materials, ratings, type, model, and reference number.
  - 2. Layout drawings customized for the project including physical details, dimensions, clearances, mounting, elevations, sections, and nameplates.
  - 3. Assembly ratings including short circuit rating, voltage, continuous current rating and cable termination sizes.
  - 4. Schematic Diagrams showing interlock wiring.
- C. CONTRACTOR's Drawings: Provide cabinet installation details including concrete pad details, mounting details and conduit and cable termination details.

### 1.4 QUALITY CONTROL

- A. Test Reports: Provide the manufacturer's certified factory test reports for each cabinet.

### 1.5 OPERATIONS AND MAINTENANCE MANUALS

- A. General: Provide operation and maintenance manuals, including spare parts lists, as specified in Division 01.

### 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 and as follows:
- B. Storage and Protection: Store all equipment in a dry, covered, heated and ventilated location. Provide any additional measures in accordance with manufacturer's instructions.

## 1.7 SPARE PARTS

- A. General: Provide the following spare parts:
  - 1. Two 12-ounce spray cans per cabinet of the final finish for touch-up.
  - 2. Two bushing wells of each type.
- B. Packaging: Pack spare parts in containers bearing labels clearly designating contents and related pieces of equipment. Deliver spare parts in original factory packages. Identify all spare parts with information needed for reordering.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: The basis of design for this specification is the 4.16kV 600A GLQC MF-2 Series Switchgear by Advanced Power Technologies (APT). Other manufacturers of equivalent products may be submitted for review.

### 2.2 RATINGS

- A. Provide an assembly rated to withstand mechanical forces exerted during short-circuit conditions when connected to a power source with an available fault current not exceeding 35,000 symmetrical amperes at rated voltage.
- B. BIL: 60 kV
- C. Rated Voltage: Provide the system operating voltage not to exceed 5kV
- D. Ampere Rating: 600A

### 2.3 CONSTRUCTION

- A. Construct the cabinet as follows:
  - 1. Build out of bolted structural steel members, together with formed or fitted sections of smooth sheet steel.
  - 2. Provide sufficient structural strength to support all the equipment mounted within, withstand the handling and shipment of the assembly, maintaining the proper alignment, and be rigid and freestanding.
  - 3. Provide all terminations accessible from the front of the enclosure.
  - 4. Provide rear access for accessory equipment.

5. Provide top entry/exit.
6. Provide the assembly with adequate lifting means.
7. Provide filtered ventilation louver.
8. Provide with a pad-lockable front hinged main access door.
9. Provide with a pad-lockable integral lower flip door to allow the main access door to be closed with the mobile generator cables connected.
10. Provide an assembly that is outdoor NEMA 3R rated.
11. Polished Stainless Steel finish.
12. Typical Dimensions of Structure:
  - a. 80”H x 36”W x 64”D

B. Bus Terminations:

1. Provide cable terminations consisting of copper horizontal landing bars with the phases arranged in a staggered vertical plane to accommodate wire terminations. Size bars based on a 65 degrees C temperature rise over a 40 degrees C ambient.
2. Provide a full capacity copper neutral bus.
3. Provide a copper ground bus.

C. Cable Terminations:

1. Isolated customer low voltage control power wiring panel.
2. Rear phase barriers physically isolate each phase to minimize the possibility of phase-to-phase contact.
3. Standard air-insulated bushing wells allow the versatility to connect either a portable temporary generator or load bank to the same receptacle.
  - a. ANSI/IEEE Std. 386 connectors compatible
  - b. 200A Air insulated load break bushing wells, inserts, and caps, three (3) connections per phase
4. Hanger for insulated caps when cables are connected to the bushings.

5. Insulated caps installed on bushing inserts when cables are not connected using elbows.
  6. Grounding wires for insulating caps.
- D. Interlocking, Monitoring, and Metering:
1. Interlocking:
    - a. NEC 700.3 compliant key interlocking with the Medium Voltage Switchgear Main and Tie Circuit Breakers to prevent inadvertent paralleling of the temporary generator source with normal source(s).
- E. Finish:
1. Provide all exterior and interior surfaces with a rust inhibiting, phosphatized finish of polyester powder coat paint in accordance with the requirements of Section 09 96 00 – High Performance Coatings.
- F. Identification:
1. Provide identification of the cabinet and its components as specified in Section 26 05 53.

## 2.4 SOURCE QUALITY CONTROL

- A. Conduct standard production shop tests.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install the assembly in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 01.
- B. Compliance: Install the assembly as shown, in accordance with manufacturer's written instruction and recognized industry practices. Comply with referenced standards and codes.
- C. Coordination: Coordinate with other work including cabling and wiring work.
- D. Torque Requirements: Tighten electrical connectors and terminals including screws and bolts, in accordance with equipment manufacturer's published torque tightening values of equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals in accordance with UL Standard 486A.

- E. Ground Connections: Make equipment grounding connections for the assembly as required. Tighten connections in accordance with UL standard 486A for permanent and effective grounding.

### 3.2 FIELD QUALITY CONTROL

- A. Provide certified factory test reports of all standard production tests.
- B. Test and Inspect as follows:
  - 1. Inspect for shipping damage, loose materials, shipping blocks or contamination.
  - 2. Check the assembly to determine that it is level, secured to foundations and that door operate properly.
  - 3. Correct all deficiencies.

### 3.3 GROUNDING

- A. System: Inspect ground system for compliance with the latest approved drawings.
- B. Connections: Inspect all ground connections for evidence of looseness and/or corrosion.

### 3.4 CLEANING AND PAINTING

- A. Field Painting: Touch up scratched and marred surfaces to match with original finishes.

### 3.5 IDENTIFICATION

- A. General: Provide identification meeting the requirements of Section 26 05 53.
- B. Component Identification: Clearly identify all phase, neutral and ground bussing for termination of portable generator cables.

END OF SECTION

## SECTION 26 24 16

### PANELBOARDS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing lighting and distribution panelboards including circuit breakers and cabinets.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 09 96 00 – High Performance Coatings
  - 2. Section 26 05 00 - Basic Electrical Materials and Methods
  - 3. Section 26 05 53 - Electrical Identification
  - 4. Section 26 05 26 – Grounding
  - 5. Section 26 29 53 – Control Components and Devices

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. NEMA PB 1 - Panelboards
  - 2. UL 67 - Panelboards
  - 3. Fed. Spec. W-P-115 - Power Distribution Panel
  - 4. UL 486A - Wire Connectors and Soldering Lugs for Use With Copper Conductors
  - 5. NFPA 70 - National Electrical Code (NEC)
  - 6. IEC 61557-12 - Equipment for testing, measuring or monitoring of protective measures - Part 12: Power metering and monitoring devices (PMD)

##### 1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 01 and Section 26 05 00.

- B. Product Data and Information: Provide the manufacturer's catalog data for panelboards, circuit breakers and accessories.
- C. Operations and Maintenance Manuals: Furnish operation and maintenance manuals for the panelboards as specified in Division 01.

#### 1.4 QUALITY ASSURANCE

- A. Codes: Provide all materials and workmanship meeting the requirements of the NFPA, the National Electrical Code and local codes.
  - 1. Design, fabricate and test the panelboards in accordance with applicable ANSI, IEEE and NEMA standards.
  - 2. Provide panelboards suitable for operation at their standard nameplate ratings in accordance with ANSI standards.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Panelboards
    - a. ABB Electrification
    - b. Square D/Schneider Electric
    - c. Eaton/Cutler-Hammer
    - d. Siemens

#### 2.2 MATERIALS

- A. General: Provide factory-assembled fully rated dead-front type, panelboards, suitable for surface or flush mounting with branch circuit breakers and a main circuit breaker or main lugs as indicated.
  - 1. Provide panelboards with a full capacity separate ground bus and connected to a three-phase four-wire or a single-phase three-wire service with insulated neutral buses as indicated.

2. Provide panelboards with the voltage, frequency and current ratings as indicated conforming to NEMA Standard PB 1, Fed. Spec. W-P-115, UL 67 and the NEC.
  3. Provide panelboards with copper main, neutral and ground buses.
  4. Where required, label panelboards suitable for use as service entrance equipment
- B. Bracing: Provide main bus bracing exceeding the lowest interrupting rating of any circuit breaker installed.
- C. Fabrication: Fabricate panelboards using galvanized steel, continuously welded. Provide cabinet fronts with doors over the circuit breakers. Provide doors fastened with concealed hinges and equipped with flush type catches.
1. Provide panelboards at least 20 inches wide, 5-3/4 inches deep, with wiring gutters on both sides.
  2. Provide all panelboard trims exceeding five square feet in area with an inside permanently secured angle to support the trim during fastening.

## 2.3 COMPONENTS

- A. Circuit Breakers: Provide bolt-on type branch, and draw out, indicated in contract drawings
1. Furnish the frame sizes, trip settings and number of poles as indicated. Clearly identify the ampere trip rating on the circuit breakers.
    - a. For lighting panelboards, provide 20-ampere, single-pole, 120 or 277 volt circuit breakers unless otherwise shown or scheduled.
    - b. For distribution panelboards, provide 20-ampere, three-pole, 600-volt circuit breaker, unless otherwise shown or scheduled.
  2. Provide all breakers with quick-make, quick-break, toggle mechanisms with automatic thermal-magnetic, inverse time-limit overload and instantaneous short circuit protection on all poles, unless otherwise indicated. Indicate automatic tripping by the breaker handle assuming a clearly distinctive position from the manual ON and OFF position. Design the breaker handle to be trip-free on overloads.
  3. Interrupting Rating: 10,000 rms symmetrical amperes for circuit breakers on 240 volt systems or less, and at least 42,000 rms symmetrical amperes for circuit breakers on 277 or 480 volt systems.
  4. Provide multipole breakers that utilize a common tripping bar.

5. Provide ground fault interrupter circuit breakers for all circuits serving receptacles located below grade and outdoors and as scheduled.
  6. For 480V system provide breakers with digital, networked metering capabilities for all branch circuits and spares where the future use is defined. Include measurement of the following parameters, at standard precision as defined by IEC 61557-12:T:
    - a. Current (RMS), Amps
    - b. Ground Fault Current (RMS), Amps
    - c. Phase-to-Phase Voltages (RMS), Volts
    - d. Active Power, kW
    - e. Reactive Power, kVAR
    - f. Apparent Power, kVA
    - g. Power Factor
    - h. Energy (kWh)
    - i. Reactive Energy (kVARh)
    - j. Apparent Energy (kVAh)
  7. Provide full module size single-pole breakers. Do not install two-pole breakers in a single-pole module.
  8. Provide all 20 ampere, one pole circuit breakers with a lug wire range suitable for the termination of #14AWG through #8AWG. For circuit breakers with higher current ratings, provide lugs adequate for the wire sizes indicated on the Contract drawings.
  9. Provide circuit breakers 100 amperes and smaller with a 60/75 degree C cable temperature rating.
- B. Surge Protection Devices (SPD): Provide each panelboard with a surge protection device meeting the requirements of Section 26 29 53.

## 2.4 ACCESSORIES

- A. Directories: Provide directories in accordance with Section 26 05 53.
- B. Circuit Breaker Handle Lock: Where shown provide circuit breakers with handle clamp that holds the circuit breaker handle in the ON position.
- C. Keying: Key all panelboards alike.

## 2.5 COMMUNICATIONS

- A. Where circuit breakers in distribution panelboards include networked metering capabilities, provide communications accessories as required to interface to the plant controls system specified in Division 40, including:

1. Power Supplies
  2. Gateways
  3. Interconnecting wiring and terminations.
  4. Barriers separating power wiring from communications wiring
- B. Provide a single Modbus/TCP connection from each distribution panelboard to the plant SCADA system.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. General: Install all panelboards in accordance with manufacturer's recommendations and approved shop drawings and as specified in Division 1 and in compliance with the requirements of NEMA standards, NEC, and applicable ANSI Publications.
- B. Mounting Height: Mount all panelboards either surface or flush mounted as shown such that the height of the top operating handle does not exceed 6 feet 6 inches from the floor.
- C. Coordination: Coordinate with other Work including cabling and wiring work to interface the installation of the panelboards.
- D. Torque Requirements: Tighten electrical connectors and terminals, including screws and bolts, in accordance with the equipment manufacturer's published torque tightening values for the equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals in accordance with UL 486A.
- E. Circuit Breaker Handle Lock: Install circuit breaker handle clamp on each circuit breaker as shown.
- F. Directory: Provide a laminated typewritten directory with the following information:
1. Circuit number
  2. Area served
  3. Utilizing equipment

#### 3.2 CLEANING AND PAINTING

- A. Shop Painting: Paint the panelboards as specified in Section 09 96 00.

- B. Field Painting: Touch up scratched and marred surfaces to match the original finish.

END OF SECTION

## SECTION 26 24 19

### MOTOR CONTROL CENTERS

#### PART 1 GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Requirements for providing new feeder units in existing motor control center P 116 in the Water Plant.
2. Requirement for performing maintenance activities on existing motor control centers at the standpipe facilities:
  - a. North Standpipe
  - b. South Standpipe

###### B. Related Work Specified in Other Sections includes, but is not limited to, the following:

1. Section 09 96 00 – High Performance Coatings
2. Section 26 05 00 – Basic Electrical Materials and Methods
3. Section 26 05 19 – Wires and Cables - 600 Volts and Below
4. Section 26 05 26 – Grounding
5. Section 26 05 53 – Electrical Identification
6. Section 26 08 00 – Electrical Testing Requirements
7. Section 26 29 53 – Control Components and Devices

##### 1.2 REFERENCES

###### A. Codes and standards referred to in this Section are:

1. ANSI/NETA MTS - Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems
2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
3. NFPA 70B - Standard for Electrical Equipment Maintenance
4. UL 486A - Wire Connectors and Soldering Lugs for Use With Copper Conductors
5. UL 845 - Motor Control Centers

### 1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Provide equipment capable of operating in an ambient temperature range of 0 to 40 degrees C and humidity of up to 90 percent noncondensing.
  - 1. Provide motor control center components designed for 480-volt, three-phase, three-wire, 60-hertz operation.
  - 2. Provide all control devices in the center suitable for operation at 120-volts, 60-hertz, unless specifically noted otherwise.
  - 3. Provide all control equipment and devices that meet the requirements of the 600-volt insulation class.

### 1.4 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1 and Section 26 05 00.
- B. Product Data and Information: Provide catalog data for all associated equipment and devices.
- C. Shop Drawings: Provide shop drawings customized to the project for motor control centers to include the following:
  - 1. Bill of materials including manufacturers' name and catalog number.
  - 2. Interconnecting wiring diagrams, where required.
  - 3. Individual schematic and wiring diagrams for each compartment.
  - 4. Furnish instruction booklets and time-current curves for each circuit breaker supplied.
- D. Maintenance and Testing Plan: Provide detailed list of planned maintenance and testing activities for each motor control center listed in 1.1 A.2:
  - 1. Checklist of all systems and components receiving maintenance service, demonstrating compliance with the requirements of referenced standards.
  - 2. Where test results consist of numerical measured values, indicate expected range for each test.
- E. Quality Control: Furnish the following test reports and certificates as specified in Division 01:
  - 1. Qualifications of Third-Party Testing Firm performing Maintenance Testing

2. Certified Shop Test Reports for motor control centers and related components. Provide a minimum of 15 days written notice prior to shop tests.
  3. Detailed field test reports of all tests indicating test performed as specified, discrepancies found, and corrective action taken.
  4. Detailed list of Proposed Corrective Maintenance Work, with itemized costs.
- F. Operation and Maintenance Manuals: Furnish operation and maintenance manuals as specified in Division 01.

#### 1.5 QUALITY ASSURANCE

- A. Standards: Provide motor control center components in accordance with NEMA ICS 2, ICS 3, and UL Standard No. 845.
- B. Codes: Provide motor control center components in accordance with the NEC and local codes.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, and handle all products and materials as specified in Division 01.
- B. Shipping and Packing: Provide all equipment and materials rigidly braced and protected against weather, damage, and undue strain during shipment.
- C. Storage and Protection: Store all equipment and materials in a dry, covered, heated and ventilated location. Provide any additional measures in accordance with manufacturer's instructions.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Provide components, accessories and replacement parts of the same manufacturer as the existing motor control centers.
  1. Motor Control Centers:
    - a. MCC P 116: Westinghouse Series 3200 (Eaton)
    - b. North Standpipe: Square D (Schneider)
    - c. South Standpipe: Cutler Hammer (Eaton)

#### 2.2 MOTOR CONTROL CENTER

- A. Individual Units: Provide motor control or circuit breaker units in combinations of not less than 12-inch modular heights.

1. Provide units of the plug-in or nonremovable type in accordance with the manufacturer's standard for type and size of controller.
  2. Provide plug-in units within-plated, pressure-type line disconnecting stabs of high strength copper alloy. Hold each plug-in unit in place and arrange the units such that they can be removed or remounted readily without access to the rear of the structure.
  3. Provide units that are totally enclosed and effectively baffled to isolate ionized gases that may occur within each unit. In addition, ventilate each unit so that it can be located anywhere within the structure using the same overload heaters for the same load.
  4. Provide automatic shutter mechanism to cover the vertical bus stub area when a unit is removed.
  5. Construct doors to be drip-proof and dust-tight. Provide all doors with hinges and screw fasteners for holding the doors closed. Fabricate each door as a part of the structure and not part of the unit.
  6. Equip the doors for branch feeder equipment with a circuit breaker operating mechanism.
  7. Provide mechanical interlocks between the compartment door and circuit breaker operating mechanism to prevent opening of the door unless the breaker is in the OFF position, and to prevent closing the breaker unless the door is fully closed.
  8. Provide circuit breaker operating mechanisms or handles that are padlockable in the OFF position with room for a minimum of three padlocks.
  9. Provide units having devices that are serviceable from the front, without provisions for rear access.
- B. Feeder Circuit Breakers: Provide molded-case type, two- or three-pole feeder circuit breakers as shown, with a minimum voltage rating of 600-volt ac.
1. Interrupting Ratings: Provide an interrupting capacity of 65,000 rms symmetrical amperes at 480 volts. Base interrupting rating on the IEEE and NEMA Standard duty cycle for this class of equipment.
  2. Provide circuit breakers trip units as follows:
    - a. Provide individual, thermal-magnetic trip units for all frame sizes smaller than 400 amperes.
    - b. Provide solid-state trip units for all frame sizes 400 amperes and larger.

- c. Provide trip units that actuate a common tripping bar to open all poles when an overload or short circuit occurs on any one.
  - d. Provide trip elements with inverse time tripping and instantaneous tripping at about ten times the normal trip device rating.
  - e. Provide circuit breakers with trip-free handles.
- C. Feeder Cable Terminals: Provide closed-end, compression-type, solderless connectors and terminals, suitable for copper conductors for terminating cables in accordance with Section 26 05 19.
  - D. Identification: Provide nameplates having the same type, appearance and shape throughout each motor control center in accordance with the requirements of Section 26 05 53.

### PART 3 EXECUTION

#### 3.1 MAINTENANCE SERVICES

- A. Perform maintenance services at the main motor control centers serving the following locations:
  - 1. North Standpipe, 2536 Gross Point Rd, Evanston
  - 2. South Standpipe, 640 Hartrey Ave, Evanston
- B. Perform all periodic maintenance and testing described in NFPA 70B for the following:
  - 1. Molded-Case Circuit Breakers within each MCC, according to NFPA 70B, Chapter 15.
  - 2. Feeder and branch circuit cables originating at each MCC, according to NFPA 70B, Chapter 18.
  - 3. Motor Control Equipment, according to NFPA 70B, Chapter 28.
- C. Maintenance testing shall be performed by a third party testing firm, and shall meet the requirements of Section 26 08 00 and ANSI/NETA MTS
- D. Submit a list of proposed corrective work for approval.
- E. Upon approval, perform corrective work under the allowances described in Section 01 29 00.

#### 3.2 INSTALLATION

- A. General: Install all equipment in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 01.

- B. Adjustments: Set all motor circuit protectors and circuit breakers for the approved short circuit and coordination study.
- C. Cable Connections: Terminate and label all field wiring per the approved diagrams.
- D. Torque Requirements: Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturers' published torque tightening recommendations. Where manufacturers' torquing requirements are not available, tighten connectors and terminals in accordance with UL Standard 486 A.

### 3.3 FIELD QUALITY CONTROL

- A. Inspections: Inspect, adjust and check the installation for physical alignment, cable terminations and ventilation.
- B. Tests: Perform the following field tests:
  - 1. Close and open each circuit breaker and motor circuit protector to test operation.
  - 2. Energize the motor control center and test for hot spots.
- C. Operation and Maintenance: Furnish operation and maintenance instructions as specified in Division 1.

### 3.4 CLEANING AND PAINTING

- A. Field Painting: Clean and touch up any scratched or marred surface to match original finish.

END OF SECTION

## SECTION 26 27 26

### WIRING DEVICES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing wiring devices and appurtenances as indicated, in accordance with the Contract Documents.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 26 05 00 - Basic Electrical Materials and Methods
  - 2. Section 26 05 33 - Electrical Raceway System
  - 3. Section 26 05 26 - Grounding

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. Fed Spec WC 596 - Electrical Power Connector, Plug, Receptacle and Cable Outlet
  - 2. Fed Spec WS 896 - Toggle and Lock, Flush Mounted Switches
  - 3. CSA C22.2-182.1 - Industrial-type, Special-Use Attachment Plugs, Receptacles and Connectors
  - 4. UL 20 - General - Use Snap Switches
  - 5. UL 498 - Attachment Plugs and Receptacles
  - 6. UL 508 - Industrial Control Equipment
  - 7. UL943 - Ground Fault Circuit Interrupters
  - 8. UL 1010 - Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations
  - 9. UL 1682 - Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type

### 1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 01 and Section 26 05 00.
- B. Product Data and Information: Provide manufacturers' catalog data for each device type, plate and cover type.

### 1.4 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Standard of Quality and General Configuration: Use of manufacturer's name and model or catalog number is for the purpose of establishing the desired.
- B. Configuration And Rating: Provide NEMA specification grade wiring devices in the type, color, configuration and electrical rating for the service indicated.
- C. Symbols: See the electrical symbol list shown for identification of all device types.
- D. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Hubbell Wiring Device-Kellems
  - 2. Hubbell/Bryant
  - 3. Pass & Seymour/Legrand
  - 4. Cooper Wiring Devices by Eaton
  - 5. Leviton
  - 6. Emerson Industrial Automation/Appleton
  - 7. Crouse-Hinds by Eaton
  - 8. Meltric Corporation
  - 9. Lutron
  - 10. NSI Industries/Tork

- 11. Hubbell/Tay Mac
- 12. Thomas & Betts/ABB Group

2.2 LIGHTING TOGGLE SWITCHES

A. General: Provide toggle switches of specification grade rated 20- amperes, 120-277 volts ac conforming to Fed. Spec. WS 896 and UL Standard 20. Manufacture switches with back and side wired binding screw type terminals, one piece spring contact arm and terminal plate with silver alloy contacts, one piece steel mounting strap with an assured grounding clip, thermoset body color coded for identification by amperage and a brown toggle. Provide ivory toggles in finished areas.

B. Types:

DESCRIPTION	HUBBELL CAT. NO.
Single pole, brn/ivory	HBL1221/HBL1221I
Two pole, brn/ivory	HBL1222/HBL1222I
Three way, brn/ivory	HBL1223/HBL1223I
Four way, brn/ivory	HBL1224/HBL1224I
SPDT center off momentary contact	HBL1557
Keyed single pole	HBL1221L
Keyed three way	HBL1223L

C. Accessories: Provide a flush neon "ON" pilot light in conjunction with switches controlling equipment whose operation is not evident at the switch location. Provide an engraved nameplate to identify equipment controlled.

2.3 AC MANUAL MOTOR STARTING SWITCHES

A. General: Provide ac manual motor starting switches where overload protection is not required or is provided separately. Provide switches similar in construction to the lighting toggle switches except conforming to UL 508 and rated 30-amperes, 120-277 volts ac.

B. Types:

DESCRIPTION	HUBBELL CAT. NO.
Single pole, brn/ivory	HBL-3031/HBL-3031I
Double pole, brn/ivory	HBL-3032/HBL3032I

C. Accessories: Provide a flush neon "ON" pilot light in conjunction with switches controlling equipment whose operation is not evident at the switch location. Provide an engraved nameplate to identify the equipment being controlled.

2.4 CONVENIENCE RECEPTACLES

A. General: Provide specification grade convenience receptacles conforming to Fed. Spec. WC 596 UL listed, with nylon impact resistant face, one piece metal wrap around mounting strap with assured grounding clip, back and side wired binding screw type terminals, brass power contacts and a heavy duty heat stabilized thermoset plastic base. Provide brown devices in unfinished areas and ivory devices in finished areas unless otherwise specified.

B. TYPES:

DESCRIPTION	RATING	COLOR	HUBBELL CAT. NO.
Single	NEMA 5-20R 20A, 125V, 2P, 3W	Brown/ Ivory	HBL5361/ HBL5361I
Duplex	NEMA 5-20R 20A, 125V, 2P, 3W	Brown/ Ivory	HBL5362/ HBL5362I
Single- corrosion- resistant	NEMA 5-20R 20A, 125V, 2P, 3W	Yellow	HBL53CM61
Duplex- corrosion- resistant	NEMA 5-20R 20A, 125V, 2P, 3W	Yellow	HBL53CM62
Single	NEMA 6-20R 20A, 250V, 2P, 3W	Brown/ Ivory	HBL5461/ HBL5461I
Duplex	NEMA 6-20R 20A, 250V, 2P, 3W	Brown/ Ivory	HBL5462/ HBL5462I
Quadraplex	NEMA 5-20R 20A, 125V, 2P, 3W	Brown/ Ivory	HBL420H/ HBL420HI

2.5 SPECIAL USE RECEPTACLES

A. General: Provide special use receptacles of specification grade in accordance with applicable Fed. Specs., UL, ANSI and CSA Standards.

B. Types:

<u>DESCRIPTION</u>	<u>RATING</u>	<u>COLOR</u>	<u>HUBBELL CAT. NO.</u>
Duplex-ground fault circuit interrupter	NEMA 5-20R 20A, 125V, 2P, 3W	Brown/ Ivory	GF20L GF20IL
Duplex – surge suppression w/isolated ground	NEMA 5-20R 20A, 125V, 2P, 3W	Blue	IG5352S

2.6 BOXES

- A. Outlet Boxes: Provide outlet boxes in accordance with the requirements specified in Section 26 05 33.

2.7 PLATES AND COVERS

- A. General: Provide covers and plates for the various areas as follows:
1. Architectural Finished Areas: Provide Type 302/304 stainless steel plates and covers for devices.
  2. Areas Below Grade, Corrosive and Wet Areas:
    - a. For switches provide weatherproof, gasketed, covers with external operating handle.
    - b. For receptacles provide a weatherproof, gasketed, clear, flame-retardant, jumbo, polycarbonate cover a minimum of 5.4-inches deep, suitable for use with a 10-3 cord that allows the cover to be closed even when the receptacle is in use.

PART 3 EXECUTION

3.1 INSTALLATION

- A. General: Install all wiring devices in accordance with manufacturer's recommendations and approved shop drawings as specified in Division 01.
- B. Toggle Switches: Install toggle switches applicable for the area environment for switching lighting or other branch circuit loads.
- C. Receptacles: Install receptacles applicable for the area environment.

- D. Grounding: Ground all devices in accordance with the requirements specified in Section 26 05 26.

END OF SECTION

## SECTION 26 28 16

### DISCONNECT SWITCHES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing and installing enclosed fused and nonfused safety switches for use as feeder and branch circuit switching and disconnect devices for motors and equipment.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 09 96 00 - High Performance Coatings
  - 2. Section 26 05 00 - Basic Electrical Materials and Methods
  - 3. Section 26 05 53 - Electrical Identification
  - 4. Section 26 05 26 - Grounding

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. NFPA 70 - National Electrical Code (NEC)
  - 2. NEMA KS1 - Enclosed Switches
  - 3. UL 198E - Class R Fuses
  - 4. UL 486A - Wire Connectors and Soldering Lugs for Use With Copper Conductors

##### 1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1 and Section 26 05 00.
- B. Product Data and Information: Provide manufacturers' data indicating disconnect switch ratings and dimensions. Provide manufacturer's data on fuses including time-current curves.

##### 1.4 QUALITY ASSURANCE

- A. Codes: Provide disconnect switches meeting the requirements of NFPA, the National Electrical Code and local codes.

- B. Regulatory Requirements: Provide all disconnect switches designed, manufactured and tested in accordance with latest ANSI, IEEE and NEMA Standards, and UL listed.

## 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 and Section 25 05 00.

## 1.6 SPARE PARTS

- A. General: Provide the following spare parts:
  - 1. Twelve of each size and type fuse installed.
- B. Packaging: Pack spare parts in containers bearing labels clearly identifying the contents. Deliver spare parts in original factory packages. Identify all spare parts with information needed for reordering.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are as listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Disconnect Switches
    - a. Square D /Schneider Electric
    - b. Eaton/CutlerHammer
    - c. ABB Electrification
    - d. Hubbell/Killark
  - 2. Fuses
    - a. Eaton/Bussmann
    - b. Littelfuse

### 2.2 DISCONNECT SWITCHES

- A. General: Provide disconnect switches of the NEMA KS-1, heavy-duty, load-interrupter, enclosed-knife switch type with externally operating handle interlocked to prevent opening of the front cover with the switch in the ON position. Provide an interlock that is defeatable and operable from the front of the switch. Provide handle lockable in the OFF position.

- B. Disconnect Switch Ratings: Provide disconnect switches rated for 600-volts as applicable and horsepower rated when used in motor circuits. Current ratings are as indicated.
- C. Interrupting Rating: If the approved short circuit and coordination study indicates that the available fault current at any disconnect switch exceeds the interrupting rating of the switch, provide a fused disconnect switch with rejection feature. Size the fuses for the load served.
- D. Small Three Phase Motor Disconnect Switches: Provide a fusible switch for each small three phase motor where the branch feeder breaker directly upstream of the motor cannot provide overcurrent protection in accordance with NEC Table 430.52.
- E. Service Entrance: Where shown, provide disconnect switches suitable for service entrance.
- F. Disconnect Switches for Use with Adjustable Frequency Drives: Provide disconnect switches with auxiliary contacts for interlocking with the associated AFD permissive start circuit. Confirm whether normally open or normally closed contacts are required per logic being provided.
- G. Fusible Switches: Provide switches with rejection feature to allow only Class R fuses to be installed.
- H. Disconnect Switch Housings: Provide disconnect switches housed in NEMA rated enclosures as follows:

AREA	ENCLOSURE
Outdoor and below grade elevation indoors	NEMA 4 – Watertight
Above grade indoor	NEMA 12 – Industrial

2.3 FUSES

- A. Characteristics: Provide UL 248 listed Class RK1 dual element, time-delay fuse with an interrupting rating of 200,000 rms symmetrical amperes.

PART 3 EXECUTION

3.1 INSTALLATION

- A. General: Install disconnect switches as shown or required. Comply with requirements of NEC and local electrical codes.
- B. Provide fuses in the fusible disconnect switches sized to protect the associated motor in accordance with the NEC and per the nameplate rating of the approved equipment.

Provide an adhesive label attached to the inside of the switch cover indicating the replacement fuses type and size.

- C. Coordination: Coordinate with other work including cabling and wiring work.
- D. Torque Requirements: Tighten electrical connectors and terminals including screws and bolts in accordance with equipment manufacturers' published torque tightening recommendations. Where manufacturers' torquing requirement are not available, tighten connectors and terminals in accordance with UL Standard 486A.

### 3.2 CLEANING AND PAINTING

- A. Painting: Paint the disconnect switches as specified in Section 09 96 00.

END OF SECTION

## SECTION 26 29 23

### ADJUSTABLE FREQUENCY DRIVES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing, installing and testing the 480-volt adjustable frequency drives. Provide drives in individual, wall mounted enclosures, or incorporated into motor control centers, as shown.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 01 79 00 - Training
  - 2. Section 09 96 00 - High Performance Coatings
  - 3. Section 26 05 00 - Basic Electrical Materials and Methods
  - 4. Section 26 05 19 - Wires and Cables - 600 Volts and Below
  - 5. Section 26 05 60 - Electrical Requirements for Shop-Assembled Equipment
  - 6. Section 26 05 53 - Electrical Identification
  - 7. Section 26 05 26 - Grounding
  - 8. Section 26 30 00 - Control Components and Devices
  - 9. Section 26 09 13 - Electrical Monitoring System
  - 10. Section 26 80 00 - Electrical Testing Requirements

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. NEMA ICS 1 - General Standards for Industrial Control and Systems
  - 2. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays rated 600V.
  - 3. NEMA ICS 3 - Industrial Control and Systems Factory Built Assemblies
  - 4. NEMA ICS 7 - Industrial Control and Systems: Adjustable Speed Drives
  - 5. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems
  - 6. NEMA 250 - Enclosures for Electrical Equipment

7. NFPA 70 - National Electrical Code (NEC)
8. IEEE 85 - Test Procedure for Airborne Sound Measurements on Rotating Electric Machinery
9. IEEE 519 - IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
10. UL 845 - Motor Control Centers

### 1.3 SYSTEM DESCRIPTION

#### A. Design Requirements:

1. Provide adjustable frequency drives to vary the speed of NEMA standard, 3-phase, 460-volt, induction motors and driven equipment by varying the frequency and voltage applied to the motors.
2. Provide adjustable frequency drives that fit the physical space shown. Units exceeding the dimensions shown will not be acceptable.
3. Provide adjustable frequency drives that automatically restart when power is restored after a power outage. Provide control logic so the drive is allowed to restart when power is restored.
4. UL 508C listed with a minimum labeled Short-circuit Current Rating (SCCR) of 42kAIC at 460V.

B. Rated Output Power: Provide adjustable frequency drives with an output that is at least 3 percent greater than the driven motor's full nameplate rating.

C. Torque Output: Provide variable torque or constant torque output drives as required by driven equipment.

D. 6-Pulse Drive Technology: Adjustable frequency drives serving motors 50 HP or smaller may utilize 6-pulse drive technology provided the drive complies with all performance requirements specified herein.

E. Performance Requirements: Provide adjustable frequency drives to meet the following requirements of IEEE 519:

Total harmonic distortion THD (Voltage): Maximum of five percent for general distribution systems as measured at the point of common coupling.

1. Total current harmonic distortion: Not to exceed the values in Table 10.3, Current Distortion Limits for General Distribution Systems (120 V through 69000 V) of IEEE-519 at the point of common coupling.

2. Capacitor traps for controlling harmonics that require tuning to the power system are not acceptable.
3. Operate at a minimum efficiency of 95 percent at rated load.
4. Operate from a 480-volt, 3-phase, 60-hertz supply with a voltage variation of plus 10-percent or minus 20-percent and a frequency variation of plus or minus 2-hertz.
5. Input power factor: Maintain a 95 percent minimum power factor over a 20 to 100 percent speed range.
6. Operate an induction motor as specified, including a high-efficiency, high-power factor, premium-duty motor, with no detriment to motor life.
7. Operate an induction motor without exceeding the motor sound and power decibel level listed and measured in accordance with NEMA MG1, Tables 9-2 and 9-3.
8. Operate under the following ambient conditions:
  - a. Ambient Temperature: 0 to 40 degrees C
  - b. Humidity: 0 to 95 percent

#### 1.4 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01 and Section 26 05 00.
- B. Product Data and Information: Furnish catalog data including rating and descriptive literature of all components and systems.
- C. Shop Drawings: Furnish the following shop drawings customized for the project:
  1. Bill of materials including manufacturers name and catalog number
  2. Outline drawings showing dimensions, arrangement, elevations, identification of components and nameplate schedule for all units
  3. Interconnection wiring diagrams
  4. Individual schematic control diagrams for each unit
  5. One line diagrams
  6. Obtain and enter full performance data for all motors shown

7. Certification that the adjustable frequency drives are compatible with the motors and the equipment loads to be driven
- D. Quality Control: Furnish test reports, certificates of inspection and manufacturer's instructions.
- E. Operations and Maintenance Manuals: Furnish operations and maintenance manuals as specified in Division 1.

#### 1.5 QUALITY ASSURANCE

- A. Standards: Provide all adjustable frequency drives manufactured in accordance with referenced standards.
- B. UL Label: Provide a UL Inc. Label or certification of listing by C.S.A. or other recognized testing organization for each adjustable frequency drive.
- C. Codes: Manufacture and install each adjustable frequency drive in accordance with the NEC and local codes.
- D. Failure to Meet the Harmonic Requirement as Determined by Field Measurement: If the installed adjustable frequency drives fail to meet the harmonic limits specified, modify the adjustable frequency drives as follows at no additional cost to the OWNER.
  1. Provide additional harmonic reduction equipment until the specified limit is achieved. Equipment which requires expanding on the physical footprint of the adjustable frequency drive previously approved is to be submitted for approval.
  2. In the event that harmonic distortion limits cannot be achieved, replace the adjustable frequency drive equipment with equipment that conforms to this specification.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 (and as follows :)
- B. Shipping and Packing: Rigidly brace and protect against weather, damage, and undue strain, all structures, equipment and materials.
- C. Storage and Protection: Furnish clean storage facilities for all equipment delivered but not installed. Provide conditioned air for storage facilities in accordance with the equipment manufacturer's recommendations.

- D. Spare Parts: Furnish spare parts at the same time as the associated adjustable frequency drive. Deliver the spare parts to the OWNER after completion of the work.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Siemens/Robicon
  - 2. Eaton/Cutler-Hammer
  - 3. Toshiba
  - 4. Danfoss

### 2.2 DESIGN

- A. Input Disconnect: Provide an input circuit breaker with an interrupting rating of 42,000 rms symmetrical amperes.
- B. Input Reactor: Provide input reactor or isolation transformer, if required, as determined by system harmonic distortion analysis.
- C. Converter Section: Provide input section that converts 480-volts, 60-hertz, 3-phase input to a fixed dc voltage using diodes, bridged rectifiers or SCR's.
- D. Filter Sections: Provide dc link reactor and filter capacitors as required.
- E. Inverter Section: Provide adjustable frequency drive inverter section that converts the fixed dc voltage to an adjustable frequency output utilizing a pulse-width modulation inverter. Maintain a constant volts per hertz ratio on the output with voltage boost for startup as required.
- F. Control Circuit: Provide with a control circuit conforming to the logic shown on the Contract Drawing schematic diagrams or as otherwise described in the equipment specifications. The run permissive logic shall include an auxiliary contact signal from the local disconnect switch at the motor (where provided or otherwise shown) which will deactivate the drive whenever the motor disconnect switch is opened.
- G. Control Devices: Provide a digital operator keypad located on the front door to allow setting of all programmable parameters and the following control functions:
  - 1. Start push button
  - 2. Stop push button
  - 3. "Local-Remote" control selection
  - 4. Speed control settings

5. Speed meter with hertz and 0-100 percent scales
  6. Output ammeter
  7. Elapsed time meter
  8. Diagnostics package with fault indication and reset push button
- H. Control Features: Provide a control system for each drive that allows the following functions:
1. Remote, isolated 4-20 ma speed control input
  2. Isolated 4-20 ma speed output
  3. Alarm outputs
  4. ON/OFF status output
  5. Additional features and controls as specified with the driven equipment
- I. Internal Control Adjustments: Include the following control adjustments for each drive:
1. Acceleration time, 4 to 60 seconds
  2. Deceleration time, 4 to 60 seconds
  3. Minimum speed limit
  4. Maximum speed limit
  5. Inverter current limit
  6. Supply undervoltage trip
- J. Protection Features: Provide the following drive protection features:
1. Electronic overcurrent protection for instantaneous overload
  2. AC input line undervoltage protection, adjustable from 60-100 percent nominal voltage with time delay adjustment and low speed override.
  3. Overfrequency protection
  4. Phase loss protection
  5. DC overvoltage protection
  6. Logic supply voltage low level protection
  7. Line-to-line and line-to-ground output short circuit protection
  8. Line-to-line and line-to-ground surge arresters sized for 480-volt 3-phase grounded wye system
  9. Overload capability of 110% of the motor FLA based on the NEC ratings for 60 seconds

10. Control circuit fuses
  11. Overtemperature protection
  12. Diagnostics module to indicate protection trip conditions
- K. Communications: Provide an addressable communication card capable of transmitting the following data over a two-wire network to the Plant SCADA System as specified in Section 26 09 13:
1. Status (ON, OFF, TRIPPED, NO RESPONSE)
  2. Input and output current in each phase
  3. Output frequency
  4. Input and output kW
  5. Cause of trip

## 2.3 COMPONENTS

- A. General: Provide circuit breakers, fuses, transformers, push buttons, switches, indicating lights, relays and timers as specified in Section 26 30 00.
- B. Power Solid State Components: Provide power solid state switching components with a one minute current rating greater than 110 percent of rated current for variable torque drives or 150 percent of rated current for constant torque drives.
- C. Printed Circuit Boards: Apply a clear conformal coating of acrylic to all printed circuit boards.

## 2.4 ENCLOSURES

- A. General: Provide adjustable frequency drives in NEMA 1 filtered and gasketed enclosures with full rear cover plates.

### IDENTIFICATION

- B. General: Provide identification of the adjustable frequency drives and their components as specified in Section 26 05 53.
- C. Nameplates: Install nameplates for devices located on doors so they are readable to a person 5'-8" tall standing 3'-0" in front of the equipment.
- D. Location: Locate nameplates so that they are readily associated with items labeled.
- E. Additional Nameplate: Where nameplates are installed on removable relay or device doors, install an additional nameplate within the relay or device.

- F. Additional Engraving: Where nameplates are located on other compartments than those served, add additional engraving to identify units served.

## 2.5 WIRING:

- A. General: Provide internal wiring with stranded switchboard wire having 600-volt rated, flame-resistant, type SIS insulation. Use No. 14 AWG wire for control interconnections. Provide power connections as required for the service.
- B. Wire Marker: Provide wire markers at each end of all wires.
- C. Wiring to Door Mounted Devices: Where wiring connections are made to equipment mounted on hinged doors, provide connections with extra flexible wires suitably cabled together and cleated.
- D. Terminal Blocks: Provide wiring of all control connections to all external connections through individual, positive-latch, pull-apart type control terminal blocks rated 600-volts. Locate terminal blocks for front access.
- E. Terminal for External Connections: Provide sufficient terminals for all devices external to the adjustable frequency drive.

## 2.6 SOURCE QUALITY CONTROL

- A. Shop Test: Shop test each adjustable frequency drive in accordance with IEEE and NEMA standards, including high potential tests and other standard tests for that particular class of equipment. Notify the OWNER fourteen (14) days prior to start of factory testing so that the OWNER, at his option, may witness the testing.
  - 1. After final assembly, test each adjustable frequency drive at full load with application of line-to-line and line-to-ground bolted faults and show that the adjustable frequency drive trips electronically without device failure.
  - 2. After all tests have been performed, burn-in each adjustable frequency drive for 40 hours at 100 percent inductive or motor load.
  - 3. After the burn-in cycle is complete, subject each adjustable frequency drive to a 30 minute cycling motor load test before inspection and shipping.
- B. Operational Tests: After the equipment has been completely assembled, perform operational test to determine operating conditions and circuit continuity. Provide pushbuttons and selector switches to simulate all control input contacts and indicating lights to indicate all control outputs. Provide a 4-20ma signal generator to simulate analog signals.
- C. Test Equipment: Provide all equipment, devices, instrumentation, and personnel required to perform the tests. Upon satisfactory completion of the test, submit two

(2) certified copies of the test report to the ENGINEER. Component failure during testing will require repeating any test associated with the failure or modified components to demonstrate proper operation.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install all equipment in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.
- B. Protective Adjustments: Set all circuit breakers per the approved short circuit and coordination study.
- C. Operational Adjustments: Set all operational devices for proper system operation.
- D. Cable Connections: Terminate and label all field wiring per approved drawings.

### 3.2 FIELD QUALITY CONTROL

- A. Inspections: Inspect, adjust and check the installation for physical alignment, cable terminations and ventilation.
- B. Tests: Perform the following field tests:
  - 1. Close and open each circuit breaker to test operation
  - 2. When site conditions permit, energize and de-energize each equipment item served by each drive, testing the complete control sequence of each item including acceleration and deceleration over complete operating range.
  - 3. Harmonic Measurement: Perform a harmonic system analysis to demonstrate full compliance with IEEE 519 voltage and current harmonic distortion requirements specified. Accurately measure the amplitude of the harmonic current imposed on the 60 hertz sine wave with a harmonic spectrum analyzer. Provide additional harmonic reduction equipment to meet the specified limits. If the harmonic distortion limits are not achieved, replace the adjustable frequency drive equipment with equipment that conforms to this specification.
  - 4. Operate each adjustable frequency drive with driven equipment at full load and test for hot spots.
  - 5. Test Reports: Furnish detailed test reports of all tests indicating test performed, discrepancies found, and corrective action taken.

- C. Manufacturer's Field Services Representative: Provide the services of a factory-trained service engineer, specifically trained on the adjustable frequency equipment to assist in installation, start-up, testing, calibration, placing into operation and provide training, as specified in Section 01 79 00.
1. Provide a service engineer when each drive is placed into operation.
  2. Provide a service engineer at the jobsite as often as necessary until all problems are corrected and the equipment installation and operation are satisfactory.
  3. Following completion of installation and field testing provide training for 12 employees of the OWNER in the proper operation, troubleshooting and maintenance of the equipment as outlined below. All training will be at the OWNER'S facilities at a time agreeable to the OWNER:
    - a. Operational Training: A minimum of one 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.
    - b. Maintenance Training: A minimum of one 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.
  4. Provide service engineer at the job site as often as necessary to assist in the programming of the SCADA system in accessing the memory map of each device.
  5. Provide replacement spare parts which may have been used during the course of startup and testing.

### 3.3 CLEANING AND PAINTING

- A. Shop Painting: Paint the adjustable frequency drive equipment as specified in Section 09 96 00.
- B. Field Painting: Furnish three 12-ounce spray cans of the final finish for touch-up. Touch-up scratched and marred surfaces to meet the requirements of Section 09 90 00.

END OF SECTION

## SECTION 26 29 53

### CONTROL COMPONENTS AND DEVICES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing manual starters, motor controllers and remote-control stations. In addition, the requirements for control components and devices for use in equipment provided under various other sections.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 09 96 00 - High Performance Coatings
  - 2. Section 26 05 00 - Basic Electrical Materials and Methods
  - 3. Section 26 05 19 - Wires and Cables - 600 Volts and Below
  - 4. Section 26 05 60 - Requirements for Shop-Assembled Equipment
  - 5. Section 26 29 23 - Adjustable Frequency Drives
  - 6. Section 26 19 00 - Medium Voltage Adjustable Frequency Drives
  - 7. Section 26 05 53 - Electrical Identification
  - 8. Section 26 05 26 - Grounding
  - 9. Section 26 24 19 - Motor Control Centers
  - 10. Section 26 29 43 - Contactors
  - 11. Section 26 50 00 - Lighting

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies
  - 2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
  - 3. UL 486A - Wire Connectors and Soldering Lugs for Use With Copper Conductors

##### 1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Provide equipment capable of operating in an ambient temperature range of 0 to 40 degrees C and humidity of up to 90 percent noncondensing.

- B. Motor Controllers: Provide motor controllers suitable for 480-volt, three-phase, three-wire, 60-hertz operation.
- C. Control Devices: Provide control devices suitable for operation at 120-volts, 60-hertz, unless specifically noted otherwise.
- D. Insulation Class: Provide control equipment and devices that meet the requirements of the 600-volt insulation class.

#### 1.4 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01 and Section 26 05 00.
- B. Product Data and Information: Furnish catalog data for all associated equipment and devices.
- C. Shop Drawings: Furnish shop drawings customized to the project for motor controllers and remote control stations that include the following:
  - 1. Outline drawings showing dimensions, identification of components and a nameplate schedule for all units.
  - 2. Bill of materials including manufacturers' name and catalog number.
  - 3. Individual schematic and wiring diagrams for each motor controller
- D. Equipment Ratings: Obtain and enter full performance details on all motors and other equipment being served on the above drawings.

#### 1.5 QUALITY ASSURANCE

- A. Codes: Provide manual starters, motor controllers and remote control stations that are in accordance with NEMA ICS 2.
  - 1. Provide manual starters, motor controllers and remote control stations that are in accordance with the NEC and local codes.
- B. UL Listing: Provide UL-listed manual starters, motor controllers and remote control stations.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, and handle all products and materials as specified in Division 01.

- B. Storage and Protection: Store all equipment and materials in a dry, covered, heated and ventilated location. Provide any additional measures in accordance with manufacturer's instructions.

## 1.7 SPARE PARTS

- A. General: Furnish the following spare parts:
  - 1. Two control stations of each type provided.
  - 2. Three of each type of manual starter.
  - 3. One of each type of motor controllers.
- B. Packaging: Pack spare parts in containers bearing labels clearly designating contents and related pieces of equipment. Deliver spare parts in original factory packages. Identify all spare parts with information needed for reordering.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Motor Controllers
    - a. Eaton/Cutler-Hammer
    - b. General Electric Company
    - c. Square D/Schneider Electric
    - d. Emerson Industrial Automation/Appleton
    - e. Eaton/Crouse-Hinds
    - f. Rockwell Automation/Allen-Bradley
  - 2. Control Relays:
    - a. Eaton/Cutler-Hammer
    - b. Square D/Schneider Electric
    - c. General Electric Company
    - d. Rockwell Automation/Allen-Bradley
  - 3. Timing Relays:
    - a. TE Connectivity/Agastat 7000 Series
    - b. Danaher Specialty Products/Eagle Signal

4. Reset and Repeat Cycle Timers:
  - a. Danaher Specialty Products/Eagle Signal
  - b. Marsh Bellofram/Automatic Timing and Controls
5. Current Switches
  - a. Veris Industries Inc.
6. Surge Protection Devices (SPD)
  - a. Thomas & Betts/Current Technologies, Inc.
  - b. Eaton/Cutler-Hammer
7. Rubber Work Mats
  - a. Salisbury by Honeywell
  - b. North American Mat
  - c. White Equipment

## 2.2 MOTOR CONTROLLERS

- A. General: Provide 480-volt, 3-phase, 60-hertz, across-the-line, combination motor circuit protector magnetic starters with individual control power transformers.
- B. Magnetic Starters: Provide magnetic starters as follows:
  1. Full voltage non-reversing or full voltage reversing, as required.
  2. Starter contacts of the replaceable, spring-loaded, wedge type with silver-cadmium oxide plated contact surfaces.
  3. Provide replaceable coils of the epoxy sealed type.
  4. Thermal Overload Elements: Class 20 thermal overload element and all required accessories. Provide size five and larger starters with current transformer operated overload relays.
    - a. Bimetallic type with an adjustment knob which allow plus or minus 15-percent adjustment of the heater's nominal rating.
    - b. Size the overload relays after approval of the corresponding motor.
    - c. Provide and adjust overload relays that match the associated motor nameplate running-current rating.

- d. Provide a set of isolated, normally-open and normally-closed contacts for each overload relay.
- C. Motor Circuit Protectors: Provide a motor circuit protector for each combination starter as follows:
- 1. Molded-case, air-break type designed for 600-volt, 60-hertz service with an interrupting capacity of 65,000 rms symmetrical amperes at 480 volts.
  - 2. Three-pole motor circuit protectors with magnetic, adjustable-trip units actuating a common tripping bar to open all poles when an overload or short circuit occurs.
  - 3. No thermal elements.
  - 4. Magnetic trip units capable of being set from 700 to 1,300 percent of the motor full-load amperes.
- D. Control Components: Provide push buttons, switches, indicating lights, transformers, relays and timers as specified herein under paragraph 2.5.

2.3 REMOTE CONTROL STATIONS

- A. General: Provide heavy-duty, oiltight remote control stations, consisting of push buttons, indicating lights, and selector switches with double-break silver contacts meeting the requirements specified under the section Control Components.
- B. Enclosures: Provide motor controllers installed in NEMA 250 rated enclosures as follows:

AREA	ENCLOSURE
Outdoor and below grade elevation indoors	NEMA 4 – Watertight
Corrosive areas as defined in Section 26 05 00 or as shown	NEMA 4X 316 Stainless Steel
Above grade indoor	NEMA 12 – Industrial

- C. Lockout Attachments: Where shown, provide lockout attachments as follows:
  - 1. Push buttons with padlockable attachment that holds the button depressed.
  - 2. Selector switch with a padlockable attachment that covers the selector switch operators and allows the switch to be set in any position. Selector switch operators that use a removable key are not acceptable.

## 2.4 CONTROL COMPONENTS

- A. Push Buttons, Selector Switches and Indicating Lights:
1. Provide heavy-duty, oiltight, 30.5 mm, push-button or selector switch control stations arranged for flush-panel mounting.
  2. Provide the additional switches, relays, and other electrical accessories necessary to control and safeguard the operation of the associated equipment.
  3. Provide 30.5 mm, low-voltage, push-to-test, LED type indicating lights suitable for operation at 120-volt, 60-hertz ac control circuit voltages.
  4. Color code indicating lights as follows:
    - Red - Motor running or valve open
    - Green - Motor off or valve closed
    - Amber - Capable of operation from this point
    - Blue - Alarm or trouble condition
- B. Control Power Transformer: Provide an individual, control power transformer for each starter to derive the 120 volts for the unit's control circuit. Provide transformers with sufficient capacity to meet the energy demands for all related control components including relays, solenoids and other indicated items. Provide dual fuses on the primary and one fuse on the secondary. Ground the unfused leg of the secondary to the enclosure.
- C. Elapsed Time Meters: Provide nonreset-type elapsed time meters to register up to 9999.9 hours, having square cases suitable for panel mounting and having coils for 120-volt, 60-hertz operation.
- D. Control and Latching Relays: Provide control and latching relays of 600-volt class, machine-tool quality with convertible contacts. Provide relay-operating contacts rated at a minimum of 10 amperes, 120 volts, 60 hertz.
- E. Timing Relays: Provide four-pole, double-throw, timing relays with timing ranges and ON/DELAY or OFF/DELAY operation as required. Provide contacts rated a minimum of 10 amperes at 120 volts, 60 hertz.
- F. Reset and Repeat Cycle Timers: Provide electromechanical or solid-state type reset and repeat cycle timers, with timing ranges and functions as indicated. Provide contacts rated at a minimum of 10 amperes, 120 volts, 60 hertz. Solid-state output contacts are not acceptable.

- G. Current Switches: Provide current switches as follows:
1. General: Provide electric current switches to accomplish specified control functions.
  2. Construction: Provide current switches of a solid state type with compatible current and voltage ratings. Provide sensors complete with in-rush delay, single set joint adjustment, power and status LED's and adjustable trip set point with accuracy of +/- 2 percent of range. UL listing and NEMA 12 sealing is required. Provide with two normally open dry contacts.
  3. Design: Provide switches designed for a 5 to 185 degree F and 0 to 95 percent humidity, and of a power induced type. Sensors with external power supply are not acceptable.
- H. Phase Failure and Undervoltage Relay: Provide a 3-phase, power monitor to detect phase failure, phase reversal, phase unbalance and undervoltage, suitable for operation at 480 volts. Provide an adjustable, drop-out voltage range of 380 to 500 volts and an adjustable time delay from 0.2 to 20 seconds. Provide a normally-open and normally-closed alarm contact rated 10 amperes at 120 volts with automatic reset.
- I. Lock out Relay: Provide 600V class relay that is an electrically operated hand, or electrically reset relay that functions to shut down or hold an equipment out of service, or both, upon the occurrence of abnormal conditions as shown in contract drawings.

## 2.5 SURGE PROTECTION DEVICES (SPD):

- A. Provide SPD equipment that complies with UL 1449 and UL 1283.
- B. Provided units with a maximum continuous operating voltage that exceeds 115 percent of the nominal system operating voltage.
- C. Provide SPD equipment suitable for wye configured systems.
- D. Provide SPD equipment having directly connected suppression elements between line-neutral (L-N), line-ground (L-G) and neutral-ground (N-G).
- E. Provide SPD equipment that distributes the surge current to all MOV components to ensure equal stressing and maximum performance and provides equal impedance paths to each match MOV.
- F. Provide high-performance EMI/RFI noise rejection filters that attenuate the electric line noise at least 55dB at 100 kHz using MIL-STD-220A insertion loss test method.

- G. Wire internal components with connections utilizing low impedance conductors and compression fittings.
- H. Provide a monitoring panel for each system that incorporates the following features:
  - 1. Green/Red solid state indicator lights to indicate which phase(s) have been damaged.
  - 2. A flashing trouble light to indicate fault detection.
  - 3. Transient event counter.
  - 4. Audible alarm.
  - 5. Form C contacts for remote monitoring of the unit status.
- I. Provide SPD suitable for location application and minimum surge current per mode as follows:
  - 1. 480V and 480Y/277V Panelboard: UL 1449, Type 1/2, 150kA
  - 2. 120/240V and 208Y/120V Panelboard: UL 1449, Type 2, 80kA
- J. Location: Install SPD as follows:
  - 1. Panelboard: Mount SPD internally or externally to minimize lead length. Provide a branch circuit breaker disconnect sized in accordance with the manufacturer's recommendations. Locate the SPD unit branch circuit breaker immediately downstream of the main circuit breaker or main lugs.

## 2.6 RUBBER WORK MATS:

- A. Provide a three foot wide rubber work mat on the floor in front of each switchgear, switchboard and motor control center. The mat will be long enough to cover the full length of the line-up. Provide mats that are 1/4 inch thick with beveled edges, canvas back and solid type with corrugations running the entire length. Mats will be guaranteed to be free from cracks, blow holes or other defects detrimental to their mechanical and electrical strengths. Mats will meet all OSHA requirements and those of ANSI/ASTM J6.7 – 1935 (R1971) / D178, Type 2, Class 2.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install all equipment in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.

- B. Mounting: Mount manual starters, motor controllers and remote control stations 4 feet 6 inches from the finished floor up to their centerlines, unless otherwise shown. Mount all devices at least ½ inch away from concrete wall surfaces.
- C. Adjustments: Set all motor circuit protectors and circuit breakers based on the approved short circuit and coordination study.
- D. Overloads: Adjust the thermal overloads on each phase of each starter unit for the actual motor installed.
- E. Cable Connections: Terminate and label all field wiring per the approved diagrams.
- F. Torque Requirements: Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturers' published torque tightening recommendations. Where manufacturers' torquing requirements are not available, tighten connectors and terminals in accordance with UL Standard 486 A.

### 3.2 FIELD QUALITY CONTROL

- A. Inspections: Inspect, adjust and check the installation for physical alignment, cable terminations and ventilation.
- B. Operation and Maintenance: Furnish operation and maintenance instructions as specified in Division 01.

END OF SECTION

(NO TEXT ON THIS PAGE)

## SECTION 26 32 13

### PACKAGED ENGINE GENERATOR SYSTEMS

#### PART 1 GENERAL

##### 1.1 SUMMARY

A. Section Includes: Requirements for providing packaged engine generator system to supply emergency and standby electrical power as specified and shown. Each system consists of:

1. Natural gas engine-driven generator mounted on a structural steel base.
2. Heat exchanger system for transfer of heat to plant cooling water, on separate skid.
3. Natural gas fuel train with regulators, valves, and piping to building natural gas supply.
4. Exhaust silencer, fittings, and piping.
5. Generator control and instrument panel.
6. Battery and charger including battery rack.
7. Vibration isolators.
8. Remote annunciator.
9. Master control panel for synchronizing and paralleling of generators, suitable for remote operation of circuit breakers at medium voltage switchgear provided under Section 26 13 00.

B. Related Work Specified in Other Sections Includes, But is Not Limited to the Following:

1. Section 01 79 00 - Training
2. Section 03 30 00 - Cast-in-Place Concrete
3. Section 09 96 00 - High Performance Coatings
4. Section 26 05 00 - Basic Electrical Materials and Methods
5. Section 26 05 13 - Medium Voltage Cable
6. Section 26 05 19 - Wires and Cables - 600 Volts and Below
7. Section 26 05 26 - Grounding
8. Section 26 05 33 - Electrical Raceway Systems
9. Section 26 05 53 - Electrical Identification
10. Section 26 08 00 - Electrical Testing Requirements
11. Section 26 13 00 - Medium Voltage Switchgear
12. Section 26 23 00 - 480 Volt Switchgear

## 1.2 REFERENCES

### A. Codes and Standards: Codes and standards referred to in this section:

1. ASTM A 185 - Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
2. ASTM A 615/A615M - Standard Specification for Deformed and Plain Billet Steel Bars for Concrete
3. NFPA 30 - Flammable and Combustible Liquids Code
4. NFPA 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines
5. NFPA 54 - National Fuel Gas Code
6. NFPA 110 - Standard for Emergency and Standby Power Systems
7. UL 1709 - Rapid Rise Fire Tests of Protection Materials for Structural Steel
8. UL 2200 - Stationary Engine Generator Assemblies

## 1.3 SYSTEM DESCRIPTION

- A. General: Each generator unit is to function as an emergency/standby power source for use in the event of incoming normal power service failure and during normal exercising operations. Each unit consists of a natural gas engine-driven, generator mounted on a structural steel base, complete with instrument panel, generator control panel, starting system, governor, engine jacket-water cooling system, exhaust silencer, voltage regulator, and all appurtenances necessary for a complete functioning generation system.
- B. Minimum Generator Capacity: Provide a minimum generator capacity of 1,000 kW at 4160Y/2400 volts, 3-phase, 60 hertz, 0.8 power factor and 1800 rpm; at an elevation of 600 feet above sea level; at an ambient temperature ranging between 55 degrees to 86 degrees F. Provide a generator system capable of starting and running the following motors in the sequence and with the starting device indicated, with a 1030 kVa incidental load already on the generator bus and a voltage drop not exceeding 20 percent:
1. Squirrel-cage induction 250 hp (33 A full-load at 4,160 V), motor starting by reduced-voltage, solid-state starter.

## 1.4 SUBMITTALS

- A. General: Furnish all submittals including the following as required in Division 01 and Section 26 05 00.
1. Furnish calculations to support the generator's capacity to start and operate the motors listed in Subsection 1.3 B.
  2. Furnish starting battery sizing calculations.
- B. Product Data and Information: Furnish product data and information showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, fuel tank, cooling system, and remote annunciator.
- C. Contractor's Shop Drawings: Furnish Contractor's shop drawings showing plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.
- D. Quality Control: Furnish the manufacturer's certified, shop-test report including the following tests:
1. Generator tests in accordance with IEEE Test Code for synchronous machines including heat run at rated output, insulation resistance and high potential.
  2. Engine generator tests in accordance with specifications including the following:
    - a. Two hours continuous operation at full load.
    - b. One-half hour at 75 percent of full load.
    - c. One-half hour at 50 percent of full load.

Furnish test reports indicating voltage, amperes, kilovolt-amperes, kilowatts, rpm and fuel consumption for each load condition as curves; and containing statements on temperature rise of oil and cooling water, vibration and other objectionable performance conditions. Furnish test data showing voltage drop and frequency fluctuations when block loads are added and removed in 25 percent, 50 percent, 75 percent and 100 percent increments.
  3. Furnish manufacturer's installation instructions in accordance with the provisions of Division 01.
  4. Submit certified Generator ANSI and Decrement Curve data sheets.

5. Where paralleling controls are to be provided, furnish with all the features and capabilities as shown and specified. Proprietary paralleling systems unable to provide all the features and capabilities of the system as designed are not acceptable.
- E. Operation and Maintenance Manuals: Furnish manufacturer's operation and maintenance manuals as required in Division 01.
- F. Record Documents: Furnish record documents in accordance with the provisions in Division 01. Accurately indicate the locations of engine generator and mechanical and electrical connections.

#### 1.5 WARRANTY

- A. Written Warranty: Furnish a written warranty for a period of not less than two years from the date of the system acceptance that covers, but is not limited to, the following:
  1. Repair parts
  2. Labor
  3. Travel expense
  4. Expendables made unserviceable by the defect and used during a repair

#### 1.6 DELIVERY

- A. General: Deliver, store and handle all products and materials as required in Division 01.

#### 1.7 SPARE PARTS

- A. General: Furnish the following spare parts.
  1. Two fuse replacements of each type used.
  2. One current transformer of each type used.
  3. One potential transformer of each type used.
  4. Two full sets of fuel, air and oil filters
  5. Two complete sets of V-belts
  6. One complete set of maintenance manuals
  7. One complete set of parts manuals
  8. Two 12-ounce spray cans of the final finish for touch-up

- B. Packaging: Pack spare parts in containers bearing labels clearly designating contents and related pieces of equipment. Deliver spare parts in original factory packages. Identify all spare parts with information needed for reordering.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.

- 1. Engine generator set and accessories

- a. Caterpillar Inc.
- b. Cummins Power Generation
- c. MTU Solutions

- 2. Battery and Charger

- a. Alcad Inc.
- b. Emerson Network Power/Chloride Industrial Power
- c. SAFT Nife
- d. LaMarche Manufacturing Company

### 2.2 ENGINE

- A. Fuel: Natural Gas

- B. Rated engine speed: 1800 RPM

- C. Lubrication system: The following items are mounted on engine or base rails:

- 1. Filter and strainer: Oil filters rated to remove 90% of particles 5 micrometers and smaller while passing full flow
- 2. Lube oil pump
- 3. Oil level regulator
- 4. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassemble and without use of pumps, siphons, special tools, or appliances

- D. Engine Fuel System:

- 1. Sized for 31.5 to 47.2 MJ/ nM3 (800 to 1200 btu/cu ft) dry pipeline natural gas

2. Fuel Control Valve: Electronic, engine-installed.
3. Throttle Plate: 24V DC actuator electronically controlled by Engine Control Module.

4. Gas Fuel Train:

- a. Factory-standard package. Designed, sourced and shipped by genset manufacturer along with the genset. Designed for installation just upstream of engine fuel inlet.

Shall be capable to handle gas supply pressures from 4.9 to 18.9 kPa (0.65 to 2.6 psi) at the gas train inlet. Maximum pressure drop across gas train at full rated flow, with a new filter: 1.03 kPa (0.15 psi). Inlet Connection Size: DN125.

- b. Gas train shall include the following components:

- (1) Manual gas shutoff valve
- (2) Electronic Gas Shutoff Valve: 24V DC, energized-to-run, double solenoid with visual position indicators.
- (3) Fuel filter: 96 % efficiency at 1 micron particle size, shall include differential pressure gauges.
- (4) Gas pressure regulator
- (5) Connection to Engine Fuel Inlet: Flexible, braided hose.
- (6) Outlet Connection: ASME/ANSI B16.5 Class 150, type (3-)
- (7) Gas train pressure sensors, 4-20 mA, 0-100 kPag, installed in the gas train with ½” NPT conduit connectors.
  - (a) Two sensors installed to provide differential filter pressure.
  - (b) One sensor installed to provide post regulator engine fuel inlet pressure.

- E. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity. Heater shall include a circulation pump. Provide isolation valves that allow for change out of the heater without having to drain the entire system.

- F. Governor:

1. Digital speed governor built into engine control module, speed input 4 to 20 ma (0V to 5V).
2. Dual speed sensing system.
3. Engine over speed protection.

G. Cooling System:

1. Provide a shell and tube heat exchanger sized by the manufacturer to dissipate the heat from the engine-generator during operation. The heat exchanger shall be a steel shell with copper tubes sized for water as the cooling fluid with an inlet temperature of 65°F. The cooling fluid outlet temperature shall not exceed 145°F. Fluid velocity and pressure drop shall not exceed heat exchanger manufacturer requirements. Provide a solenoid valve on the cooling water supply line to open during generator operation.

H. Muffler / Silencer:

1. Provide a cylindrical, critical-grade, exhaust silencer with valved condensate drain that extends beyond the depth of the insulation, and of the appropriate size for use with the engine. The silencer shall have inlet and outlets configured as required to meet the project exhaust system design with a 12 inch water column maximum pressure drop. Flexible, full length stainless steel connector/wye shall be furnished as required between the silencer and the engine exhaust outlet(s). The generator set manufacturer shall furnish all appropriate fittings, flanges, etc., as required between the engine and the silencer.
2. For indoor applications, the silencer shall be turned over to the mechanical contractor for mounting, installation and insulating per the project contract documents.

I. Air Intake Filter: Heavy duty dual element, engine mounted air cleaners with replaceable dry-filter elements, “blocked filter” visual indicator

J. Starting System: 24 VDC electric with negative ground

1. Dual cranking motor: Dual electric starters that automatically engage and release from engine flywheel without binding.
2. Cranking cycle: as required by NFPA 110 for system level Type 1
3. Battery: Oversize (10%) capacity to accommodate starting within ambient temperature range specified in Part 1 “Project Conditions” Article to provide specified cranking cycle at least three times without recharging.
4. Battery Cable: Size as recommended by engine manufacturer for cable length required as per site conditions to be field verified by manufacturer’s

representative prior to order. Include required interconnecting conductors and connection accessories.

5. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
6. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
  - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
  - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from -40°C to +60°C to prevent overcharging at high temperatures and undercharging at low temperatures.
  - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to  $\pm 10\%$ .
  - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
  - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
  - f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

### 2.3 CONTROLS AND MONITORING

- A. Provide a fully solid-state, microprocessor based, generator set controller. The control panel shall be designed and built by the engine manufacturer. The controller shall provide all operating, monitoring, and control functions for the generator set. The control panel shall provide real time digital communications to all engine and regulator controls via secure communication network.
- B. Mounting: Provide a control panel mounted on the generator set.

C. Environmental

1. The generator set controller shall be tested and certified to the following environmental conditions:
  - a. -40°C to +70°C Operating Range
  - b. 100% condensing humidity, 30°C to 60°C
  - c. IP22 protection for rear of controller; IP55 when installed in control panel
  - d. 5% salt spray, 48 hours, +38°C, 36.8V system voltage
  - e. Sinusoidal vibration 4.3G's RMS, 24-1000Hz
  - f. Electromagnetic Capability (89/336/EEC, 91/368/EEC, 93/44/EEC, 93/68/EEC, BS EN 50081-2, 50082-2)
  - g. Shock: withstand 20G

D. Functional Requirements: The following functionality shall be integral to the control panel.

1. Remote start/stop control
2. Local run/off/auto control
3. Cooldown timer
4. Speed adjust
5. Lamp test
6. Emergency stop push button
7. Voltage adjust
8. Password protected system programming

E. Digital Monitoring Capability: The controls shall provide the following digital readouts for the engine and generator. All readings shall be indicated in either metric or English units.

1. Engine
  - a. Engine oil pressure
  - b. Engine oil temperature
  - c. Engine coolant temperature
  - d. Engine RPM
  - e. Battery volts
  - f. Engine hours
  - g. Service maintenance interval

2. Generator

- a. Generator AC volts (Line to Line, Line to Neutral and Average)
- b. Generator AC current (Avg and Per Phase)
- c. Generator AC Frequency
- d. Generator kW (Total and Per Phase)
- e. Generator kVA (Total)
- f. Generator kVAR (Total)
- g. Power Factor (Avg and Per Phase)
- h. Total kW-hr
- i. Total kVAR-hr

F. Alarms and Shutdowns: The control shall monitor and provide alarm indication and subsequent shutdown for the following conditions. All alarms and shutdowns are accompanied by a time, date, and engine hour stamp that are stored by the control panel for first and last occurrence:

1. Engine Alarm/Shutdown

- a. Low oil pressure alarm/shutdown
- b. High coolant temperature alarm/shutdown
- c. Loss of coolant shutdown
- d. Overspeed shutdown
- e. Overcrank shutdown
- f. Emergency stop shutdown
- g. Low coolant temperature alarm
- h. Low battery voltage alarm
- i. High battery voltage alarm
- j. Control switch not in auto position alarm
- k. Battery charger failure alarm

2. Generator Alarm/Shutdown

- a. Generator over voltage
- b. Generator under voltage
- c. Generator over frequency
- d. Generator under frequency
- e. Generator reverse power

G. Inputs and Outputs

1. Programmable Digital Inputs. The Controller shall include the ability to accept programmable digital input signals. The signals may be programmed for either high or low activation using programmable Normally Open or Normally Closed contacts.

2. Programmable Discrete Outputs. The control shall include the ability to operate discrete outputs, integral to the controller, which are capable of sourcing up to 200mA per input.
  - a. The solenoid valve on the heat exchanger shall receive a start command from the run relay contact.

#### H. Accessibility and Maintenance

1. All engine, voltage regulator, control panel and accessory units shall be accessible through a single electronic service tool. The following maintenance functionality shall be integral to the generator set control:
  - a. Engine running hours display
  - b. Service maintenance interval (running hours)
  - c. Engine crank attempt counter
  - d. Engine successful starts counter

#### I. Remote Communications

1. Remote Communications. The Communications Module (CCM) shall provide bi-directional communication between a personal computer (PC) or other RS-232 type device, and up to 8 EMCP II Control Panels. CCM output shall be compatible for either direct connection or connection via a Hayes compatible modem. The module shall include a digital display to indicate the status of communications and fault conditions. The adaptor shall be microprocessor based 100% solid state and comply with FCC Class A requirements for computer equipment. It shall operate in -40°C to 70°C ambients and be suitable for switchgear or similar mounting.
2. Remote Monitoring Software. The control shall provide Monitoring Software with the following functionality
  - a. Monitor up to eight (8) generator sets.
  - b. Provide access to all date and events on generator set communications network
  - c. Provide remote control capability for the generator set(s)

#### J. Local and Remote Annunciation

1. Local Annunciator (NFPA 99/110, CSA 282). Provide a local, control panel mounted, annunciator to meet the requirements of NFPA 110, Level 1.
  - a. Annunciators shall be networked directly to the generator set control

- b. Local Annunciator shall include a lamp test pushbutton, alarm horn and alarm acknowledge pushbutton
- c. Provide the following individual light indications for protection and diagnostics:
  - (1) Overcrank
  - (2) Low coolant temperature
  - (3) High coolant temperature warning
  - (4) High coolant temperature shutdown
  - (5) Low oil pressure warning
  - (6) Low oil pressure shutdown
  - (7) Overspeed
  - (8) Low coolant level
  - (9) EPS supplying load
  - (10) Control switch not in auto
  - (11) High battery voltage
  - (12) Low battery voltage
  - (13) Battery charger AC failure
  - (14) Emergency stop

2. Remote Annunciator (NFPA 99/110, CSA 282). Provide a remote annunciator to meet the requirements of NFPA 110, Level 1.

- a. The annunciator shall provide remote annunciation of all points stated above and shall incorporate ring-back capability so that after silencing the initial alarm, any subsequent alarms will sound the horn. Ability to be located up to 1000 ft from the generator set without the use of a data repeater.

K. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector shall perform the following functions:

- 1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
- 2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
- 3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.

4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

## 2.4 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H insulation. Windings shall be of the random wound type. Temperature rise shall not exceed 125°C over 40°C ambient temperature.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Enclosure: Drip proof.
- G. Instrument Transformers: Mounted within generator enclosure.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
  1. Voltage adjustment on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
- I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- K. Provide each generator rated for continuous standby service at 1000 kW, 1250 kVA at 0.8 power factor, 4160Y/2400 volts, three phase, three wire, wye connected, 60 Hertz, 1800 rpm, with a temperature rise not exceeding 105 degrees C in an ambient temperature of 40 degrees C. (Do not specify 80 degree C rise for standby generators smaller than 1500kW as it is not readily available in the smaller sizes and the added cost cannot be justified for standby applications. Follow recommendations in manufacturer's sizing software.)

## 2.5 VIBRATION ISOLATION DEVICES

- A. Restrained Spring Isolators: Freestanding, steel, open-spring isolators.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions, NFPA 110 and all local codes
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- C. Install packaged engine generator with restrained spring isolators having a minimum deflection of 1 inch.
- D. Install Schedule 40, stainless steel piping with welded joints and connect to engine muffler. Install thimble at roof. Piping shall be same diameter as muffler outlet.
  1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, stainless steel pipe with welded joints.

- E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted. Electrical wiring includes but is not limited to battery chargers, heaters, control power, load bank, grounding, remote annunciator panels, remote control panels, etc. Contractor to include as part of their scope of work, wall wiring and empty conduit indicated on contract drawings, specified herein, indicated/noted on approved manufacturers shop drawings and as required to provide a fully functional system.
- F. Install piping as specified in Division 23 Sections. Drawings indicate general arrangement of piping and specialties.
- G. Arrange fuel, cooling-system, and exhaust-system piping to packaged engine generator to allow service and maintenance.
- H. Connect cooling-system water piping to engine-generator set and with single braid corrosion resistant type 302 stainless steel wire braid and compression fittings.
- I. Connect engine exhaust pipe to engine with stainless steel flexible connector.
- J. Connect fuel piping to engines with a gate valve and union and stainless steel flexible connector. Provide all required fire safe-off and solenoid valves.
- K. Connect to SCADA, coordinate with controls contractor.
- L. Ground equipment according to Division 26 Section 26 05 26.
- M. Connect wiring according to Division 26 Section 26 05 19.

### 3.3 FIELD QUALITY CONTROL

- A. Initial Test Run: Test start and run the engine generator set at no load for at least 30 minutes to check dc starting system, vibration free installation, fuel line leaks, all gauges and meters, engine rpm, generator voltage and to warm up the engine generator for the load test, as per the manufacturer's instructions.
- B. Inspections: Inspect all engine generator systems after initial test run for defects and rectify in accordance with manufacturer's instructions.
- C. Tests: Carry out a field test of the engine generator system for 4 hours at full load in the presence of the ENGINEER. Furnish dry type load banks for the load test and provide precise incremental loading on engine generator till full load. Check phase voltages, current frequency, vibration, and temperatures as per manufacturer's instructions.

### 3.4 OPERATION DEMONSTRATION

- A. Manufacturer's Service Representative: Furnish the services of the engine generator manufacturer's representative to assist in installation, start-up, field testing,

calibration, placing into operation and provide training, as specified in Section 01 79 00 including the acceptance test run of the set. have the representative carry out a thorough inspection of the installation; certify that the installation is correct and complete in accordance with the manufacturer's instructions; to confirm that the set is ready for acceptance test run; and to instruct operating personnel in the operation and maintenance of the set.

- B. Final Acceptance Test (Demonstration) Run: Have the manufacturer's service representative perform the final acceptance test run of the engine generator set in the presence of the ENGINEER. Perform the final acceptance test run by simulating a power failure and observing automatic engine generator startup, acceleration to speed and assumption of available load at the site without any problems and as per claimed performance. Demonstrate the compatibility of the engine generator with the adjustable frequency drives and solid-state starters used for motors; and its capability to start and operate the loads in the desired sequence. Also demonstrate that the engine generator is capable of starting and sustaining the load with a voltage drop of not more than 20 percent of the rated value. Simulate and demonstrate that the alarm and shut down features operate satisfactorily.
- C. Training: Following completion of installation and field testing furnish training for 12 employees of the OWNER in the proper operation, troubleshooting and maintenance of the equipment as outlined below. All training will be at the OWNER'S facilities at a time agreeable to the OWNER:
  - 1. Operational Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction , excluding travel time.
  - 2. Maintenance Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.
- D. Lubricants, Coolants, Filters and Fuel: Upon satisfactory completion of all tests and training, replenish all lubricants and coolant to factory recommended levels. Check all filters for serviceability and replace if needed. Top off fuel tanks to full capacity.

### 3.5 CLEANING AND PAINTING

- A. Shop Painting: Paint the generator systems as specified in Section 09 90 00.
- B. Field Painting: Touch up scratched and marred surfaces to match with original finishes.

### 3.6 IDENTIFICATIONS

- A. General: Provide identifications meeting the requirements of Section 26 05 53.

- B. Component Identification: Identify all system components, cables and wires by applicable labels indicating unit numbers, circuit numbers.

END OF SECTION

(NO TEXT ON THIS PAGE)

SECTION 26 33 00  
BATTERY SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Requirements for providing battery systems as indicated, in accordance with the Contract Documents.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 26 05 00 - Basic Electrical Materials and Methods
  - 2. Section 26 05 26 - Grounding
  - 3. Section 26 05 53 - Electrical Identification
  - 4. Section 26 08 00 - Electrical Testing Requirements
  - 5. Section 26 05 19 - Wire and Cables - 600 Volts and Below
  - 6. Section 26 05 33 - Electrical Raceway Systems
  - 7. Section 26 13 00 - Medium Voltage Switchgear

1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. IEEE 485 - IEEE Recommended Practice for Sizing Lead Acid Batteries for Stationary Applications
  - 2. NFPA 70 - National Electrical Code (NEC)
  - 3. UL 486A - Wire Connectors
  - 4. UL 924 - Emergency Lighting and Power Equipment
- B. Materials and Workmanship Requirements: Provide all battery systems meeting the requirements of NFPA standards and codes.
- C. Design, Manufacture and Testing Requirements: Provide battery system components that are designed, manufactured and tested in accordance with the latest NEMA, IEEE and ANSI standards and are UL listed.
- D. Installation Requirements: Install battery systems in accordance with the requirements of NEC and local electrical codes.

1.3 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01 and Section 26 05 00.
- B. Product Data and Information: Furnish manufacturer's catalog data on the battery systems' major components and accessories, including batteries, battery charger and dc distribution panel indicating type, model, service voltages, number of phases, current ratings, sequence of operation and control and alarms. Furnish manufacturer's schematic control diagrams and interconnection diagrams with terminals for connection of equipment external to the battery system.
- C. Battery Sizing Calculations: Furnish battery sizing calculations meeting the following criteria:
  - 1. Size batteries to provide a capacity of at least two times the total requirement on an 8-hour rating plus the sum of all simultaneous operating trip coils on a 1-minute rating to a final voltage of 1.75 volts per cell in accordance with IEEE 485.
  - 2. Use the following loads and duty cycles for sizing the batteries:

Battery Duty Cycle	
Load Description	Duty Cycle (Approximate operating time)
Simultaneous operation of the circuit breakers, trip coils and spring-charging motors	10 seconds
Switchgear indicating lights and relays	24 hours
Simultaneous operation of the circuit breakers, trip coils and spring-charging motors	10 seconds to occur after 8 hours

- D. Battery Charger Calculations: Furnish battery charger calculations confirming the charger is capable of fully recharging the batteries from low level within 12 hours while continuing to provide the full power requirements of the system.
- E. Shop Drawings: Furnish manufacturers layout drawings for the battery systems showing accurately scaled plan views and elevations.

1.4 OPERATION AND MAINTENANCE MANUALS

- A. General: Furnish operation and maintenance manuals including spare parts list for the battery systems as specified in Division 01.

## 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 and Section 26 05 00.
- B. Storage and Protection: Store battery system equipment in a dry, covered, heated and ventilated location. Provide any additional measures in accordance with manufacturer's instructions.

## 1.6 SPARE PARTS

- A. General: Furnish the following spare parts for each group of similar battery systems.
  - 1. All spare parts and accessories recommended by the manufacturer in published literature. As a minimum, provide the following:
    - a. Six of all sizes and types of power and control fuses
    - b. One battery test kit
    - c. One set of interior and interstep jumpers of each length used
    - d. Six terminal lugs
    - e. One cell lifting strap
    - f. Three 12-ounce spray cans of the final finish for touch-up
- B. Packaging: Package spare parts and accessories in containers bearing labels and identify all for reordering. Deliver all in original factory packages.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Batteries
    - a. Enersys
    - b. C&D Technologies
    - c. Emerson Network Power/Chloride Industrial Power
    - d. Johnson Controls Inc.

2. Chargers
  - a. La Marche
  - b. Sens
  - c. Saft
  - d. Hindle Power

## 2.2 MATERIALS

- A. General: Provide central station-type battery systems, 125 volts dc nominal, complete with console and built-in batteries, battery chargers and dc secondary distribution panel, as shown.
- B. Battery Console: Provide the consoles that are in compliance with the provisions of UL 924 and the National Electrical Code. Provide flue-effect cooling by a completely-open raised bottom and openings at the top of both front and rear. Protect all ventilation openings by heavy perforated metal. Equip doors with key locks, and a tamper-resistant, glass, viewing panel.
- C. Batteries: Provide valve-regulated lead-acid (VRLA) type station batteries with flame arrester. Provide a NEMA 1 enclosure for the batteries on two tier racks.
- D. Battery Chargers:
  1. Provide high-frequency switch-mode battery charger with automatic voltage regulation arranged for operation at 120 volts ac, 1-phase, 60-hertz.
  2. Provide dual battery chargers with load-sharing feature. Provide chargers arranged so that if one fails the other will accept the complete load. Provide chargers that have a nominal output voltage of 130 volts. Provide inverse temperature compensations of plus or minus one percent regulation from no load to full load with plus or minus 10 percent ac voltage variation. Provide continuous, current-limiting features at no more than 140 percent of rated current.
  3. Provide low-voltage dc alarm and ac power failure relays with contacts for remote alarm indication.
  4. Provide automatic load-equalizing devices.
  5. Provide LCD front panel display with voltage and current indication.
  6. Provide LED front panel alarm and status indicators, including:
    - a. Fan Failure
    - b. AC Failure/ AC Available
    - c. Over-Temperature
    - d. Current Limit

- e. Thermal Control
- f. Float/Equalize
- g. Positive and Negative Ground

- 7. Provide fuse protection on ac input and and dc output.
- 8. Provide surge suppressors, ground fault indication and alarm devices.

E. Dc Distribution Panel:

- 1. Provide a 125-volt dc, secondary distribution, circuit breaker panel located as shown on the Drawings, with molded-case circuit breakers as scheduled, having an interrupting capacity of 10000 amperes. Provide a panel with its own door to protect the circuit breakers.

Provide the following alarm functions wired to a labeled terminal strip for remote alarm indication:

- a. Charger No. 1 Failure
- b. Charger No. 2 Failure
- c. Battery Low Voltage
- d. Ac Power Failure
- e. Dc Power Ground Fault

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install all battery systems as indicated and in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 01. Comply with the requirements of NEMA standards, NEC, and applicable ANSI Publications.
- B. Coordination: Coordinate with cabling/wiring, as necessary, to interface the installation of battery charger.
- C. Torque Requirements: Tighten electrical connectors and terminals, including screws bolts and ground connections, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals in accordance with UL Std 486A.
- D. Fuses: Provide required fuses.
- E. Adjustments: Make all necessary adjustments to the equipment to provide complete and satisfactory operation.

### 3.2 FIELD QUALITY CONTROL

- A. **Manufacturer's Representative:** Furnish the services of a factory-trained, experienced, competent, and authorized representative of the manufacturer of the battery equipment to visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation as specified in Division 1. Provide all instruments necessary to conduct the required tests and adjustments. Have the manufacturer's representative utilize prepared comprehensive check sheets covering inspections, and required checks and tests. Furnish copies of these documents executed and signed by the manufacturer's representative. Have the representative present when the equipment is placed in operation. Furnish the representative's services as often as necessary until all problems are corrected and the equipment is installed and operating satisfactorily.
- B. **Certified Report:** Furnish a written report certifying that the equipment (1) has been properly installed, (2) is in accurate alignment, (3) is free from any undue stress imposed by connections or anchor bolts, and (4) has been operated under full load conditions and that it operated satisfactorily.
- C. **Tests and Inspections:** Perform the following tests and inspections: Record all tests and submit a written report for approval with retests as necessary.
1. Inspect battery for physical damage.
  2. Verify system configuration with drawings.
  3. Check that battery ampere-hour rating and charger are adequate for the system.
  4. Check intercell bus link integrity.
  5. Examine the electrolyte level in each cell. Verify that the electrolyte level is between the low and high level lines. If the level is lower than 1/2-inch below the top of the plates, replace the battery since it is considered damaged.
  6. Check the new battery installation on the rack using the manufacturer's recommended spacing between units and that the positive of one unit is connected to negative of the adjacent unit.
  7. To provide a good connection, check the battery terminals and all intercell connector links and cables to be sure they are cleaned and that the no-oxide grease is properly applied according to the manufacturer's instructions.
  8. Measure the resistance of each intercell connection using a 10 amp ductor in accordance with manufacturer's instructions. If the measured resistance value is 10 percent above the average, take corrective measures by tightening, cleaning or re-greasing the connection until its resistance measurement reaches an acceptable level.

9. Measure system charging voltage.
10. Test all battery charger alarm circuits.

### 3.3 GROUNDING

- A. System: Inspect the ground system for compliance with the latest drawings.
- B. Connections: Inspect all ground connections for evidence of looseness and/or corrosion.

### 3.4 CLEANING AND PAINTING

- A. Shop Painting: Paint the battery system as specified in Section 09 90 00.
- B. Field Painting: Touch up scratched and marred surfaces to match with original finishes.

### 3.5 IDENTIFICATIONS

- A. General: Provide identifications meeting the requirements of Section 26 05 53.
- B. Component Identifications: Identify all system components, cables and wires by labels indicating unit numbers, circuit numbers and date of installation.

END OF SECTION

(NO TEXT ON THIS PAGE)

## SECTION 26 33 53

### UNINTERRUPTIBLE POWER SUPPLY SYSTEMS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing and testing three-phase modular uninterruptible power supply (UPS) systems consisting of rectifier/battery charger, solid-state inverter, static transfer switch, manual bypass switch, batteries with associated controls, ac and dc protection, instrumentation and alarms; housed in suitable metal enclosures.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to the Following:
  - 1. Section 01 79 00 - Training
  - 2. Section 26 05 00 - Basic Electrical Materials and Methods
  - 3. Section 26 05 26 - Grounding
  - 4. Section 26 05 53 - Electrical Identification
  - 5. Section 26 05 19 - Wires and Cables - 600 Volts and Below
  - 6. Section 26 05 33 - Electrical Raceway Systems

##### 1.2 REFERENCES

- A. Codes and Standards: The following codes and standards are referred to in this Section as follows:
  - 1. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors
  - 2. UL 1778 - Uninterruptible Power Supply Equipment
  - 3. NFPA 70 - National Electrical Code
  - 4. IEEE 446 - Recommended Practice for Standby Power Systems
  - 5. IEEE C62.41 - Recommended Practice for Surge Withstand ability
  - 6. NEMA PE 1 - Uninterruptible Power Systems
  - 7. OSHA - Occupational Safety and Health Administration
  - 8. Quality System Standard ISO 9001

### 1.3 SUBMITTALS

- A. General: Furnish all submittals, including the following, in accordance with the requirements contained in Division 01.
- B. Product Data and Information: Furnish manufacturers data on all equipment and devices in the assembly, including voltages, number of phases, current ratings, capacities, finishes for all the system components and other relevant data.
- C. Contractors Shop Drawings: Furnish contractors shop drawings for the shop assembled equipment, including the following:
  - 1. Layout drawings of the assembly showing accurately scaled basic equipment sections, auxiliary compartments, combination sections and location of various system components and their interconnection. Show special relationships of assemblies to associated equipment, including plan and front views of the equipment and layout dimensions. Provide a bill of materials.
  - 2. Wiring diagrams for assemblies showing connections to electrical power. Clearly differentiate between shop-installed portions of wiring and field installed portions.
  - 3. Furnish construction drawings for equipment requiring field assembly. Clearly differentiate between shop-assembled portions and field assembled portions.
  - 4. A schematic control diagram for the entire system showing connections to other related systems.
  - 5. Manufacturer's installation, testing and commissioning instruction for the entire system.
- D. Quality Control: Furnish manufacturers test reports and certified performance records of all equipment installed. Furnish field test reports after equipment is installed.
- E. Operations and Maintenance Manuals: Furnish Operations and Maintenance Manuals of all equipment and assemblies in accordance with Division 01.

### 1.4 QUALITY ASSURANCE

- A. Codes: Comply with local codes and all other applicable codes.
- B. Regulatory Requirements: Comply with applicable Regulatory Agency requirements.

## 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials in accordance with the requirements contained in Division 01.

## 1.6 WARRANTY

- A. General: Provide warranty for all equipment and services furnished as described in Division 01 of these Specifications.

## 1.7 SPARE PARTS

- A. General: Provide the following spare parts:
  - 1. One set of each type of fuses.
  - 2. Two batteries of each type and rating.
- B. Packaging: Pack spare parts in containers bearing labels clearly designating contents and related pieces of equipment. Deliver spare parts in original factory packages. Identify all spare parts with information needed for reordering.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are as listed below. Other manufacturers of equivalent products may be submitted for approval for review.
  - 1. Three-phase UPS system.
    - a. ABB Group, TLE Series
    - b. Vertiv/Liebert, EXM Series
    - c. Eaton/Tripplite, SmartOnline Series

### 2.2 SINGLE-PHASE UPS SYSTEMS

- A. Operating Parameters: Provide UPS systems having the following operating parameters:
  - 1. Nominal Power Rating: 40 kW/40 kVA
  - 2. Input Voltage: 480 Volts, 3-phase, 3-wire  $\pm 10$  percent without discharging the battery.
  - 3. Input Power Factor: 99 percent minimum at full load and nominal voltage.
  - 4. Current Distortion (THDi):  $\leq 3\%$  input current THD at full load at nominal input voltage.

5. Rectifier and Bypass Surge Protection: module shall withstand tested according to IEC 62040-2:2016 that requires 1kV L-L and 2kV L-PE
6. Withstand Rating: UPS module shall carry 65kA standard for short circuit withstanding. System has been tested under the guidance of U.L. as to meet National Electrical Code.
7. Output Voltage: 277Y/480 Volts, 3-phase,4-wire.
  - a. Voltage Regulation:  $\pm 1\%$  nominal voltage at balance load.
  - b. Voltage Adjustability:  $\pm 4\%$  adjustable
  - c. Dynamic Regulation:  $\pm 3\%$  from nominal for 0 to 100% step load. Recovering to within 1% in less than 1 cycle.
  - d. Voltage unbalance:  $\pm 3\%$  of nominal for 100% unbalanced loads
8. Phase Imbalance:
  - a.  $120^\circ \pm 1\%$  of nominal for 100% balanced loads.
  - b.  $120^\circ \pm 3\%$  of nominal for 100% unbalanced loads
9. Voltage Harmonic Distortion @Linear Load:  $<3\%$  THD at 100% load
10. Voltage Harmonic Distortion @non-Linear Load:  $<5\%$  THD at 100% load (per - IEC62040)
11. Output Frequency: 60 Hz  $\pm 10$  percent
  - a. Frequency Stability: 60 HZ  $\pm 0.01\%$  free running.
  - b. Phase-lock Window: 60 HZ,  $\pm 4\%$  (adjustable).
  - c. Frequency Slew Rate: 0.1 Hz to 20 Hz/second, selectable in 0.1 Hz increments.
12. Overload Capability: 110 percent for 10 minutes
  - a. Inverter Overload:
    - (1) 105% continuous operation
    - (2) 110% for 10 minutes
    - (3) 125% for 1 minute
    - (4) 150% for 30 seconds

- b. 14. Static Bypass Overload:
  - (1) 110% Continuous (at 25°C Ambient temperature)
  - (2) 150% for 1 minute
- 13. Operate under the following ambient conditions:
  - a. Ambient Temperature: 0 to 30 degrees C (+32 to +86 degrees F)
  - b. Humidity: 0 to 95 percent non-condensing
- 14. Acoustical Noise: less than 65-decibels, A-weighted at 3 feet
- 15. Minimum Battery Backup Time: Batteries shall support the UPS at 100% rated kW load for at least 120 minutes at end of life (EOL run time) at 77°F (25°C).
- 16. Install batteries in a matching cabinet.

B. System Description

- 1. The UPS shall be of transformer-free design, requiring no internal transformer in the main power path for the basic operation of the module.
- 2. System shall be of modular construction, allowing up to six (6) UPS modules to be paralleled in any combination for capacity or redundancy
- 3. Modules shall be easily serviced from the front of the enclosure. Major consumable parts (fans, capacitors, etc.) shall be interchangeable, without the need of replacing the whole Power Block. Cable and conduit connections shall be through the top or bottom of the UPS enclosure and terminations can be made from the front of the UPS.
- 4. The UPS shall be able to supply all required power to full rated output kVA loads with power factor from 0.7 leading to 0.6 lagging.

C. Description of Operation: Design three-phase UPS systems to operate as follows:

- 1. Normal Operation: Power the load continuously from the inverter. Derive the power for the rectifier/battery charger from the ac incoming line to provide dc power to the inverter while simultaneously float charging the battery.
- 2. Emergency: Upon loss of the ac input power, continue to power the load from the inverter without interruption or switching while the battery provides dc power to the inverter.

3. Battery Recharge: Upon restoration of the ac power, power the load continuously from the inverter while the rectifier/battery charger provides dc power to the inverter while simultaneously recharging the battery.
  4. Bypass Mode: Upon failure of the UPS system, transfer the load from the inverter to the ac line using a static-bypass transfer switch.
  5. Maintenance Bypass/Test Mode: Provide a manual make-before-break maintenance bypass switch to isolate the UPS for maintenance and testing.
- D. Rectifier/Battery Charger: Provide rectifier/chargers to convert the input AC power to a regulated dc voltage with the following features:
1. Solid state rectifier/charger of a modular design to facilitate maintenance.
  2. Size the rectifier/charger to serve full load of the inverter and fully recharge the battery within 10 times the rated run time at full load.
  3. Provide fuses to protect the rectifier/charger.
- E. Batteries: Use sealed, maintenance-free, high-discharge rate batteries consisting of lead acid cells. Size batteries for the specified backup time having a minimum end voltage of 1.67 volts per cell.
- F. Inverter: Provide inverters having the following features:
1. Pulse width modulated (PWM) type capable of providing the output power characteristics specified.
  2. Design the inverter of modular assemblies to facilitate maintenance.
- G. Static-Bypass Transfer Switches: Provide solid-state transfer switches rated for continuous duty with the following operational features:
1. Uninterrupted Transfer: Transfer the load to the bypass source without interruption upon sensing any of the following fault conditions:
    - a. Inverter overload
    - b. Inverter failure
    - c. Battery low voltage
  2. Interrupted Transfer: Transfer the load to the bypass source with an interruption not exceeding 0.2 seconds during a fault condition when any of the following occur:
    - a. Bypass voltage exceeds  $\pm 10$  percent of the UPS rated output voltage.
    - b. Bypass frequency exceeds  $\pm 2$  hertz from the UPS rated output frequency.

3. Forward Transfer: Transfer the load from bypass source to the UPS automatically without an interruption when the UPS is operating within its ratings.
- H. Internal Bypass Switches: Provide internal bypass switches for maintenance of the system.
- I. Enclosures: Provide ventilated, free-standing enclosures for the electronic components of the UPS system. Provide separate free-standing battery enclosures.
- J. Controls, Indicators and Alarms
1. Provide each UPS system with a visual display panel indicating the following parameters:
    - a. UPS On-line
    - b. UPS On Battery
    - c. UPS Off-line
    - d. UPS Fault
    - e. Input voltage
    - f. Bypass voltage
    - g. Bypass input frequency
    - h. UPS Output voltage
    - i. UPS Output frequency
    - j. UPS Output current
    - k. UPS Output kVA
    - l. dc Voltage
    - m. Available battery capacity
  2. Provide each UPS system with the following dry contacts rated 10-amperes at 120V ac:
    - a. UPS On-line
    - b. UPS On Battery
    - c. Load On Bypass
    - d. UPS Fault
  3. Provide each UPS system having the following controls and protection:
    - a. ac circuit breaker
    - b. Inverter "ON/OFF" switch
    - c. Manual bypass switch
    - d. Float/equalize switch
    - e. Transfer test switch
    - f. Emergency Power Off switch

K. Communications

1. The UPS shall allow for flexibility in communications. The UPS shall be able to communicate through two communications ports simultaneously; the media of either communications port may change without affecting the operation of the UPS. The use of relay contacts shall not affect the operation of the two communications ports.
2. RS-232/RJ45 port:
  - a. The UPS shall provide at least one RS-232 port, allowing full remote monitoring, control and management of the UPS system. All access to control functions through this port shall be protected from unauthorized access.
  - b. The RS-232 port shall allow access to critical UPS measurements, functions and historical data through the UPS Management Software suite.
3. Connectivity slot: The UPS shall be equipped with Connectivity slot(s) allowing the installation of the following plug-in options:
  - a. Additional Customer Interface Card (CIC) option, providing: six alarm contacts for remote signaling, two inputs for connection of external contact closures and one RS-232 port.
  - b. SNMP/Web adapter option, providing the following functionalities over an Ethernet connection:
  - c. SNMP Agent for integration into SNMP-based Network Management Systems (NMS)
  - d. Web server for remote monitoring using a standard Web browser
  - e. Modbus TCP or 485 slave for integration into Modbus-based Building Management Systems (BMS)
  - f. Configurable alarm notification via e-mail or SNMP Traps
  - g. Network shutdown of controlled servers following prolonged power outages via UPS Management Software suite.
4. Remote monitoring and diagnostics: UPS shall have a secure TCP/IP based RMD feature available as an option. Activation of this feature is standard and no charge for the first 12months. The feature provides remote monitoring and diagnostics via an in house 24x7 service team, and provides quarterly diagnostics reports, alarm history and power quality trending of the UPS.

L. Identification: Provide identification meeting the requirements of Section 26 05 53.

## 2.3 SOURCE QUALITY CONTROL

- A. General: Provide complete Uninterruptible Power Supply (UPS) systems designed, assembled, wired and tested at the point of manufacture in accordance with the latest NEC (NFPA), NEMA, UL, IEEE and ANSI standards.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install all equipment as indicated, in accordance with manufacturer's written instructions and comply with requirements of NEMA Standards, NEC, project-applicable portions of NECA's Standard of Installation and applicable ANSI Publications.
- B. Coordination: Coordinate with other work including cabling and wiring work as necessary to interface installation of shop assembled equipment with other work.
- C. Torque Requirements: Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals in accordance with UL Standard 486A.
- D. Grounding Connections: Make equipment grounding connections for the shop assembled equipment as indicated on the Drawings. Tighten connections in accordance with UL Standard 486A to assure permanent and effective grounding.
- E. Adjustments: Make all necessary adjustments to the equipment to provide complete and satisfactory operation upon completion of the Contract.

### 3.2 FIELD QUALITY CONTROL

- A. General: Perform field inspection and testing for each UPS system to demonstrate that each unit meets the following:
  - 1. Has not been damaged during transportation and installation.
  - 2. Has been properly installed.
  - 3. Has no mechanical defects.
  - 4. Has been properly connected.

- B. Tests: Perform field tests as follows:
1. Inspect and test the installation with respect to the safety requirements of NEC pertaining to grounding and insulation resistance.
  2. Demonstrate proper operation of each UPS system by simulating conditions.
  3. Repair or replace defective materials at no cost to the (OWNER)
- C. Manufacturer's Field Services: Provide the services of a qualified representative of each manufacturer of the Uninterruptible Power Supply (UPS) systems to inspect the installation of equipment, make any necessary adjustments and instruct the operating personnel about operation, maintenance and provide training as specified in Section 01 79 00.
1. Provide a service engineer when the equipment is placed into operation.
  2. Provide a service engineer at the jobsite as often as necessary until all problems are corrected and the equipment installation and operation are satisfactory.
  3. Following completion of installation and field testing provide training for 12 employees of the OWNER in the proper operation, troubleshooting and maintenance of the equipment as outlined below. Provide training at the OWNER'S facilities at a time agreeable to the OWNER:
    - a. Operational Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.
    - b. Maintenance Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.

END OF SECTION

## SECTION 26 50 00

### LIGHTING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing complete lighting systems as specified and as shown.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 09 21 16 - Gypsum Wallboard System
  - 2. Section 09 51 00 - Suspended Acoustical Ceilings
  - 3. Section 09 96 00 - High Performance Coatings
  - 4. Section 26 05 00 - Basic Electrical Materials and Methods
  - 5. Section 26 05 53 - Electrical Identification
  - 6. Section 26 05 33 - Electrical Raceway Systems
  - 7. Section 26 27 26 - Wiring Devices
  - 8. Section 26 29 33 - Contactors
  - 9. Section 26 30 00 - Control Components and Devices

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. NFPA 70 - National Electrical Code (NEC)
  - 2. UL 924 - Emergency Lighting and Power Equipment

##### 1.3 SYSTEM DESCRIPTION

- A. System Components: Provide all interior and exterior lighting fixtures including all supports, plaster frames, trim rings, outlet boxes, light standards, concrete bases, ground rods, and all accessories and appurtenances required for complete functioning lighting systems, as shown and as specified.
- B. Performance Requirements: Provide lighting systems that adhere to code and are in accordance with manufacturers' recommendations.

##### 1.4 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01.

- B. Manufacturer's Data and Information:
  - 1. Furnish catalog data for all equipment provided under this section including the total input wattage for each type of lighting fixture specified.
  - 2. Furnish complete photometric data reports from an independent testing laboratory with shop drawings for each luminaire. Luminaires submitted without photometric data will not be reviewed.
- C. Shop Drawings: Furnish layout drawings showing arrangement, circuiting, erection requirements of equipment and details of construction and assembly.
- D. Quality Control: Furnish the following:
  - 1. Manufacturers certificates for equipment performance.
  - 2. Manufacturers test reports.
  - 3. Manufacturers installation instructions.
- E. Operation and Maintenance Manuals: Furnish two copies of the operation and maintenance manuals for lighting equipment as specified in Division 01.

#### 1.5 QUALITY ASSURANCE

- A. Codes: Provide materials and workmanship that meet the requirements of the NFPA Standards and the National Electrical Code.
- B. Regulatory Requirements: Provide UL and FMS listed and labeled lighting equipment.
- C. Provide LED fixtures from the Design Lights Consortium (DLC) Qualified Products List (QPL) for the location and application.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 and as follows:
- B. Storage and Protection: Store and protect equipment, components and accessories in accordance with the manufacturer's instructions and in accordance with the requirements of Division 01.

## 1.7 SPARE PARTS

- A. General: Furnish the following spare parts:
  - 1. Fixtures: Provide one lighting fixture of each type for every 40, but not less than one, for each type provided. For LED type, provide 20% spare fixtures.
  - 2. Emergency battery package for LED lighting fixtures: Provide 10 percent, but not less than two, of each type of provided.
  - 3. Provide two sets of special tools that may be required for maintenance of lighting fixtures.
- B. Packaging: Deliver all spare parts neatly wrapped or boxed, indexed and tagged with complete information for use and reordering.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. General: The lighting fixture descriptions and catalog numbers listed in the Lighting Fixture Schedule are used to indicate the acceptable quality, design and distribution characteristics of approved lighting fixtures.
  - 1. Emergency Battery Packages for LED Lighting Fixtures:
    - a. Philips/Bodine
    - b. Radiant Power Corp.
    - c. Siltron
  - 2. Emergency Battery Systems:
    - a. Emerson Network Power/Chloride Industrial Power
    - b. Hubbell/Dual-Lite
    - c. Teledyne/Big Beam
  - 3. Luminaire Quick Disconnects:
    - a. WAGO
    - b. Sta-Kon (Thomas and Betts/ABB Group)

### 2.2 MATERIALS

- A. General: Provide lighting fixtures complete with all required lamps, ballasts, fittings, receptacles, gaskets, globes and diffusers, as shown and scheduled.

- B. Wiring Channel Construction: Construct the wiring channels to permit access to the auxiliaries and sockets for repair or replacement of components without removal of the fixture.
- C. Suspended Ceilings: Provide fixtures suitable for the type of suspended ceilings in which they are installed. Provide trim moldings to conceal exposed parts of a concealed ceiling suspension system.
- D. Plaster Frames: Provide plaster frames for all fixtures recessed in plaster ceilings.
- E. Globes: Provide gasketed, heat and impact-resistant, glass globes for incandescent, compact fluorescent, metal halide and sodium vapor fixtures.
- F. Lamp Holders: Rigidly support screw-type, lamp holders, secure them against turning, and install them in a manner that allows for easy replacement. In general, fixtures designed to accept lamps of different wattages shall have adjustable sockets to allow for variations in lamp light centers. Provide brass, shell-type lamp holders. Aluminum shells will not be accepted.
- G. Insulation: Provide a wire insulation systems and components that are capable of withstanding the temperatures to which they will be subjected in the fixture, while maintaining normal expected ballast life.

## 2.3 COMPONENTS

### A. LED Drivers

1. Provide LED drivers meeting the following requirements:
  - a. Minimum Efficiency: 85%.
  - b. Starting Temperature: - 40 degrees F.
  - c. Input Voltage: 120 – 480 volts.
  - d. Power Supplies: Class I or II output.
  - e. Power Factor: .90 or greater.
  - f. Total Harmonic Distortion: 20% or less.
  - g. Comply with FCC Title 47, CFR Part 18 Non-consumer RFI/EMI Standards.
  - h. Drivers shall be reduction of hazardous substance (ROHS) compliant.
  - i. Surge Protection: Survive 250 repetitive strikes of “C Low” waveforms at 1 minute intervals with less than 10% degradation in

clamping voltage. "C Low" waveforms are as defined in IEEE/ANSI C62.41.2-2002, Scenario 1 Location Category C.

B. LED Sources

1. Provide LED sources meeting the following requirements:
  - a. Operating Temperature Range: - 40 degrees F and 120 degrees F.
  - b. Correlated Color Temperature: As scheduled.
  - c. Color Rendering Index: 65 and greater.

C. Emergency Battery Packages For LED Lighting Fixtures:

1. General: Provide emergency battery packages for the designated LED lighting fixtures as listed in the Lighting Fixture Schedule. Provide a test station suitable for remote mounting. Provide an emergency lighting system that will normally operate from the ac wiring system, with the capability of operating the fixture for a period of 1-1/2 hours during an ac power outage. Provide battery packages listed by UL, and complying with OSHA regulations for emergency lighting.
2. Electronic Assembly: Provide an emergency battery package with an electronic inverter or driver, battery charger, solid-state transfer switches and ON indicating light circuit. Hermetically seal the electronic assembly in a low profile case.
3. Battery Packs: Provide battery packs of the nickel-cadmium, rechargeable type, encased in a low profile case. Under emergency mode, provide batteries with sufficient capacity to provide approximately 40 percent of the rated lumen output of the scheduled fluorescent lamps during the power outage.
4. Wiring: Factory install the electronic assembly and battery pack within the lighting fixture housing.
5. Test Station: Provide a test station consisting of a test button and charger ON indicating light suitable for remote mounting in flush- or surface-mounted outlet boxes. Provide test buttons of spring-loaded-return, normally-on type. Provide an indicating light of the solid-state indicator lamp type.

2.4 EXIT SIGNS

- A. General: Provide fully-automatic, self-contained, battery-pack, LED type exit signs, normally operated from the ac wiring system, but capable of remaining lighted for a period of 1.5 hours during an ac power outage. Provide exit signs suitable for dual voltage input with surge protection suitable for operation on either 120 volts or 277 volts. Equip each sign with nickel cadmium batteries and a totally solid-state

charger which constantly evaluates the state of charge of the batteries and keeps them fully charged. Provide a charger that is capable of fully recharging the batteries in 24 hours, following a discharge. Provide a press-to-test switch located on the bottom of the housing to test the lamps and battery, and an ac indicator lamp to indicate that the charger is functioning and the unit is in operating condition. Provide UL listed exit signs complying with OSHA regulations.

- B. Construction: Provide exit signs having a cast-aluminum housing with field selectable direction arrows, a red, translucent optical diffuser over the LED lamps, single or double-faced, as listed in the Lighting Fixture Schedule or as shown.

## 2.5 OUTDOOR LIGHTING

- A. General: Provide outdoor lighting luminaires as listed in the Lighting Fixture Schedule.
- B. Mounting: Mount outdoor lighting on building exterior as shown.

## 2.6 EMERGENCY BATTERY LIGHTING

- A. General: Provide emergency battery lighting equipment as listed in the Lighting Fixture Schedule capable of providing emergency lighting instantaneously upon the failure or interruption of the normal electric power supply.
- B. Batteries: Provide 12-volt, sealed, maintenance-free, batteries as specified capable of operating 40 watts of light for 1-1/2 hours to 87-1/2 percent of the battery capacity.
  - 1. Charging Systems: Provide solid-state, 2-rate, charging systems consisting of a high-charge rate and a trickle-charge rate. Provide chargers suitable for operation on 120 or 277 volts.
  - 2. Lamps: Provide LED type lamps.
  - 3. Housings: Provide NEMA 12 sealed and gasketed, fiberglass or thermoplastic enclosures.
  - 4. Controls: Provide a test push buttons and ac ON indicating lights.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Packing: Suitably pack and rigidly brace all equipment and protect it against weather, damage and undue strain during shipment.

## 3.2 INSTALLATION

- A. General: Install lighting fixtures and lamps in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1. Locate fixtures to suit the architectural details of the area involved. Coordinate placement with the details indicated on the architectural reflected ceiling drawings or architectural elevations. Install lamps of proper type, wattage and voltage rating in fixtures prior to completion of project. Install all fixtures to comply with applicable provisions of the NEC. Provide fluorescent fixtures "quick disconnects" when not factory installed.
- B. Recessed Fixtures: Install recessed fluorescent fixtures in suspended ceiling openings in conformance with manufacturer's recommendations. Install fixtures with adjustable fittings to permit alignment with ceiling panels. Support recess fixtures using the ceiling suspension system. Provide additional steel work as required to support fixtures. Install recessed fixtures to permit removal from below.
- C. Obstructions: In areas, such as equipment and mechanical rooms, which have obstructions at the ceiling or walls such as ducts, large pipes, groups of pipes, and like items, install fixtures so that maximum utilization of the light is achieved.
- D. Accessories: Provide straps, mounting plates, nipples, plaster rings, brackets and all accessories necessary for proper installation.
- E. Suspended Fixture Support: Support suspended fixtures by approved means, consisting of rods, stems attached to studs, hickies and suitable outlet box cover aligners of the shock-absorbing, vaportight or swivel type having flexible joints permitting fixtures to hang plumb. Install stems using 3/4-inch galvanized steel conduits, unless otherwise specified. Where indicated or required, support fixtures by means of a suspended channel. Provide channels that meet the requirements for the type of conduit provided, as specified in Section 26 05 33. Where the channel is used as the wiring raceway, provide closure strips, end caps and fittings as required for an approved raceway.
- F. Emergency Lighting: Connect emergency light fixtures and exit signs to separate unswitched circuits in the lighting panelboard. Lock these circuit breakers in the closed position.
- G. Test Station: Install the test station for fluorescent fixtures with emergency battery package on the nearest wall or column at 5 feet above finished floor. Surface mount the test stations, except flush mount them in partitioned construction and architecturally finished areas.
- H. Exit Fixtures: In general, mount exit and stair sign fixtures so that the bottom of the fixture will be centered and three inches above the top of the door frame. Variations in the mounting height and horizontal offsets are to be approved by the Engineer.
- I. Nameplates: Install nameplates as specified in Section 26 05 53.

### 3.3 FIELD QUALITY CONTROL

- A. Testing: Test the entire lighting system for continuity and balance after installation and prior to acceptance.

### 3.4 ADJUSTING

- A. Fixtures: Aim and adjust fixtures as shown.
- B. Exit Sign Arrows: Adjust exit sign directional arrows as shown.

### 3.5 OPERATION DEMONSTRATION

- A. Manufacturer's Representative: Furnish the services of an authorized and qualified representative of the manufacturer of the emergency system battery packages for high intensity discharge luminaires as specified in Division 1 and sign and date the manufacturer's warranty book/card on behalf of the manufacturer for the equipment and system components installed.

### 3.6 CLEANING AND PAINTING

- A. Shop Painting: Shop paint equipment as specified in Section 09 96 00.
- B. Steel Surfaces: Prior to final completion of the Work, thoroughly clean all steel surfaces and retouch all scratches and abrasions. Use the same paint as used for shop finishing coats.
- C. Photometric Control Surfaces: Clean photometric control surfaces as recommended by the manufacturer.

END OF SECTION

## SECTION 26 24 13

### 480V MOBILE GENERATOR TERMINATION CABINET

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing a low voltage, front accessible, freestanding, termination cabinet for use as an intermediate termination point between the trailer mounted portable generator and the disconnecting means feeding the designated emergency loads as shown on the Contract drawings. The cabinet is to include the following major components:
1. Stationary structure including phase, neutral and ground bus bars
  2. Mechanical line and load cable lugs.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to the Following:
1. Section 26 05 00 - Basic Electrical Materials and Methods
  2. Section 26 05 26 - Grounding
  3. Section 26 05 53 - Electrical Identification
  4. Section 26 08 00 - Electrical Testing Requirements
  5. Section 26 05 73 - Short Circuit and Coordination Study
  6. Section 26 05 19 - Wires and Cables - 600 Volts and Below

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
1. NEC - National Electrical Code
  2. UL 1008 - Transfer Switch Equipment
  3. UL 1773 - Standard for Safety Termination Boxes
  4. NEMA 250 - Enclosure Types
- B. Material Workmanship Requirements: Provide all materials and workmanship meeting the requirements of NFPA Standards and Codes.
- C. Design and Testing Requirements: Provide all cabinet components designed, manufactured and tested in accordance with the latest applicable standards and UL listed.
- D. Installation Requirements: Install the cabinet assemblies meeting the requirements of NEC and local Electrical Codes.

### 1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 01.
- B. Product Data and Information: Furnish the following:
  - 1. Manufacturers' catalog data on cabinet assemblies and on each component detailing materials, ratings, type, model and reference number.
  - 2. Layout drawings customized for the project including physical details, dimensions, clearances, mounting, elevations, sections, and nameplates.
  - 3. Assembly ratings including short circuit rating, voltage, continuous current rating and cable termination sizes.
- C. CONTRACTOR's Drawings: Provide cabinet installation details including concrete pad details, mounting details and conduit and cable termination details.

### 1.4 QUALITY CONTROL

- A. Regulatory Requirements: Provide UL listed components and assemblies.
- B. Test Reports: Provide the manufacturer's certified factory test reports for each cabinet.

### 1.5 OPERATIONS AND MAINTENANCE MANUALS

- A. General: Provide operation and maintenance manuals, including spare parts lists, as specified in Division 01.

### 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 and as follows:
- B. Storage and Protection: Store all equipment in a dry, covered, heated and ventilated location. Provide any additional measures in accordance with manufacturer's instructions.

### 1.7 SPARE PARTS

- A. General: Provide the following spare parts:
  - 1. Two 12-ounce spray cans per cabinet of the final finish for touch-up.

- B. Packaging: Pack spare parts in containers bearing labels clearly designating contents and related pieces of equipment. Deliver spare parts in original factory packages. Identify all spare parts with information needed for reordering.

## 1.8 EQUIPMENT WARRANTY

- A. Warrant the equipment to be free from defects in materials and workmanship for a period of twelve (12) months after the Date of Substantial Completion. The warranty shall cover all repairs for all systems furnished by the manufacturer. The Manufacturer will repair or replace, at its option, any such equipment found to be defective, provided written notice of the alleged defect is received within twelve (12) months after the Date of Substantial Completion.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Berthold Electric
  - 2. ESL
  - 3. Eaton/Cutler-Hammer
  - 4. Square D/ASCO Power Technologies/Schneider Electric

### 2.2 RATINGS

- A. Provide an assembly rated to withstand mechanical forces exerted during short-circuit conditions when connected to a power source with an available fault current not exceeding 35,000 symmetrical amperes at rated voltage.
- B. Rated Voltage: Provide the system operating voltage not to exceed 600V.
- C. Ampere Rating: 1600A

### 2.3 CONSTRUCTION

- A. Construct the cabinet as follows:
  - 1. Freestanding, pad mounted or wall mounted design.
  - 2. Top and bottom accessible for cabling. front accessible for maintenance.
  - 3. Provide sufficient structural strength to support all the equipment mounted within, withstand the handling and shipment of the assembly, maintaining the proper alignment, and be rigid and freestanding.

4. Provide all terminations accessible from the front of the enclosure.
5. Provide the assembly with adequate lifting means.
6. Provide with a padlockable front hinged door.
7. Provide interlocking to breaker in the corresponding switchgear to prevent the cabinet from being open when the generator is active.
8. Provide an enclosure that is indoor NEMA 12 rated.

B. Bus Terminations:

1. Provide cable terminations consisting of copper horizontal landing bars with the phases arranged in a staggered vertical plane to accommodate wire terminations. Size bars based on a 65 degrees C temperature rise over a 40 degrees C ambient.
2. Provide a full capacity copper neutral bus.
3. Provide a copper ground bus.

C. Cable Terminations:

1. Provide generator (line side) terminations based upon the bus ampacity and wiring as shown, scheduled, or otherwise noted on the Contract drawings.
2. Provide standard 400A, single-pole cam-style receptacles, with phases color-coded as defined in Section 26 05 53 - Electrical Identification.
3. Provide 4 connections per phase for 1600 A ampacity.
4. Provide Eaton Cam-Lok series E1016 or equal.

D. Finish:

1. Provide all exterior and interior surfaces with a rust inhibiting, phosphatized finish of polyester powder coat paint.
2. Stainless steel cabinets: #4 brushed finish.

E. Identification:

1. Provide identification of the cabinet and its components as specified in Section 26 05 53.

## 2.4 SOURCE QUALITY CONTROL

- A. Conduct standard production shop tests.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install the assembly in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 01.
- B. Compliance: Install the assembly as shown, in accordance with manufacturer's written instruction and recognized industry practices. Comply with referenced standards and codes.
- C. Coordination: Coordinate with other work including cabling and wiring work.
- D. Torque Requirements: Tighten electrical connectors and terminals including screws and bolts, in accordance with equipment manufacturer's published torque tightening values of equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals in accordance with UL Standard 486A.
- E. Ground Connections: Make equipment grounding connections for the assembly as required. Tighten connections in accordance with UL standard 486A for permanent and effective grounding.

### 3.2 FIELD QUALITY CONTROL

- A. Provide certified factory test reports of all standard production tests.
- B. Test and Inspect as follows:
  - 1. Inspect for shipping damage, loose materials, shipping blocks or contamination.
  - 2. Check the assembly to determine that it is level, secured to foundations and that door operate properly.
  - 3. Correct all deficiencies.

### 3.3 GROUNDING

- A. System: Inspect ground system for compliance with the latest approved drawings.
- B. Connections: Inspect all ground connections for evidence of looseness and/or corrosion.

3.4 CLEANING AND PAINTING

- A. Field Painting: Touch up scratched and marred surfaces to match with original finishes.

3.5 IDENTIFICATION

- A. General: Provide identification meeting the requirements of Section 26 05 53.
- B. Component Identification: Clearly identify all phase, neutral and ground bussing for termination of portable generator cables.

END OF SECTION

## SECTION 26 24 14

### 4,160V MOBILE GENERATOR TERMINATION CABINET

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing a medium voltage, front and rear accessible, freestanding, termination cabinet for use as an intermediate termination point between the trailer mounted temporary generator and the disconnecting means feeding the designated emergency loads as shown on the Contract drawings. The cabinet is to include the following major components:

1. Stationary structure
2. Copper phase, neutral, and ground bus bars for elbow connections
3. Alternative bus bar for hard wire connections
4. Rear phase barriers
5. Air-insulated bushing wells
6. Interlocking capabilities
7. Surge protection, phase rotation monitoring, CTs, PTs, and power quality metering

- B. Related Work Specified in Other Sections Includes, But is Not Limited to the Following:

1. Section 09 96 00 - High Performance Coatings
2. Section 26 05 00 - Basic Electrical Materials and Methods
3. Section 26 05 26 - Grounding
4. Section 26 05 53 - Electrical Identification
5. Section 26 08 00 - Electrical Testing Requirements
6. Section 26 05 73 - Short Circuit and Coordination Study
7. Section 26 05 13 - Medium Voltage Cables

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:

1. NEC - National Electrical Code
2. ANSI C12.20 - ANSI Standard for Electricity Meters
3. ANSI/IEEE 386- Standard for Insulated Connectors

- B. Material Workmanship Requirements: Provide all materials and workmanship meeting the requirements of NFPA Standards and Codes.

- C. Design and Testing Requirements: Provide all cabinet components designed, manufactured and tested in accordance with the latest applicable standards and UL listed.
- D. Installation Requirements: Install the cabinet assemblies meeting the requirements of NEC and local Electrical Codes.

### 1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 01.
- B. Product Data and Information: Furnish the following:
  - 1. Manufacturers' catalog data on cabinet assemblies and on each component detailing materials, ratings, type, model, and reference number.
  - 2. Layout drawings customized for the project including physical details, dimensions, clearances, mounting, elevations, sections, and nameplates.
  - 3. Assembly ratings including short circuit rating, voltage, continuous current rating and cable termination sizes.
  - 4. Schematic Diagrams showing interlock wiring.
- C. CONTRACTOR's Drawings: Provide cabinet installation details including concrete pad details, mounting details and conduit and cable termination details.

### 1.4 QUALITY CONTROL

- A. Test Reports: Provide the manufacturer's certified factory test reports for each cabinet.

### 1.5 OPERATIONS AND MAINTENANCE MANUALS

- A. General: Provide operation and maintenance manuals, including spare parts lists, as specified in Division 01.

### 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 and as follows:
- B. Storage and Protection: Store all equipment in a dry, covered, heated and ventilated location. Provide any additional measures in accordance with manufacturer's instructions.

## 1.7 SPARE PARTS

- A. General: Provide the following spare parts:
  - 1. Two 12-ounce spray cans per cabinet of the final finish for touch-up.
  - 2. Two bushing wells of each type.
- B. Packaging: Pack spare parts in containers bearing labels clearly designating contents and related pieces of equipment. Deliver spare parts in original factory packages. Identify all spare parts with information needed for reordering.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: The basis of design for this specification is the 4.16kV 600A GLQC MF-2 Series Switchgear by Advanced Power Technologies (APT). Other manufacturers of equivalent products may be submitted for review.

### 2.2 RATINGS

- A. Provide an assembly rated to withstand mechanical forces exerted during short-circuit conditions when connected to a power source with an available fault current not exceeding 35,000 symmetrical amperes at rated voltage.
- B. BIL: 60 kV
- C. Rated Voltage: Provide the system operating voltage not to exceed 5kV
- D. Ampere Rating: 600A

### 2.3 CONSTRUCTION

- A. Construct the cabinet as follows:
  - 1. Build out of bolted structural steel members, together with formed or fitted sections of smooth sheet steel.
  - 2. Provide sufficient structural strength to support all the equipment mounted within, withstand the handling and shipment of the assembly, maintaining the proper alignment, and be rigid and freestanding.
  - 3. Provide all terminations accessible from the front of the enclosure.
  - 4. Provide rear access for accessory equipment.

5. Provide top entry/exit.
6. Provide the assembly with adequate lifting means.
7. Provide filtered ventilation louver.
8. Provide with a pad-lockable front hinged main access door.
9. Provide with a pad-lockable integral lower flip door to allow the main access door to be closed with the mobile generator cables connected.
10. Provide an assembly that is outdoor NEMA 3R rated.
11. Polished Stainless Steel finish.
12. Typical Dimensions of Structure:
  - a. 80”H x 36”W x 64”D

B. Bus Terminations:

1. Provide cable terminations consisting of copper horizontal landing bars with the phases arranged in a staggered vertical plane to accommodate wire terminations. Size bars based on a 65 degrees C temperature rise over a 40 degrees C ambient.
2. Provide a full capacity copper neutral bus.
3. Provide a copper ground bus.

C. Cable Terminations:

1. Isolated customer low voltage control power wiring panel.
2. Rear phase barriers physically isolate each phase to minimize the possibility of phase-to-phase contact.
3. Standard air-insulated bushing wells allow the versatility to connect either a portable temporary generator or load bank to the same receptacle.
  - a. ANSI/IEEE Std. 386 connectors compatible
  - b. 200A Air insulated load break bushing wells, inserts, and caps, three (3) connections per phase
4. Hanger for insulated caps when cables are connected to the bushings.

5. Insulated caps installed on bushing inserts when cables are not connected using elbows.
  6. Grounding wires for insulating caps.
- D. Interlocking, Monitoring, and Metering:
1. Interlocking:
    - a. NEC 700.3 compliant key interlocking with the Medium Voltage Switchgear Main and Tie Circuit Breakers to prevent inadvertent paralleling of the temporary generator source with normal source(s).
- E. Finish:
1. Provide all exterior and interior surfaces with a rust inhibiting, phosphatized finish of polyester powder coat paint in accordance with the requirements of Section 09 96 00 – High Performance Coatings.
- F. Identification:
1. Provide identification of the cabinet and its components as specified in Section 26 05 53.

## 2.4 SOURCE QUALITY CONTROL

- A. Conduct standard production shop tests.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install the assembly in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 01.
- B. Compliance: Install the assembly as shown, in accordance with manufacturer's written instruction and recognized industry practices. Comply with referenced standards and codes.
- C. Coordination: Coordinate with other work including cabling and wiring work.
- D. Torque Requirements: Tighten electrical connectors and terminals including screws and bolts, in accordance with equipment manufacturer's published torque tightening values of equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals in accordance with UL Standard 486A.

- E. Ground Connections: Make equipment grounding connections for the assembly as required. Tighten connections in accordance with UL standard 486A for permanent and effective grounding.

### 3.2 FIELD QUALITY CONTROL

- A. Provide certified factory test reports of all standard production tests.
- B. Test and Inspect as follows:
  - 1. Inspect for shipping damage, loose materials, shipping blocks or contamination.
  - 2. Check the assembly to determine that it is level, secured to foundations and that door operate properly.
  - 3. Correct all deficiencies.

### 3.3 GROUNDING

- A. System: Inspect ground system for compliance with the latest approved drawings.
- B. Connections: Inspect all ground connections for evidence of looseness and/or corrosion.

### 3.4 CLEANING AND PAINTING

- A. Field Painting: Touch up scratched and marred surfaces to match with original finishes.

### 3.5 IDENTIFICATION

- A. General: Provide identification meeting the requirements of Section 26 05 53.
- B. Component Identification: Clearly identify all phase, neutral and ground bussing for termination of portable generator cables.

END OF SECTION

## SECTION 26 24 16

### PANELBOARDS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing lighting and distribution panelboards including circuit breakers and cabinets.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 09 96 00 – High Performance Coatings
  - 2. Section 26 05 00 - Basic Electrical Materials and Methods
  - 3. Section 26 05 53 - Electrical Identification
  - 4. Section 26 05 26 – Grounding
  - 5. Section 26 29 53 – Control Components and Devices

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. NEMA PB 1 - Panelboards
  - 2. UL 67 - Panelboards
  - 3. Fed. Spec. W-P-115 - Power Distribution Panel
  - 4. UL 486A - Wire Connectors and Soldering Lugs for Use With Copper Conductors
  - 5. NFPA 70 - National Electrical Code (NEC)
  - 6. IEC 61557-12 - Equipment for testing, measuring or monitoring of protective measures - Part 12: Power metering and monitoring devices (PMD)

##### 1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 01 and Section 26 05 00.

- B. Product Data and Information: Provide the manufacturer's catalog data for panelboards, circuit breakers and accessories.
- C. Operations and Maintenance Manuals: Furnish operation and maintenance manuals for the panelboards as specified in Division 01.

#### 1.4 QUALITY ASSURANCE

- A. Codes: Provide all materials and workmanship meeting the requirements of the NFPA, the National Electrical Code and local codes.
  - 1. Design, fabricate and test the panelboards in accordance with applicable ANSI, IEEE and NEMA standards.
  - 2. Provide panelboards suitable for operation at their standard nameplate ratings in accordance with ANSI standards.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Panelboards
    - a. ABB Electrification
    - b. Square D/Schneider Electric
    - c. Eaton/Cutler-Hammer
    - d. Siemens

#### 2.2 MATERIALS

- A. General: Provide factory-assembled fully rated dead-front type, panelboards, suitable for surface or flush mounting with branch circuit breakers and a main circuit breaker or main lugs as indicated.
  - 1. Provide panelboards with a full capacity separate ground bus and connected to a three-phase four-wire or a single-phase three-wire service with insulated neutral buses as indicated.

2. Provide panelboards with the voltage, frequency and current ratings as indicated conforming to NEMA Standard PB 1, Fed. Spec. W-P-115, UL 67 and the NEC.
  3. Provide panelboards with copper main, neutral and ground buses.
  4. Where required, label panelboards suitable for use as service entrance equipment
- B. Bracing: Provide main bus bracing exceeding the lowest interrupting rating of any circuit breaker installed.
- C. Fabrication: Fabricate panelboards using galvanized steel, continuously welded. Provide cabinet fronts with doors over the circuit breakers. Provide doors fastened with concealed hinges and equipped with flush type catches.
1. Provide panelboards at least 20 inches wide, 5-3/4 inches deep, with wiring gutters on both sides.
  2. Provide all panelboard trims exceeding five square feet in area with an inside permanently secured angle to support the trim during fastening.

## 2.3 COMPONENTS

- A. Circuit Breakers: Provide bolt-on type branch, and draw out, indicated in contract drawings
1. Furnish the frame sizes, trip settings and number of poles as indicated. Clearly identify the ampere trip rating on the circuit breakers.
    - a. For lighting panelboards, provide 20-ampere, single-pole, 120 or 277 volt circuit breakers unless otherwise shown or scheduled.
    - b. For distribution panelboards, provide 20-ampere, three-pole, 600-volt circuit breaker, unless otherwise shown or scheduled.
  2. Provide all breakers with quick-make, quick-break, toggle mechanisms with automatic thermal-magnetic, inverse time-limit overload and instantaneous short circuit protection on all poles, unless otherwise indicated. Indicate automatic tripping by the breaker handle assuming a clearly distinctive position from the manual ON and OFF position. Design the breaker handle to be trip-free on overloads.
  3. Interrupting Rating: 10,000 rms symmetrical amperes for circuit breakers on 240 volt systems or less, and at least 42,000 rms symmetrical amperes for circuit breakers on 277 or 480 volt systems.
  4. Provide multipole breakers that utilize a common tripping bar.

5. Provide ground fault interrupter circuit breakers for all circuits serving receptacles located below grade and outdoors and as scheduled.
  6. For 480V system provide breakers with digital, networked metering capabilities for all branch circuits and spares where the future use is defined. Include measurement of the following parameters, at standard precision as defined by IEC 61557-12:T:
    - a. Current (RMS), Amps
    - b. Ground Fault Current (RMS), Amps
    - c. Phase-to-Phase Voltages (RMS), Volts
    - d. Active Power, kW
    - e. Reactive Power, kVAR
    - f. Apparent Power, kVA
    - g. Power Factor
    - h. Energy (kWh)
    - i. Reactive Energy (kVARh)
    - j. Apparent Energy (kVAh)
  7. Provide full module size single-pole breakers. Do not install two-pole breakers in a single-pole module.
  8. Provide all 20 ampere, one pole circuit breakers with a lug wire range suitable for the termination of #14AWG through #8AWG. For circuit breakers with higher current ratings, provide lugs adequate for the wire sizes indicated on the Contract drawings.
  9. Provide circuit breakers 100 amperes and smaller with a 60/75 degree C cable temperature rating.
- B. Surge Protection Devices (SPD): Provide each panelboard with a surge protection device meeting the requirements of Section 26 29 53.

## 2.4 ACCESSORIES

- A. Directories: Provide directories in accordance with Section 26 05 53.
- B. Circuit Breaker Handle Lock: Where shown provide circuit breakers with handle clamp that holds the circuit breaker handle in the ON position.
- C. Keying: Key all panelboards alike.

## 2.5 COMMUNICATIONS

- A. Where circuit breakers in distribution panelboards include networked metering capabilities, provide communications accessories as required to interface to the plant controls system specified in Division 40, including:

1. Power Supplies
  2. Gateways
  3. Interconnecting wiring and terminations.
  4. Barriers separating power wiring from communications wiring
- B. Provide a single Modbus/TCP connection from each distribution panelboard to the plant SCADA system.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. General: Install all panelboards in accordance with manufacturer's recommendations and approved shop drawings and as specified in Division 1 and in compliance with the requirements of NEMA standards, NEC, and applicable ANSI Publications.
- B. Mounting Height: Mount all panelboards either surface or flush mounted as shown such that the height of the top operating handle does not exceed 6 feet 6 inches from the floor.
- C. Coordination: Coordinate with other Work including cabling and wiring work to interface the installation of the panelboards.
- D. Torque Requirements: Tighten electrical connectors and terminals, including screws and bolts, in accordance with the equipment manufacturer's published torque tightening values for the equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals in accordance with UL 486A.
- E. Circuit Breaker Handle Lock: Install circuit breaker handle clamp on each circuit breaker as shown.
- F. Directory: Provide a laminated typewritten directory with the following information:
1. Circuit number
  2. Area served
  3. Utilizing equipment

#### 3.2 CLEANING AND PAINTING

- A. Shop Painting: Paint the panelboards as specified in Section 09 96 00.

- B. Field Painting: Touch up scratched and marred surfaces to match the original finish.

END OF SECTION

## SECTION 26 24 19

### MOTOR CONTROL CENTERS

#### PART 1 GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Requirements for providing new feeder units in existing motor control center P 116 in the Water Plant.
2. Requirement for performing maintenance activities on existing motor control centers at the standpipe facilities:
  - a. North Standpipe
  - b. South Standpipe

###### B. Related Work Specified in Other Sections includes, but is not limited to, the following:

1. Section 09 96 00 – High Performance Coatings
2. Section 26 05 00 – Basic Electrical Materials and Methods
3. Section 26 05 19 – Wires and Cables - 600 Volts and Below
4. Section 26 05 26 – Grounding
5. Section 26 05 53 – Electrical Identification
6. Section 26 08 00 – Electrical Testing Requirements
7. Section 26 29 53 – Control Components and Devices

##### 1.2 REFERENCES

###### A. Codes and standards referred to in this Section are:

1. ANSI/NETA MTS - Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems
2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
3. NFPA 70B - Standard for Electrical Equipment Maintenance
4. UL 486A - Wire Connectors and Soldering Lugs for Use With Copper Conductors
5. UL 845 - Motor Control Centers

### 1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Provide equipment capable of operating in an ambient temperature range of 0 to 40 degrees C and humidity of up to 90 percent noncondensing.
  - 1. Provide motor control center components designed for 480-volt, three-phase, three-wire, 60-hertz operation.
  - 2. Provide all control devices in the center suitable for operation at 120-volts, 60-hertz, unless specifically noted otherwise.
  - 3. Provide all control equipment and devices that meet the requirements of the 600-volt insulation class.

### 1.4 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1 and Section 26 05 00.
- B. Product Data and Information: Provide catalog data for all associated equipment and devices.
- C. Shop Drawings: Provide shop drawings customized to the project for motor control centers to include the following:
  - 1. Bill of materials including manufacturers' name and catalog number.
  - 2. Interconnecting wiring diagrams, where required.
  - 3. Individual schematic and wiring diagrams for each compartment.
  - 4. Furnish instruction booklets and time-current curves for each circuit breaker supplied.
- D. Maintenance and Testing Plan: Provide detailed list of planned maintenance and testing activities for each motor control center listed in 1.1 A.2:
  - 1. Checklist of all systems and components receiving maintenance service, demonstrating compliance with the requirements of referenced standards.
  - 2. Where test results consist of numerical measured values, indicate expected range for each test.
- E. Quality Control: Furnish the following test reports and certificates as specified in Division 01:
  - 1. Qualifications of Third-Party Testing Firm performing Maintenance Testing

2. Certified Shop Test Reports for motor control centers and related components. Provide a minimum of 15 days written notice prior to shop tests.
  3. Detailed field test reports of all tests indicating test performed as specified, discrepancies found, and corrective action taken.
  4. Detailed list of Proposed Corrective Maintenance Work, with itemized costs.
- F. Operation and Maintenance Manuals: Furnish operation and maintenance manuals as specified in Division 01.

#### 1.5 QUALITY ASSURANCE

- A. Standards: Provide motor control center components in accordance with NEMA ICS 2, ICS 3, and UL Standard No. 845.
- B. Codes: Provide motor control center components in accordance with the NEC and local codes.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, and handle all products and materials as specified in Division 01.
- B. Shipping and Packing: Provide all equipment and materials rigidly braced and protected against weather, damage, and undue strain during shipment.
- C. Storage and Protection: Store all equipment and materials in a dry, covered, heated and ventilated location. Provide any additional measures in accordance with manufacturer's instructions.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Provide components, accessories and replacement parts of the same manufacturer as the existing motor control centers.
  1. Motor Control Centers:
    - a. MCC P 116: Westinghouse Series 3200 (Eaton)
    - b. North Standpipe: Square D (Schneider)
    - c. South Standpipe: Cutler Hammer (Eaton)

#### 2.2 MOTOR CONTROL CENTER

- A. Individual Units: Provide motor control or circuit breaker units in combinations of not less than 12-inch modular heights.

1. Provide units of the plug-in or nonremovable type in accordance with the manufacturer's standard for type and size of controller.
  2. Provide plug-in units within-plated, pressure-type line disconnecting stabs of high strength copper alloy. Hold each plug-in unit in place and arrange the units such that they can be removed or remounted readily without access to the rear of the structure.
  3. Provide units that are totally enclosed and effectively baffled to isolate ionized gases that may occur within each unit. In addition, ventilate each unit so that it can be located anywhere within the structure using the same overload heaters for the same load.
  4. Provide automatic shutter mechanism to cover the vertical bus stub area when a unit is removed.
  5. Construct doors to be drip-proof and dust-tight. Provide all doors with hinges and screw fasteners for holding the doors closed. Fabricate each door as a part of the structure and not part of the unit.
  6. Equip the doors for branch feeder equipment with a circuit breaker operating mechanism.
  7. Provide mechanical interlocks between the compartment door and circuit breaker operating mechanism to prevent opening of the door unless the breaker is in the OFF position, and to prevent closing the breaker unless the door is fully closed.
  8. Provide circuit breaker operating mechanisms or handles that are padlockable in the OFF position with room for a minimum of three padlocks.
  9. Provide units having devices that are serviceable from the front, without provisions for rear access.
- B. Feeder Circuit Breakers: Provide molded-case type, two- or three-pole feeder circuit breakers as shown, with a minimum voltage rating of 600-volt ac.
1. Interrupting Ratings: Provide an interrupting capacity of 65,000 rms symmetrical amperes at 480 volts. Base interrupting rating on the IEEE and NEMA Standard duty cycle for this class of equipment.
  2. Provide circuit breakers trip units as follows:
    - a. Provide individual, thermal-magnetic trip units for all frame sizes smaller than 400 amperes.
    - b. Provide solid-state trip units for all frame sizes 400 amperes and larger.

- c. Provide trip units that actuate a common tripping bar to open all poles when an overload or short circuit occurs on any one.
  - d. Provide trip elements with inverse time tripping and instantaneous tripping at about ten times the normal trip device rating.
  - e. Provide circuit breakers with trip-free handles.
- C. Feeder Cable Terminals: Provide closed-end, compression-type, solderless connectors and terminals, suitable for copper conductors for terminating cables in accordance with Section 26 05 19.
  - D. Identification: Provide nameplates having the same type, appearance and shape throughout each motor control center in accordance with the requirements of Section 26 05 53.

### PART 3 EXECUTION

#### 3.1 MAINTENANCE SERVICES

- A. Perform maintenance services at the main motor control centers serving the following locations:
  - 1. North Standpipe, 2536 Gross Point Rd, Evanston
  - 2. South Standpipe, 640 Hartrey Ave, Evanston
- B. Perform all periodic maintenance and testing described in NFPA 70B for the following:
  - 1. Molded-Case Circuit Breakers within each MCC, according to NFPA 70B, Chapter 15.
  - 2. Feeder and branch circuit cables originating at each MCC, according to NFPA 70B, Chapter 18.
  - 3. Motor Control Equipment, according to NFPA 70B, Chapter 28.
- C. Maintenance testing shall be performed by a third party testing firm, and shall meet the requirements of Section 26 08 00 and ANSI/NETA MTS
- D. Submit a list of proposed corrective work for approval.
- E. Upon approval, perform corrective work under the allowances described in Section 01 29 00.

#### 3.2 INSTALLATION

- A. General: Install all equipment in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 01.

- B. Adjustments: Set all motor circuit protectors and circuit breakers for the approved short circuit and coordination study.
- C. Cable Connections: Terminate and label all field wiring per the approved diagrams.
- D. Torque Requirements: Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturers' published torque tightening recommendations. Where manufacturers' torquing requirements are not available, tighten connectors and terminals in accordance with UL Standard 486 A.

### 3.3 FIELD QUALITY CONTROL

- A. Inspections: Inspect, adjust and check the installation for physical alignment, cable terminations and ventilation.
- B. Tests: Perform the following field tests:
  - 1. Close and open each circuit breaker and motor circuit protector to test operation.
  - 2. Energize the motor control center and test for hot spots.
- C. Operation and Maintenance: Furnish operation and maintenance instructions as specified in Division 1.

### 3.4 CLEANING AND PAINTING

- A. Field Painting: Clean and touch up any scratched or marred surface to match original finish.

END OF SECTION

## SECTION 26 27 26

### WIRING DEVICES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing wiring devices and appurtenances as indicated, in accordance with the Contract Documents.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 26 05 00 - Basic Electrical Materials and Methods
  - 2. Section 26 05 33 - Electrical Raceway System
  - 3. Section 26 05 26 - Grounding

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. Fed Spec WC 596 - Electrical Power Connector, Plug, Receptacle and Cable Outlet
  - 2. Fed Spec WS 896 - Toggle and Lock, Flush Mounted Switches
  - 3. CSA C22.2-182.1 - Industrial-type, Special-Use Attachment Plugs, Receptacles and Connectors
  - 4. UL 20 - General - Use Snap Switches
  - 5. UL 498 - Attachment Plugs and Receptacles
  - 6. UL 508 - Industrial Control Equipment
  - 7. UL943 - Ground Fault Circuit Interrupters
  - 8. UL 1010 - Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations
  - 9. UL 1682 - Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type

### 1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 01 and Section 26 05 00.
- B. Product Data and Information: Provide manufacturers' catalog data for each device type, plate and cover type.

### 1.4 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Standard of Quality and General Configuration: Use of manufacturer's name and model or catalog number is for the purpose of establishing the desired.
- B. Configuration And Rating: Provide NEMA specification grade wiring devices in the type, color, configuration and electrical rating for the service indicated.
- C. Symbols: See the electrical symbol list shown for identification of all device types.
- D. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Hubbell Wiring Device-Kellems
  - 2. Hubbell/Bryant
  - 3. Pass & Seymour/Legrand
  - 4. Cooper Wiring Devices by Eaton
  - 5. Leviton
  - 6. Emerson Industrial Automation/Appleton
  - 7. Crouse-Hinds by Eaton
  - 8. Meltric Corporation
  - 9. Lutron
  - 10. NSI Industries/Tork

- 11. Hubbell/Tay Mac
- 12. Thomas & Betts/ABB Group

2.2 LIGHTING TOGGLE SWITCHES

A. General: Provide toggle switches of specification grade rated 20- amperes, 120-277 volts ac conforming to Fed. Spec. WS 896 and UL Standard 20. Manufacture switches with back and side wired binding screw type terminals, one piece spring contact arm and terminal plate with silver alloy contacts, one piece steel mounting strap with an assured grounding clip, thermoset body color coded for identification by amperage and a brown toggle. Provide ivory toggles in finished areas.

B. Types:

<u>DESCRIPTION</u>	<u>HUBBELL CAT. NO.</u>
Single pole, brn/ivory	HBL1221/HBL1221I
Two pole, brn/ivory	HBL1222/HBL1222I
Three way, brn/ivory	HBL1223/HBL1223I
Four way, brn/ivory	HBL1224/HBL1224I
SPDT center off momentary contact	HBL1557
Keyed single pole	HBL1221L
Keyed three way	HBL1223L

C. Accessories: Provide a flush neon "ON" pilot light in conjunction with switches controlling equipment whose operation is not evident at the switch location. Provide an engraved nameplate to identify equipment controlled.

2.3 AC MANUAL MOTOR STARTING SWITCHES

A. General: Provide ac manual motor starting switches where overload protection is not required or is provided separately. Provide switches similar in construction to the lighting toggle switches except conforming to UL 508 and rated 30-amperes, 120-277 volts ac.

B. Types:

<u>DESCRIPTION</u>	<u>HUBBELL CAT. NO.</u>
Single pole, brn/ivory	HBL-3031/HBL-3031I
Double pole, brn/ivory	HBL-3032/HBL3032I

C. Accessories: Provide a flush neon "ON" pilot light in conjunction with switches controlling equipment whose operation is not evident at the switch location. Provide an engraved nameplate to identify the equipment being controlled.

2.4 CONVENIENCE RECEPTACLES

A. General: Provide specification grade convenience receptacles conforming to Fed. Spec. WC 596 UL listed, with nylon impact resistant face, one piece metal wrap around mounting strap with assured grounding clip, back and side wired binding screw type terminals, brass power contacts and a heavy duty heat stabilized thermoset plastic base. Provide brown devices in unfinished areas and ivory devices in finished areas unless otherwise specified.

B. TYPES:

DESCRIPTION	RATING	COLOR	HUBBELL CAT. NO.
Single	NEMA 5-20R 20A, 125V, 2P, 3W	Brown/ Ivory	HBL5361/ HBL5361I
Duplex	NEMA 5-20R 20A, 125V, 2P, 3W	Brown/ Ivory	HBL5362/ HBL5362I
Single- corrosion- resistant	NEMA 5-20R 20A, 125V, 2P, 3W	Yellow	HBL53CM61
Duplex- corrosion- resistant	NEMA 5-20R 20A, 125V, 2P, 3W	Yellow	HBL53CM62
Single	NEMA 6-20R 20A, 250V, 2P, 3W	Brown/ Ivory	HBL5461/ HBL5461I
Duplex	NEMA 6-20R 20A, 250V, 2P, 3W	Brown/ Ivory	HBL5462/ HBL5462I
Quadraplex	NEMA 5-20R 20A, 125V, 2P, 3W	Brown/ Ivory	HBL420H/ HBL420HI

2.5 SPECIAL USE RECEPTACLES

A. General: Provide special use receptacles of specification grade in accordance with applicable Fed. Specs., UL, ANSI and CSA Standards.

B. Types:

<u>DESCRIPTION</u>	<u>RATING</u>	<u>COLOR</u>	<u>HUBBELL CAT. NO.</u>
Duplex-ground fault circuit interrupter	NEMA 5-20R 20A, 125V, 2P, 3W	Brown/ Ivory	GF20L GF20IL
Duplex – surge suppression w/isolated ground	NEMA 5-20R 20A, 125V, 2P, 3W	Blue	IG5352S

2.6 BOXES

- A. Outlet Boxes: Provide outlet boxes in accordance with the requirements specified in Section 26 05 33.

2.7 PLATES AND COVERS

- A. General: Provide covers and plates for the various areas as follows:
1. Architectural Finished Areas: Provide Type 302/304 stainless steel plates and covers for devices.
  2. Areas Below Grade, Corrosive and Wet Areas:
    - a. For switches provide weatherproof, gasketed, covers with external operating handle.
    - b. For receptacles provide a weatherproof, gasketed, clear, flame-retardant, jumbo, polycarbonate cover a minimum of 5.4-inches deep, suitable for use with a 10-3 cord that allows the cover to be closed even when the receptacle is in use.

PART 3 EXECUTION

3.1 INSTALLATION

- A. General: Install all wiring devices in accordance with manufacturer's recommendations and approved shop drawings as specified in Division 01.
- B. Toggle Switches: Install toggle switches applicable for the area environment for switching lighting or other branch circuit loads.
- C. Receptacles: Install receptacles applicable for the area environment.

- D. Grounding: Ground all devices in accordance with the requirements specified in Section 26 05 26.

END OF SECTION

## SECTION 26 28 16

### DISCONNECT SWITCHES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing and installing enclosed fused and nonfused safety switches for use as feeder and branch circuit switching and disconnect devices for motors and equipment.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 09 96 00 - High Performance Coatings
  - 2. Section 26 05 00 - Basic Electrical Materials and Methods
  - 3. Section 26 05 53 - Electrical Identification
  - 4. Section 26 05 26 - Grounding

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. NFPA 70 - National Electrical Code (NEC)
  - 2. NEMA KS1 - Enclosed Switches
  - 3. UL 198E - Class R Fuses
  - 4. UL 486A - Wire Connectors and Soldering Lugs for Use With Copper Conductors

##### 1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1 and Section 26 05 00.
- B. Product Data and Information: Provide manufacturers' data indicating disconnect switch ratings and dimensions. Provide manufacturer's data on fuses including time-current curves.

##### 1.4 QUALITY ASSURANCE

- A. Codes: Provide disconnect switches meeting the requirements of NFPA, the National Electrical Code and local codes.

- B. Regulatory Requirements: Provide all disconnect switches designed, manufactured and tested in accordance with latest ANSI, IEEE and NEMA Standards, and UL listed.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 and Section 25 05 00.

#### 1.6 SPARE PARTS

- A. General: Provide the following spare parts:
  - 1. Twelve of each size and type fuse installed.
- B. Packaging: Pack spare parts in containers bearing labels clearly identifying the contents. Deliver spare parts in original factory packages. Identify all spare parts with information needed for reordering.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are as listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Disconnect Switches
    - a. Square D /Schneider Electric
    - b. Eaton/CutlerHammer
    - c. ABB Electrification
    - d. Hubbell/Killark
  - 2. Fuses
    - a. Eaton/Bussmann
    - b. Littelfuse

#### 2.2 DISCONNECT SWITCHES

- A. General: Provide disconnect switches of the NEMA KS-1, heavy-duty, load-interrupter, enclosed-knife switch type with externally operating handle interlocked to prevent opening of the front cover with the switch in the ON position. Provide an interlock that is defeatable and operable from the front of the switch. Provide handle lockable in the OFF position.

- B. Disconnect Switch Ratings: Provide disconnect switches rated for 600-volts as applicable and horsepower rated when used in motor circuits. Current ratings are as indicated.
- C. Interrupting Rating: If the approved short circuit and coordination study indicates that the available fault current at any disconnect switch exceeds the interrupting rating of the switch, provide a fused disconnect switch with rejection feature. Size the fuses for the load served.
- D. Small Three Phase Motor Disconnect Switches: Provide a fusible switch for each small three phase motor where the branch feeder breaker directly upstream of the motor cannot provide overcurrent protection in accordance with NEC Table 430.52.
- E. Service Entrance: Where shown, provide disconnect switches suitable for service entrance.
- F. Disconnect Switches for Use with Adjustable Frequency Drives: Provide disconnect switches with auxiliary contacts for interlocking with the associated AFD permissive start circuit. Confirm whether normally open or normally closed contacts are required per logic being provided.
- G. Fusible Switches: Provide switches with rejection feature to allow only Class R fuses to be installed.
- H. Disconnect Switch Housings: Provide disconnect switches housed in NEMA rated enclosures as follows:

AREA	ENCLOSURE
Outdoor and below grade elevation indoors	NEMA 4 – Watertight
Above grade indoor	NEMA 12 – Industrial

2.3 FUSES

- A. Characteristics: Provide UL 248 listed Class RK1 dual element, time-delay fuse with an interrupting rating of 200,000 rms symmetrical amperes.

PART 3 EXECUTION

3.1 INSTALLATION

- A. General: Install disconnect switches as shown or required. Comply with requirements of NEC and local electrical codes.
- B. Provide fuses in the fusible disconnect switches sized to protect the associated motor in accordance with the NEC and per the nameplate rating of the approved equipment.

Provide an adhesive label attached to the inside of the switch cover indicating the replacement fuses type and size.

- C. Coordination: Coordinate with other work including cabling and wiring work.
- D. Torque Requirements: Tighten electrical connectors and terminals including screws and bolts in accordance with equipment manufacturers' published torque tightening recommendations. Where manufacturers' torquing requirement are not available, tighten connectors and terminals in accordance with UL Standard 486A.

### 3.2 CLEANING AND PAINTING

- A. Painting: Paint the disconnect switches as specified in Section 09 96 00.

END OF SECTION

## SECTION 26 29 23

### ADJUSTABLE FREQUENCY DRIVES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing, installing and testing the 480-volt adjustable frequency drives. Provide drives in individual, wall mounted enclosures, or incorporated into motor control centers, as shown.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 01 79 00 - Training
  - 2. Section 09 96 00 - High Performance Coatings
  - 3. Section 26 05 00 - Basic Electrical Materials and Methods
  - 4. Section 26 05 19 - Wires and Cables - 600 Volts and Below
  - 5. Section 26 05 60 - Electrical Requirements for Shop-Assembled Equipment
  - 6. Section 26 05 53 - Electrical Identification
  - 7. Section 26 05 26 - Grounding
  - 8. Section 26 30 00 - Control Components and Devices
  - 9. Section 26 09 13 - Electrical Monitoring System
  - 10. Section 26 80 00 - Electrical Testing Requirements

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. NEMA ICS 1 - General Standards for Industrial Control and Systems
  - 2. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays rated 600V.
  - 3. NEMA ICS 3 - Industrial Control and Systems Factory Built Assemblies
  - 4. NEMA ICS 7 - Industrial Control and Systems: Adjustable Speed Drives
  - 5. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems
  - 6. NEMA 250 - Enclosures for Electrical Equipment

7. NFPA 70 - National Electrical Code (NEC)
8. IEEE 85 - Test Procedure for Airborne Sound Measurements on Rotating Electric Machinery
9. IEEE 519 - IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
10. UL 845 - Motor Control Centers

### 1.3 SYSTEM DESCRIPTION

#### A. Design Requirements:

1. Provide adjustable frequency drives to vary the speed of NEMA standard, 3-phase, 460-volt, induction motors and driven equipment by varying the frequency and voltage applied to the motors.
2. Provide adjustable frequency drives that fit the physical space shown. Units exceeding the dimensions shown will not be acceptable.
3. Provide adjustable frequency drives that automatically restart when power is restored after a power outage. Provide control logic so the drive is allowed to restart when power is restored.
4. UL 508C listed with a minimum labeled Short-circuit Current Rating (SCCR) of 42kAIC at 460V.

B. Rated Output Power: Provide adjustable frequency drives with an output that is at least 3 percent greater than the driven motor's full nameplate rating.

C. Torque Output: Provide variable torque or constant torque output drives as required by driven equipment.

D. 6-Pulse Drive Technology: Adjustable frequency drives serving motors 50 HP or smaller may utilize 6-pulse drive technology provided the drive complies with all performance requirements specified herein.

E. Performance Requirements: Provide adjustable frequency drives to meet the following requirements of IEEE 519:

Total harmonic distortion THD (Voltage): Maximum of five percent for general distribution systems as measured at the point of common coupling.

1. Total current harmonic distortion: Not to exceed the values in Table 10.3, Current Distortion Limits for General Distribution Systems (120 V through 69000 V) of IEEE-519 at the point of common coupling.

2. Capacitor traps for controlling harmonics that require tuning to the power system are not acceptable.
3. Operate at a minimum efficiency of 95 percent at rated load.
4. Operate from a 480-volt, 3-phase, 60-hertz supply with a voltage variation of plus 10-percent or minus 20-percent and a frequency variation of plus or minus 2-hertz.
5. Input power factor: Maintain a 95 percent minimum power factor over a 20 to 100 percent speed range.
6. Operate an induction motor as specified, including a high-efficiency, high-power factor, premium-duty motor, with no detriment to motor life.
7. Operate an induction motor without exceeding the motor sound and power decibel level listed and measured in accordance with NEMA MG1, Tables 9-2 and 9-3.
8. Operate under the following ambient conditions:
  - a. Ambient Temperature: 0 to 40 degrees C
  - b. Humidity: 0 to 95 percent

#### 1.4 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01 and Section 26 05 00.
- B. Product Data and Information: Furnish catalog data including rating and descriptive literature of all components and systems.
- C. Shop Drawings: Furnish the following shop drawings customized for the project:
  1. Bill of materials including manufacturers name and catalog number
  2. Outline drawings showing dimensions, arrangement, elevations, identification of components and nameplate schedule for all units
  3. Interconnection wiring diagrams
  4. Individual schematic control diagrams for each unit
  5. One line diagrams
  6. Obtain and enter full performance data for all motors shown

- 7. Certification that the adjustable frequency drives are compatible with the motors and the equipment loads to be driven
- D. Quality Control: Furnish test reports, certificates of inspection and manufacturer's instructions.
- E. Operations and Maintenance Manuals: Furnish operations and maintenance manuals as specified in Division 1.

#### 1.5 QUALITY ASSURANCE

- A. Standards: Provide all adjustable frequency drives manufactured in accordance with referenced standards.
- B. UL Label: Provide a UL Inc. Label or certification of listing by C.S.A. or other recognized testing organization for each adjustable frequency drive.
- C. Codes: Manufacture and install each adjustable frequency drive in accordance with the NEC and local codes.
- D. Failure to Meet the Harmonic Requirement as Determined by Field Measurement: If the installed adjustable frequency drives fail to meet the harmonic limits specified, modify the adjustable frequency drives as follows at no additional cost to the OWNER.
  - 1. Provide additional harmonic reduction equipment until the specified limit is achieved. Equipment which requires expanding on the physical footprint of the adjustable frequency drive previously approved is to be submitted for approval.
  - 2. In the event that harmonic distortion limits cannot be achieved, replace the adjustable frequency drive equipment with equipment that conforms to this specification.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 (and as follows :)
- B. Shipping and Packing: Rigidly brace and protect against weather, damage, and undue strain, all structures, equipment and materials.
- C. Storage and Protection: Furnish clean storage facilities for all equipment delivered but not installed. Provide conditioned air for storage facilities in accordance with the equipment manufacturer's recommendations.

- D. Spare Parts: Furnish spare parts at the same time as the associated adjustable frequency drive. Deliver the spare parts to the OWNER after completion of the work.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.

1. Siemens/Robicon
2. Eaton/Cutler-Hammer
3. Toshiba
4. Danfoss

### 2.2 DESIGN

- A. Input Disconnect: Provide an input circuit breaker with an interrupting rating of 42,000 rms symmetrical amperes.
- B. Input Reactor: Provide input reactor or isolation transformer, if required, as determined by system harmonic distortion analysis.
- C. Converter Section: Provide input section that converts 480-volts, 60-hertz, 3-phase input to a fixed dc voltage using diodes, bridged rectifiers or SCR's.
- D. Filter Sections: Provide dc link reactor and filter capacitors as required.
- E. Inverter Section: Provide adjustable frequency drive inverter section that converts the fixed dc voltage to an adjustable frequency output utilizing a pulse-width modulation inverter. Maintain a constant volts per hertz ratio on the output with voltage boost for startup as required.
- F. Control Circuit: Provide with a control circuit conforming to the logic shown on the Contract Drawing schematic diagrams or as otherwise described in the equipment specifications. The run permissive logic shall include an auxiliary contact signal from the local disconnect switch at the motor (where provided or otherwise shown) which will deactivate the drive whenever the motor disconnect switch is opened.
- G. Control Devices: Provide a digital operator keypad located on the front door to allow setting of all programmable parameters and the following control functions:
  1. Start push button
  2. Stop push button
  3. "Local-Remote" control selection
  4. Speed control settings

5. Speed meter with hertz and 0-100 percent scales
  6. Output ammeter
  7. Elapsed time meter
  8. Diagnostics package with fault indication and reset push button
- H. Control Features: Provide a control system for each drive that allows the following functions:
1. Remote, isolated 4-20 ma speed control input
  2. Isolated 4-20 ma speed output
  3. Alarm outputs
  4. ON/OFF status output
  5. Additional features and controls as specified with the driven equipment
- I. Internal Control Adjustments: Include the following control adjustments for each drive:
1. Acceleration time, 4 to 60 seconds
  2. Deceleration time, 4 to 60 seconds
  3. Minimum speed limit
  4. Maximum speed limit
  5. Inverter current limit
  6. Supply undervoltage trip
- J. Protection Features: Provide the following drive protection features:
1. Electronic overcurrent protection for instantaneous overload
  2. AC input line undervoltage protection, adjustable from 60-100 percent nominal voltage with time delay adjustment and low speed override.
  3. Overfrequency protection
  4. Phase loss protection
  5. DC overvoltage protection
  6. Logic supply voltage low level protection
  7. Line-to-line and line-to-ground output short circuit protection
  8. Line-to-line and line-to-ground surge arresters sized for 480-volt 3-phase grounded wye system
  9. Overload capability of 110% of the motor FLA based on the NEC ratings for 60 seconds

10. Control circuit fuses
  11. Overtemperature protection
  12. Diagnostics module to indicate protection trip conditions
- K. Communications: Provide an addressable communication card capable of transmitting the following data over a two-wire network to the Plant SCADA System as specified in Section 26 09 13:
1. Status (ON, OFF, TRIPPED, NO RESPONSE)
  2. Input and output current in each phase
  3. Output frequency
  4. Input and output kW
  5. Cause of trip

## 2.3 COMPONENTS

- A. General: Provide circuit breakers, fuses, transformers, push buttons, switches, indicating lights, relays and timers as specified in Section 26 30 00.
- B. Power Solid State Components: Provide power solid state switching components with a one minute current rating greater than 110 percent of rated current for variable torque drives or 150 percent of rated current for constant torque drives.
- C. Printed Circuit Boards: Apply a clear conformal coating of acrylic to all printed circuit boards.

## 2.4 ENCLOSURES

- A. General: Provide adjustable frequency drives in NEMA 1 filtered and gasketed enclosures with full rear cover plates.

### IDENTIFICATION

- B. General: Provide identification of the adjustable frequency drives and their components as specified in Section 26 05 53.
- C. Nameplates: Install nameplates for devices located on doors so they are readable to a person 5'-8" tall standing 3'-0" in front of the equipment.
- D. Location: Locate nameplates so that they are readily associated with items labeled.
- E. Additional Nameplate: Where nameplates are installed on removable relay or device doors, install an additional nameplate within the relay or device.

- F. Additional Engraving: Where nameplates are located on other compartments than those served, add additional engraving to identify units served.

## 2.5 WIRING:

- A. General: Provide internal wiring with stranded switchboard wire having 600-volt rated, flame-resistant, type SIS insulation. Use No. 14 AWG wire for control interconnections. Provide power connections as required for the service.
- B. Wire Marker: Provide wire markers at each end of all wires.
- C. Wiring to Door Mounted Devices: Where wiring connections are made to equipment mounted on hinged doors, provide connections with extra flexible wires suitably cabled together and cleated.
- D. Terminal Blocks: Provide wiring of all control connections to all external connections through individual, positive-latch, pull-apart type control terminal blocks rated 600-volts. Locate terminal blocks for front access.
- E. Terminal for External Connections: Provide sufficient terminals for all devices external to the adjustable frequency drive.

## 2.6 SOURCE QUALITY CONTROL

- A. Shop Test: Shop test each adjustable frequency drive in accordance with IEEE and NEMA standards, including high potential tests and other standard tests for that particular class of equipment. Notify the OWNER fourteen (14) days prior to start of factory testing so that the OWNER, at his option, may witness the testing.
  - 1. After final assembly, test each adjustable frequency drive at full load with application of line-to-line and line-to-ground bolted faults and show that the adjustable frequency drive trips electronically without device failure.
  - 2. After all tests have been performed, burn-in each adjustable frequency drive for 40 hours at 100 percent inductive or motor load.
  - 3. After the burn-in cycle is complete, subject each adjustable frequency drive to a 30 minute cycling motor load test before inspection and shipping.
- B. Operational Tests: After the equipment has been completely assembled, perform operational test to determine operating conditions and circuit continuity. Provide pushbuttons and selector switches to simulate all control input contacts and indicating lights to indicate all control outputs. Provide a 4-20ma signal generator to simulate analog signals.
- C. Test Equipment: Provide all equipment, devices, instrumentation, and personnel required to perform the tests. Upon satisfactory completion of the test, submit two

(2) certified copies of the test report to the ENGINEER. Component failure during testing will require repeating any test associated with the failure or modified components to demonstrate proper operation.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install all equipment in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.
- B. Protective Adjustments: Set all circuit breakers per the approved short circuit and coordination study.
- C. Operational Adjustments: Set all operational devices for proper system operation.
- D. Cable Connections: Terminate and label all field wiring per approved drawings.

### 3.2 FIELD QUALITY CONTROL

- A. Inspections: Inspect, adjust and check the installation for physical alignment, cable terminations and ventilation.
- B. Tests: Perform the following field tests:
  - 1. Close and open each circuit breaker to test operation
  - 2. When site conditions permit, energize and de-energize each equipment item served by each drive, testing the complete control sequence of each item including acceleration and deceleration over complete operating range.
  - 3. Harmonic Measurement: Perform a harmonic system analysis to demonstrate full compliance with IEEE 519 voltage and current harmonic distortion requirements specified. Accurately measure the amplitude of the harmonic current imposed on the 60 hertz sine wave with a harmonic spectrum analyzer. Provide additional harmonic reduction equipment to meet the specified limits. If the harmonic distortion limits are not achieved, replace the adjustable frequency drive equipment with equipment that conforms to this specification.
  - 4. Operate each adjustable frequency drive with driven equipment at full load and test for hot spots.
  - 5. Test Reports: Furnish detailed test reports of all tests indicating test performed, discrepancies found, and corrective action taken.

- C. Manufacturer's Field Services Representative: Provide the services of a factory-trained service engineer, specifically trained on the adjustable frequency equipment to assist in installation, start-up, testing, calibration, placing into operation and provide training, as specified in Section 01 79 00.
1. Provide a service engineer when each drive is placed into operation.
  2. Provide a service engineer at the jobsite as often as necessary until all problems are corrected and the equipment installation and operation are satisfactory.
  3. Following completion of installation and field testing provide training for 12 employees of the OWNER in the proper operation, troubleshooting and maintenance of the equipment as outlined below. All training will be at the OWNER'S facilities at a time agreeable to the OWNER:
    - a. Operational Training: A minimum of one 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.
    - b. Maintenance Training: A minimum of one 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.
  4. Provide service engineer at the job site as often as necessary to assist in the programming of the SCADA system in accessing the memory map of each device.
  5. Provide replacement spare parts which may have been used during the course of startup and testing.

### 3.3 CLEANING AND PAINTING

- A. Shop Painting: Paint the adjustable frequency drive equipment as specified in Section 09 96 00.
- B. Field Painting: Furnish three 12-ounce spray cans of the final finish for touch-up. Touch-up scratched and marred surfaces to meet the requirements of Section 09 90 00.

END OF SECTION

## SECTION 26 29 53

### CONTROL COMPONENTS AND DEVICES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing manual starters, motor controllers and remote-control stations. In addition, the requirements for control components and devices for use in equipment provided under various other sections.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 09 96 00 - High Performance Coatings
  - 2. Section 26 05 00 - Basic Electrical Materials and Methods
  - 3. Section 26 05 19 - Wires and Cables - 600 Volts and Below
  - 4. Section 26 05 60 - Requirements for Shop-Assembled Equipment
  - 5. Section 26 29 23 - Adjustable Frequency Drives
  - 6. Section 26 19 00 - Medium Voltage Adjustable Frequency Drives
  - 7. Section 26 05 53 - Electrical Identification
  - 8. Section 26 05 26 - Grounding
  - 9. Section 26 24 19 - Motor Control Centers
  - 10. Section 26 29 43 - Contactors
  - 11. Section 26 50 00 - Lighting

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies
  - 2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
  - 3. UL 486A - Wire Connectors and Soldering Lugs for Use With Copper Conductors

##### 1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Provide equipment capable of operating in an ambient temperature range of 0 to 40 degrees C and humidity of up to 90 percent noncondensing.

- B. Motor Controllers: Provide motor controllers suitable for 480-volt, three-phase, three-wire, 60-hertz operation.
- C. Control Devices: Provide control devices suitable for operation at 120-volts, 60-hertz, unless specifically noted otherwise.
- D. Insulation Class: Provide control equipment and devices that meet the requirements of the 600-volt insulation class.

#### 1.4 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01 and Section 26 05 00.
- B. Product Data and Information: Furnish catalog data for all associated equipment and devices.
- C. Shop Drawings: Furnish shop drawings customized to the project for motor controllers and remote control stations that include the following:
  - 1. Outline drawings showing dimensions, identification of components and a nameplate schedule for all units.
  - 2. Bill of materials including manufacturers' name and catalog number.
  - 3. Individual schematic and wiring diagrams for each motor controller
- D. Equipment Ratings: Obtain and enter full performance details on all motors and other equipment being served on the above drawings.

#### 1.5 QUALITY ASSURANCE

- A. Codes: Provide manual starters, motor controllers and remote control stations that are in accordance with NEMA ICS 2.
  - 1. Provide manual starters, motor controllers and remote control stations that are in accordance with the NEC and local codes.
- B. UL Listing: Provide UL-listed manual starters, motor controllers and remote control stations.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, and handle all products and materials as specified in Division 01.

- B. Storage and Protection: Store all equipment and materials in a dry, covered, heated and ventilated location. Provide any additional measures in accordance with manufacturer's instructions.

## 1.7 SPARE PARTS

- A. General: Furnish the following spare parts:
  - 1. Two control stations of each type provided.
  - 2. Three of each type of manual starter.
  - 3. One of each type of motor controllers.
- B. Packaging: Pack spare parts in containers bearing labels clearly designating contents and related pieces of equipment. Deliver spare parts in original factory packages. Identify all spare parts with information needed for reordering.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Motor Controllers
    - a. Eaton/Cutler-Hammer
    - b. General Electric Company
    - c. Square D/Schneider Electric
    - d. Emerson Industrial Automation/Appleton
    - e. Eaton/Crouse-Hinds
    - f. Rockwell Automation/Allen-Bradley
  - 2. Control Relays:
    - a. Eaton/Cutler-Hammer
    - b. Square D/Schneider Electric
    - c. General Electric Company
    - d. Rockwell Automation/Allen-Bradley
  - 3. Timing Relays:
    - a. TE Connectivity/Agastat 7000 Series
    - b. Danaher Specialty Products/Eagle Signal

4. Reset and Repeat Cycle Timers:
  - a. Danaher Specialty Products/Eagle Signal
  - b. Marsh Bellofram/Automatic Timing and Controls
5. Current Switches
  - a. Veris Industries Inc.
6. Surge Protection Devices (SPD)
  - a. Thomas & Betts/Current Technologies, Inc.
  - b. Eaton/Cutler-Hammer
7. Rubber Work Mats
  - a. Salisbury by Honeywell
  - b. North American Mat
  - c. White Equipment

## 2.2 MOTOR CONTROLLERS

- A. General: Provide 480-volt, 3-phase, 60-hertz, across-the-line, combination motor circuit protector magnetic starters with individual control power transformers.
- B. Magnetic Starters: Provide magnetic starters as follows:
  1. Full voltage non-reversing or full voltage reversing, as required.
  2. Starter contacts of the replaceable, spring-loaded, wedge type with silver-cadmium oxide plated contact surfaces.
  3. Provide replaceable coils of the epoxy sealed type.
  4. Thermal Overload Elements: Class 20 thermal overload element and all required accessories. Provide size five and larger starters with current transformer operated overload relays.
    - a. Bimetallic type with an adjustment knob which allow plus or minus 15-percent adjustment of the heater's nominal rating.
    - b. Size the overload relays after approval of the corresponding motor.
    - c. Provide and adjust overload relays that match the associated motor nameplate running-current rating.

- d. Provide a set of isolated, normally-open and normally-closed contacts for each overload relay.
- C. Motor Circuit Protectors: Provide a motor circuit protector for each combination starter as follows:
- 1. Molded-case, air-break type designed for 600-volt, 60-hertz service with an interrupting capacity of 65,000 rms symmetrical amperes at 480 volts.
  - 2. Three-pole motor circuit protectors with magnetic, adjustable-trip units actuating a common tripping bar to open all poles when an overload or short circuit occurs.
  - 3. No thermal elements.
  - 4. Magnetic trip units capable of being set from 700 to 1,300 percent of the motor full-load amperes.
- D. Control Components: Provide push buttons, switches, indicating lights, transformers, relays and timers as specified herein under paragraph 2.5.

2.3 REMOTE CONTROL STATIONS

- A. General: Provide heavy-duty, oiltight remote control stations, consisting of push buttons, indicating lights, and selector switches with double-break silver contacts meeting the requirements specified under the section Control Components.
- B. Enclosures: Provide motor controllers installed in NEMA 250 rated enclosures as follows:

AREA	ENCLOSURE
Outdoor and below grade elevation indoors	NEMA 4 – Watertight
Corrosive areas as defined in Section 26 05 00 or as shown	NEMA 4X 316 Stainless Steel
Above grade indoor	NEMA 12 – Industrial

- C. Lockout Attachments: Where shown, provide lockout attachments as follows:
  - 1. Push buttons with padlockable attachment that holds the button depressed.
  - 2. Selector switch with a padlockable attachment that covers the selector switch operators and allows the switch to be set in any position. Selector switch operators that use a removable key are not acceptable.

## 2.4 CONTROL COMPONENTS

- A. Push Buttons, Selector Switches and Indicating Lights:
1. Provide heavy-duty, oiltight, 30.5 mm, push-button or selector switch control stations arranged for flush-panel mounting.
  2. Provide the additional switches, relays, and other electrical accessories necessary to control and safeguard the operation of the associated equipment.
  3. Provide 30.5 mm, low-voltage, push-to-test, LED type indicating lights suitable for operation at 120-volt, 60-hertz ac control circuit voltages.
  4. Color code indicating lights as follows:
    - Red - Motor running or valve open
    - Green - Motor off or valve closed
    - Amber - Capable of operation from this point
    - Blue - Alarm or trouble condition
- B. Control Power Transformer: Provide an individual, control power transformer for each starter to derive the 120 volts for the unit's control circuit. Provide transformers with sufficient capacity to meet the energy demands for all related control components including relays, solenoids and other indicated items. Provide dual fuses on the primary and one fuse on the secondary. Ground the unfused leg of the secondary to the enclosure.
- C. Elapsed Time Meters: Provide nonreset-type elapsed time meters to register up to 9999.9 hours, having square cases suitable for panel mounting and having coils for 120-volt, 60-hertz operation.
- D. Control and Latching Relays: Provide control and latching relays of 600-volt class, machine-tool quality with convertible contacts. Provide relay-operating contacts rated at a minimum of 10 amperes, 120 volts, 60 hertz.
- E. Timing Relays: Provide four-pole, double-throw, timing relays with timing ranges and ON/DELAY or OFF/DELAY operation as required. Provide contacts rated a minimum of 10 amperes at 120 volts, 60 hertz.
- F. Reset and Repeat Cycle Timers: Provide electromechanical or solid-state type reset and repeat cycle timers, with timing ranges and functions as indicated. Provide contacts rated at a minimum of 10 amperes, 120 volts, 60 hertz. Solid-state output contacts are not acceptable.

- G. Current Switches: Provide current switches as follows:
1. General: Provide electric current switches to accomplish specified control functions.
  2. Construction: Provide current switches of a solid state type with compatible current and voltage ratings. Provide sensors complete with in-rush delay, single set joint adjustment, power and status LED's and adjustable trip set point with accuracy of +/- 2 percent of range. UL listing and NEMA 12 sealing is required. Provide with two normally open dry contacts.
  3. Design: Provide switches designed for a 5 to 185 degree F and 0 to 95 percent humidity, and of a power induced type. Sensors with external power supply are not acceptable.
- H. Phase Failure and Undervoltage Relay: Provide a 3-phase, power monitor to detect phase failure, phase reversal, phase unbalance and undervoltage, suitable for operation at 480 volts. Provide an adjustable, drop-out voltage range of 380 to 500 volts and an adjustable time delay from 0.2 to 20 seconds. Provide a normally-open and normally-closed alarm contact rated 10 amperes at 120 volts with automatic reset.
- I. Lock out Relay: Provide 600V class relay that is an electrically operated hand, or electrically reset relay that functions to shut down or hold an equipment out of service, or both, upon the occurrence of abnormal conditions as shown in contract drawings.

## 2.5 SURGE PROTECTION DEVICES (SPD):

- A. Provide SPD equipment that complies with UL 1449 and UL 1283.
- B. Provided units with a maximum continuous operating voltage that exceeds 115 percent of the nominal system operating voltage.
- C. Provide SPD equipment suitable for wye configured systems.
- D. Provide SPD equipment having directly connected suppression elements between line-neutral (L-N), line-ground (L-G) and neutral-ground (N-G).
- E. Provide SPD equipment that distributes the surge current to all MOV components to ensure equal stressing and maximum performance and provides equal impedance paths to each match MOV.
- F. Provide high-performance EMI/RFI noise rejection filters that attenuate the electric line noise at least 55dB at 100 kHz using MIL-STD-220A insertion loss test method.

- G. Wire internal components with connections utilizing low impedance conductors and compression fittings.
- H. Provide a monitoring panel for each system that incorporates the following features:
  - 1. Green/Red solid state indicator lights to indicate which phase(s) have been damaged.
  - 2. A flashing trouble light to indicate fault detection.
  - 3. Transient event counter.
  - 4. Audible alarm.
  - 5. Form C contacts for remote monitoring of the unit status.
- I. Provide SPD suitable for location application and minimum surge current per mode as follows:
  - 1. 480V and 480Y/277V Panelboard: UL 1449, Type 1/2, 150kA
  - 2. 120/240V and 208Y/120V Panelboard: UL 1449, Type 2, 80kA
- J. Location: Install SPD as follows:
  - 1. Panelboard: Mount SPD internally or externally to minimize lead length. Provide a branch circuit breaker disconnect sized in accordance with the manufacturer's recommendations. Locate the SPD unit branch circuit breaker immediately downstream of the main circuit breaker or main lugs.

## 2.6 RUBBER WORK MATS:

- A. Provide a three foot wide rubber work mat on the floor in front of each switchgear, switchboard and motor control center. The mat will be long enough to cover the full length of the line-up. Provide mats that are 1/4 inch thick with beveled edges, canvas back and solid type with corrugations running the entire length. Mats will be guaranteed to be free from cracks, blow holes or other defects detrimental to their mechanical and electrical strengths. Mats will meet all OSHA requirements and those of ANSI/ASTM J6.7 – 1935 (R1971) / D178, Type 2, Class 2.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install all equipment in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.

- B. Mounting: Mount manual starters, motor controllers and remote control stations 4 feet 6 inches from the finished floor up to their centerlines, unless otherwise shown. Mount all devices at least ½ inch away from concrete wall surfaces.
- C. Adjustments: Set all motor circuit protectors and circuit breakers based on the approved short circuit and coordination study.
- D. Overloads: Adjust the thermal overloads on each phase of each starter unit for the actual motor installed.
- E. Cable Connections: Terminate and label all field wiring per the approved diagrams.
- F. Torque Requirements: Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturers' published torque tightening recommendations. Where manufacturers' torquing requirements are not available, tighten connectors and terminals in accordance with UL Standard 486 A.

### 3.2 FIELD QUALITY CONTROL

- A. Inspections: Inspect, adjust and check the installation for physical alignment, cable terminations and ventilation.
- B. Operation and Maintenance: Furnish operation and maintenance instructions as specified in Division 01.

END OF SECTION

(NO TEXT ON THIS PAGE)

## SECTION 26 32 13

### PACKAGED ENGINE GENERATOR SYSTEMS

#### PART 1 GENERAL

##### 1.1 SUMMARY

A. Section Includes: Requirements for providing packaged engine generator system to supply emergency and standby electrical power as specified and shown. Each system consists of:

1. Natural gas engine-driven generator mounted on a structural steel base.
2. Heat exchanger system for transfer of heat to plant cooling water, on separate skid.
3. Natural gas fuel train with regulators, valves, and piping to building natural gas supply.
4. Exhaust silencer, fittings, and piping.
5. Generator control and instrument panel.
6. Battery and charger including battery rack.
7. Vibration isolators.
8. Remote annunciator.
9. Master control panel for synchronizing and paralleling of generators, suitable for remote operation of circuit breakers at medium voltage switchgear provided under Section 26 13 00.

B. Related Work Specified in Other Sections Includes, But is Not Limited to the Following:

1. Section 01 79 00 - Training
2. Section 03 30 00 - Cast-in-Place Concrete
3. Section 09 96 00 - High Performance Coatings
4. Section 26 05 00 - Basic Electrical Materials and Methods
5. Section 26 05 13 - Medium Voltage Cable
6. Section 26 05 19 - Wires and Cables - 600 Volts and Below
7. Section 26 05 26 - Grounding
8. Section 26 05 33 - Electrical Raceway Systems
9. Section 26 05 53 - Electrical Identification
10. Section 26 08 00 - Electrical Testing Requirements
11. Section 26 13 00 - Medium Voltage Switchgear
12. Section 26 23 00 - 480 Volt Switchgear

## 1.2 REFERENCES

### A. Codes and Standards: Codes and standards referred to in this section:

1. ASTM A 185 - Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
2. ASTM A 615/A615M - Standard Specification for Deformed and Plain Billet Steel Bars for Concrete
3. NFPA 30 - Flammable and Combustible Liquids Code
4. NFPA 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines
5. NFPA 54 - National Fuel Gas Code
6. NFPA 110 - Standard for Emergency and Standby Power Systems
7. UL 1709 - Rapid Rise Fire Tests of Protection Materials for Structural Steel
8. UL 2200 - Stationary Engine Generator Assemblies

## 1.3 SYSTEM DESCRIPTION

- A. General: Each generator unit is to function as an emergency/standby power source for use in the event of incoming normal power service failure and during normal exercising operations. Each unit consists of a natural gas engine-driven, generator mounted on a structural steel base, complete with instrument panel, generator control panel, starting system, governor, engine jacket-water cooling system, exhaust silencer, voltage regulator, and all appurtenances necessary for a complete functioning generation system.
- B. Minimum Generator Capacity: Provide a minimum generator capacity of 1,000 kW at 4160Y/2400 volts, 3-phase, 60 hertz, 0.8 power factor and 1800 rpm; at an elevation of 600 feet above sea level; at an ambient temperature ranging between 55 degrees to 86 degrees F. Provide a generator system capable of starting and running the following motors in the sequence and with the starting device indicated, with a 1030 kVa incidental load already on the generator bus and a voltage drop not exceeding 20 percent:
1. Squirrel-cage induction 250 hp (33 A full-load at 4,160 V), motor starting by reduced-voltage, solid-state starter.

#### 1.4 SUBMITTALS

- A. General: Furnish all submittals including the following as required in Division 01 and Section 26 05 00.
1. Furnish calculations to support the generator's capacity to start and operate the motors listed in Subsection 1.3 B.
  2. Furnish starting battery sizing calculations.
- B. Product Data and Information: Furnish product data and information showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, fuel tank, cooling system, and remote annunciator.
- C. Contractor's Shop Drawings: Furnish Contractor's shop drawings showing plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.
- D. Quality Control: Furnish the manufacturer's certified, shop-test report including the following tests:
1. Generator tests in accordance with IEEE Test Code for synchronous machines including heat run at rated output, insulation resistance and high potential.
  2. Engine generator tests in accordance with specifications including the following:
    - a. Two hours continuous operation at full load.
    - b. One-half hour at 75 percent of full load.
    - c. One-half hour at 50 percent of full load.

Furnish test reports indicating voltage, amperes, kilovolt-amperes, kilowatts, rpm and fuel consumption for each load condition as curves; and containing statements on temperature rise of oil and cooling water, vibration and other objectionable performance conditions. Furnish test data showing voltage drop and frequency fluctuations when block loads are added and removed in 25 percent, 50 percent, 75 percent and 100 percent increments.
  3. Furnish manufacturer's installation instructions in accordance with the provisions of Division 01.
  4. Submit certified Generator ANSI and Decrement Curve data sheets.

5. Where paralleling controls are to be provided, furnish with all the features and capabilities as shown and specified. Proprietary paralleling systems unable to provide all the features and capabilities of the system as designed are not acceptable.
- E. Operation and Maintenance Manuals: Furnish manufacturer's operation and maintenance manuals as required in Division 01.
- F. Record Documents: Furnish record documents in accordance with the provisions in Division 01. Accurately indicate the locations of engine generator and mechanical and electrical connections.

#### 1.5 WARRANTY

- A. Written Warranty: Furnish a written warranty for a period of not less than two years from the date of the system acceptance that covers, but is not limited to, the following:
  1. Repair parts
  2. Labor
  3. Travel expense
  4. Expendables made unserviceable by the defect and used during a repair

#### 1.6 DELIVERY

- A. General: Deliver, store and handle all products and materials as required in Division 01.

#### 1.7 SPARE PARTS

- A. General: Furnish the following spare parts.
  1. Two fuse replacements of each type used.
  2. One current transformer of each type used.
  3. One potential transformer of each type used.
  4. Two full sets of fuel, air and oil filters
  5. Two complete sets of V-belts
  6. One complete set of maintenance manuals
  7. One complete set of parts manuals
  8. Two 12-ounce spray cans of the final finish for touch-up

- B. Packaging: Pack spare parts in containers bearing labels clearly designating contents and related pieces of equipment. Deliver spare parts in original factory packages. Identify all spare parts with information needed for reordering.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.

- 1. Engine generator set and accessories

- a. Caterpillar Inc.
- b. Cummins Power Generation
- c. MTU Solutions

- 2. Battery and Charger

- a. Alcad Inc.
- b. Emerson Network Power/Chloride Industrial Power
- c. SAFT Nife
- d. LaMarche Manufacturing Company

### 2.2 ENGINE

- A. Fuel: Natural Gas

- B. Rated engine speed: 1800 RPM

- C. Lubrication system: The following items are mounted on engine or base rails:

- 1. Filter and strainer: Oil filters rated to remove 90% of particles 5 micrometers and smaller while passing full flow
- 2. Lube oil pump
- 3. Oil level regulator
- 4. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassemble and without use of pumps, siphons, special tools, or appliances

- D. Engine Fuel System:

- 1. Sized for 31.5 to 47.2 MJ/ nM3 (800 to 1200 btu/cu ft) dry pipeline natural gas

2. Fuel Control Valve: Electronic, engine-installed.
3. Throttle Plate: 24V DC actuator electronically controlled by Engine Control Module.

4. Gas Fuel Train:

- a. Factory-standard package. Designed, sourced and shipped by genset manufacturer along with the genset. Designed for installation just upstream of engine fuel inlet.

Shall be capable to handle gas supply pressures from 4.9 to 18.9 kPa (0.65 to 2.6 psi) at the gas train inlet. Maximum pressure drop across gas train at full rated flow, with a new filter: 1.03 kPa (0.15 psi). Inlet Connection Size: DN125.

- b. Gas train shall include the following components:

- (1) Manual gas shutoff valve
- (2) Electronic Gas Shutoff Valve: 24V DC, energized-to-run, double solenoid with visual position indicators.
- (3) Fuel filter: 96 % efficiency at 1 micron particle size, shall include differential pressure gauges.
- (4) Gas pressure regulator
- (5) Connection to Engine Fuel Inlet: Flexible, braided hose.
- (6) Outlet Connection: ASME/ANSI B16.5 Class 150, type (3-)
- (7) Gas train pressure sensors, 4-20 mA, 0-100 kPag, installed in the gas train with ½” NPT conduit connectors.
  - (a) Two sensors installed to provide differential filter pressure.
  - (b) One sensor installed to provide post regulator engine fuel inlet pressure.

- E. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity. Heater shall include a circulation pump. Provide isolation valves that allow for change out of the heater without having to drain the entire system.

- F. Governor:

1. Digital speed governor built into engine control module, speed input 4 to 20 ma (0V to 5V).
2. Dual speed sensing system.
3. Engine over speed protection.

G. Cooling System:

1. Provide a shell and tube heat exchanger sized by the manufacturer to dissipate the heat from the engine-generator during operation. The heat exchanger shall be a steel shell with copper tubes sized for water as the cooling fluid with an inlet temperature of 65°F. The cooling fluid outlet temperature shall not exceed 145°F. Fluid velocity and pressure drop shall not exceed heat exchanger manufacturer requirements. Provide a solenoid valve on the cooling water supply line to open during generator operation.

H. Muffler / Silencer:

1. Provide a cylindrical, critical-grade, exhaust silencer with valved condensate drain that extends beyond the depth of the insulation, and of the appropriate size for use with the engine. The silencer shall have inlet and outlets configured as required to meet the project exhaust system design with a 12 inch water column maximum pressure drop. Flexible, full length stainless steel connector/wye shall be furnished as required between the silencer and the engine exhaust outlet(s). The generator set manufacturer shall furnish all appropriate fittings, flanges, etc., as required between the engine and the silencer.
2. For indoor applications, the silencer shall be turned over to the mechanical contractor for mounting, installation and insulating per the project contract documents.

I. Air Intake Filter: Heavy duty dual element, engine mounted air cleaners with replaceable dry-filter elements, “blocked filter” visual indicator

J. Starting System: 24 VDC electric with negative ground

1. Dual cranking motor: Dual electric starters that automatically engage and release from engine flywheel without binding.
2. Cranking cycle: as required by NFPA 110 for system level Type 1
3. Battery: Oversize (10%) capacity to accommodate starting within ambient temperature range specified in Part 1 “Project Conditions” Article to provide specified cranking cycle at least three times without recharging.
4. Battery Cable: Size as recommended by engine manufacturer for cable length required as per site conditions to be field verified by manufacturer’s

representative prior to order. Include required interconnecting conductors and connection accessories.

5. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
6. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
  - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
  - b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from -40°C to +60°C to prevent overcharging at high temperatures and undercharging at low temperatures.
  - c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to  $\pm 10\%$ .
  - d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
  - e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
  - f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

### 2.3 CONTROLS AND MONITORING

- A. Provide a fully solid-state, microprocessor based, generator set controller. The control panel shall be designed and built by the engine manufacturer. The controller shall provide all operating, monitoring, and control functions for the generator set. The control panel shall provide real time digital communications to all engine and regulator controls via secure communication network.
- B. Mounting: Provide a control panel mounted on the generator set.

C. Environmental

1. The generator set controller shall be tested and certified to the following environmental conditions:
  - a. -40°C to +70°C Operating Range
  - b. 100% condensing humidity, 30°C to 60°C
  - c. IP22 protection for rear of controller; IP55 when installed in control panel
  - d. 5% salt spray, 48 hours, +38°C, 36.8V system voltage
  - e. Sinusoidal vibration 4.3G's RMS, 24-1000Hz
  - f. Electromagnetic Capability (89/336/EEC, 91/368/EEC, 93/44/EEC, 93/68/EEC, BS EN 50081-2, 50082-2)
  - g. Shock: withstand 20G

D. Functional Requirements: The following functionality shall be integral to the control panel.

1. Remote start/stop control
2. Local run/off/auto control
3. Cooldown timer
4. Speed adjust
5. Lamp test
6. Emergency stop push button
7. Voltage adjust
8. Password protected system programming

E. Digital Monitoring Capability: The controls shall provide the following digital readouts for the engine and generator. All readings shall be indicated in either metric or English units.

1. Engine
  - a. Engine oil pressure
  - b. Engine oil temperature
  - c. Engine coolant temperature
  - d. Engine RPM
  - e. Battery volts
  - f. Engine hours
  - g. Service maintenance interval

2. Generator

- a. Generator AC volts (Line to Line, Line to Neutral and Average)
- b. Generator AC current (Avg and Per Phase)
- c. Generator AC Frequency
- d. Generator kW (Total and Per Phase)
- e. Generator kVA (Total)
- f. Generator kVAR (Total)
- g. Power Factor (Avg and Per Phase)
- h. Total kW-hr
- i. Total kVAR-hr

F. Alarms and Shutdowns: The control shall monitor and provide alarm indication and subsequent shutdown for the following conditions. All alarms and shutdowns are accompanied by a time, date, and engine hour stamp that are stored by the control panel for first and last occurrence:

1. Engine Alarm/Shutdown

- a. Low oil pressure alarm/shutdown
- b. High coolant temperature alarm/shutdown
- c. Loss of coolant shutdown
- d. Overspeed shutdown
- e. Overcrank shutdown
- f. Emergency stop shutdown
- g. Low coolant temperature alarm
- h. Low battery voltage alarm
- i. High battery voltage alarm
- j. Control switch not in auto position alarm
- k. Battery charger failure alarm

2. Generator Alarm/Shutdown

- a. Generator over voltage
- b. Generator under voltage
- c. Generator over frequency
- d. Generator under frequency
- e. Generator reverse power

G. Inputs and Outputs

- 1. Programmable Digital Inputs. The Controller shall include the ability to accept programmable digital input signals. The signals may be programmed for either high or low activation using programmable Normally Open or Normally Closed contacts.

2. Programmable Discrete Outputs. The control shall include the ability to operate discrete outputs, integral to the controller, which are capable of sourcing up to 200mA per input.
  - a. The solenoid valve on the heat exchanger shall receive a start command from the run relay contact.

#### H. Accessibility and Maintenance

1. All engine, voltage regulator, control panel and accessory units shall be accessible through a single electronic service tool. The following maintenance functionality shall be integral to the generator set control:
  - a. Engine running hours display
  - b. Service maintenance interval (running hours)
  - c. Engine crank attempt counter
  - d. Engine successful starts counter

#### I. Remote Communications

1. Remote Communications. The Communications Module (CCM) shall provide bi-directional communication between a personal computer (PC) or other RS-232 type device, and up to 8 EMCP II Control Panels. CCM output shall be compatible for either direct connection or connection via a Hayes compatible modem. The module shall include a digital display to indicate the status of communications and fault conditions. The adaptor shall be microprocessor based 100% solid state and comply with FCC Class A requirements for computer equipment. It shall operate in -40°C to 70°C ambients and be suitable for switchgear or similar mounting.
2. Remote Monitoring Software. The control shall provide Monitoring Software with the following functionality
  - a. Monitor up to eight (8) generator sets.
  - b. Provide access to all date and events on generator set communications network
  - c. Provide remote control capability for the generator set(s)

#### J. Local and Remote Annunciation

1. Local Annunciator (NFPA 99/110, CSA 282). Provide a local, control panel mounted, annunciator to meet the requirements of NFPA 110, Level 1.
  - a. Annunciators shall be networked directly to the generator set control

- b. Local Annunciator shall include a lamp test pushbutton, alarm horn and alarm acknowledge pushbutton
- c. Provide the following individual light indications for protection and diagnostics:
  - (1) Overcrank
  - (2) Low coolant temperature
  - (3) High coolant temperature warning
  - (4) High coolant temperature shutdown
  - (5) Low oil pressure warning
  - (6) Low oil pressure shutdown
  - (7) Overspeed
  - (8) Low coolant level
  - (9) EPS supplying load
  - (10) Control switch not in auto
  - (11) High battery voltage
  - (12) Low battery voltage
  - (13) Battery charger AC failure
  - (14) Emergency stop

2. Remote Annunciator (NFPA 99/110, CSA 282). Provide a remote annunciator to meet the requirements of NFPA 110, Level 1.

- a. The annunciator shall provide remote annunciation of all points stated above and shall incorporate ring-back capability so that after silencing the initial alarm, any subsequent alarms will sound the horn. Ability to be located up to 1000 ft from the generator set without the use of a data repeater.

K. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector shall perform the following functions:

- 1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
- 2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
- 3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.

4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

#### 2.4 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H insulation. Windings shall be of the random wound type. Temperature rise shall not exceed 125°C over 40°C ambient temperature.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Enclosure: Drip proof.
- G. Instrument Transformers: Mounted within generator enclosure.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
  1. Voltage adjustment on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.
- I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
- J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- K. Provide each generator rated for continuous standby service at 1000 kW, 1250 kVA at 0.8 power factor, 4160Y/2400 volts, three phase, three wire, wye connected, 60 Hertz, 1800 rpm, with a temperature rise not exceeding 105 degrees C in an ambient temperature of 40 degrees C. (Do not specify 80 degree C rise for standby generators smaller than 1500kW as it is not readily available in the smaller sizes and the added cost cannot be justified for standby applications. Follow recommendations in manufacturer's sizing software.)

#### 2.5 VIBRATION ISOLATION DEVICES

- A. Restrained Spring Isolators: Freestanding, steel, open-spring isolators.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions, NFPA 110 and all local codes
- B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.
- C. Install packaged engine generator with restrained spring isolators having a minimum deflection of 1 inch.
- D. Install Schedule 40, stainless steel piping with welded joints and connect to engine muffler. Install thimble at roof. Piping shall be same diameter as muffler outlet.
  1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, stainless steel pipe with welded joints.

- E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted. Electrical wiring includes but is not limited to battery chargers, heaters, control power, load bank, grounding, remote annunciator panels, remote control panels, etc. Contractor to include as part of their scope of work, wall wiring and empty conduit indicated on contract drawings, specified herein, indicated/noted on approved manufacturers shop drawings and as required to provide a fully functional system.
- F. Install piping as specified in Division 23 Sections. Drawings indicate general arrangement of piping and specialties.
- G. Arrange fuel, cooling-system, and exhaust-system piping to packaged engine generator to allow service and maintenance.
- H. Connect cooling-system water piping to engine-generator set and with single braid corrosion resistant type 302 stainless steel wire braid and compression fittings.
- I. Connect engine exhaust pipe to engine with stainless steel flexible connector.
- J. Connect fuel piping to engines with a gate valve and union and stainless steel flexible connector. Provide all required fire safe-off and solenoid valves.
- K. Connect to SCADA, coordinate with controls contractor.
- L. Ground equipment according to Division 26 Section 26 05 26.
- M. Connect wiring according to Division 26 Section 26 05 19.

### 3.3 FIELD QUALITY CONTROL

- A. Initial Test Run: Test start and run the engine generator set at no load for at least 30 minutes to check dc starting system, vibration free installation, fuel line leaks, all gauges and meters, engine rpm, generator voltage and to warm up the engine generator for the load test, as per the manufacturer's instructions.
- B. Inspections: Inspect all engine generator systems after initial test run for defects and rectify in accordance with manufacturer's instructions.
- C. Tests: Carry out a field test of the engine generator system for 4 hours at full load in the presence of the ENGINEER. Furnish dry type load banks for the load test and provide precise incremental loading on engine generator till full load. Check phase voltages, current frequency, vibration, and temperatures as per manufacturer's instructions.

### 3.4 OPERATION DEMONSTRATION

- A. Manufacturer's Service Representative: Furnish the services of the engine generator manufacturer's representative to assist in installation, start-up, field testing,

calibration, placing into operation and provide training, as specified in Section 01 79 00 including the acceptance test run of the set. have the representative carry out a thorough inspection of the installation; certify that the installation is correct and complete in accordance with the manufacturer's instructions; to confirm that the set is ready for acceptance test run; and to instruct operating personnel in the operation and maintenance of the set.

- B. Final Acceptance Test (Demonstration) Run: Have the manufacturer's service representative perform the final acceptance test run of the engine generator set in the presence of the ENGINEER. Perform the final acceptance test run by simulating a power failure and observing automatic engine generator startup, acceleration to speed and assumption of available load at the site without any problems and as per claimed performance. Demonstrate the compatibility of the engine generator with the adjustable frequency drives and solid-state starters used for motors; and its capability to start and operate the loads in the desired sequence. Also demonstrate that the engine generator is capable of starting and sustaining the load with a voltage drop of not more than 20 percent of the rated value. Simulate and demonstrate that the alarm and shut down features operate satisfactorily.
- C. Training: Following completion of installation and field testing furnish training for 12 employees of the OWNER in the proper operation, troubleshooting and maintenance of the equipment as outlined below. All training will be at the OWNER'S facilities at a time agreeable to the OWNER:
  - 1. Operational Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction , excluding travel time.
  - 2. Maintenance Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.
- D. Lubricants, Coolants, Filters and Fuel: Upon satisfactory completion of all tests and training, replenish all lubricants and coolant to factory recommended levels. Check all filters for serviceability and replace if needed. Top off fuel tanks to full capacity.

### 3.5 CLEANING AND PAINTING

- A. Shop Painting: Paint the generator systems as specified in Section 09 90 00.
- B. Field Painting: Touch up scratched and marred surfaces to match with original finishes.

### 3.6 IDENTIFICATIONS

- A. General: Provide identifications meeting the requirements of Section 26 05 53.

- B. Component Identification: Identify all system components, cables and wires by applicable labels indicating unit numbers, circuit numbers.

END OF SECTION

(NO TEXT ON THIS PAGE)

SECTION 26 33 00  
BATTERY SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Requirements for providing battery systems as indicated, in accordance with the Contract Documents.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 26 05 00 - Basic Electrical Materials and Methods
  - 2. Section 26 05 26 - Grounding
  - 3. Section 26 05 53 - Electrical Identification
  - 4. Section 26 08 00 - Electrical Testing Requirements
  - 5. Section 26 05 19 - Wire and Cables - 600 Volts and Below
  - 6. Section 26 05 33 - Electrical Raceway Systems
  - 7. Section 26 13 00 - Medium Voltage Switchgear

1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. IEEE 485 - IEEE Recommended Practice for Sizing Lead Acid Batteries for Stationary Applications
  - 2. NFPA 70 - National Electrical Code (NEC)
  - 3. UL 486A - Wire Connectors
  - 4. UL 924 - Emergency Lighting and Power Equipment
- B. Materials and Workmanship Requirements: Provide all battery systems meeting the requirements of NFPA standards and codes.
- C. Design, Manufacture and Testing Requirements: Provide battery system components that are designed, manufactured and tested in accordance with the latest NEMA, IEEE and ANSI standards and are UL listed.
- D. Installation Requirements: Install battery systems in accordance with the requirements of NEC and local electrical codes.

1.3 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01 and Section 26 05 00.
- B. Product Data and Information: Furnish manufacturer's catalog data on the battery systems' major components and accessories, including batteries, battery charger and dc distribution panel indicating type, model, service voltages, number of phases, current ratings, sequence of operation and control and alarms. Furnish manufacturer's schematic control diagrams and interconnection diagrams with terminals for connection of equipment external to the battery system.
- C. Battery Sizing Calculations: Furnish battery sizing calculations meeting the following criteria:
  - 1. Size batteries to provide a capacity of at least two times the total requirement on an 8-hour rating plus the sum of all simultaneous operating trip coils on a 1-minute rating to a final voltage of 1.75 volts per cell in accordance with IEEE 485.
  - 2. Use the following loads and duty cycles for sizing the batteries:

Battery Duty Cycle	
Load Description	Duty Cycle (Approximate operating time)
Simultaneous operation of the circuit breakers, trip coils and spring-charging motors	10 seconds
Switchgear indicating lights and relays	24 hours
Simultaneous operation of the circuit breakers, trip coils and spring-charging motors	10 seconds to occur after 8 hours

- D. Battery Charger Calculations: Furnish battery charger calculations confirming the charger is capable of fully recharging the batteries from low level within 12 hours while continuing to provide the full power requirements of the system.
- E. Shop Drawings: Furnish manufacturers layout drawings for the battery systems showing accurately scaled plan views and elevations.

1.4 OPERATION AND MAINTENANCE MANUALS

- A. General: Furnish operation and maintenance manuals including spare parts list for the battery systems as specified in Division 01.

## 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 and Section 26 05 00.
- B. Storage and Protection: Store battery system equipment in a dry, covered, heated and ventilated location. Provide any additional measures in accordance with manufacturer's instructions.

## 1.6 SPARE PARTS

- A. General: Furnish the following spare parts for each group of similar battery systems.
  - 1. All spare parts and accessories recommended by the manufacturer in published literature. As a minimum, provide the following:
    - a. Six of all sizes and types of power and control fuses
    - b. One battery test kit
    - c. One set of interior and interstep jumpers of each length used
    - d. Six terminal lugs
    - e. One cell lifting strap
    - f. Three 12-ounce spray cans of the final finish for touch-up
- B. Packaging: Package spare parts and accessories in containers bearing labels and identify all for reordering. Deliver all in original factory packages.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Batteries
    - a. Enersys
    - b. C&D Technologies
    - c. Emerson Network Power/Chloride Industrial Power
    - d. Johnson Controls Inc.

2. Chargers
  - a. La Marche
  - b. Sens
  - c. Saft
  - d. Hindle Power

## 2.2 MATERIALS

- A. General: Provide central station-type battery systems, 125 volts dc nominal, complete with console and built-in batteries, battery chargers and dc secondary distribution panel, as shown.
- B. Battery Console: Provide the consoles that are in compliance with the provisions of UL 924 and the National Electrical Code. Provide flue-effect cooling by a completely-open raised bottom and openings at the top of both front and rear. Protect all ventilation openings by heavy perforated metal. Equip doors with key locks, and a tamper-resistant, glass, viewing panel.
- C. Batteries: Provide valve-regulated lead-acid (VRLA) type station batteries with flame arrester. Provide a NEMA 1 enclosure for the batteries on two tier racks.
- D. Battery Chargers:
  1. Provide high-frequency switch-mode battery charger with automatic voltage regulation arranged for operation at 120 volts ac, 1-phase, 60-hertz.
  2. Provide dual battery chargers with load-sharing feature. Provide chargers arranged so that if one fails the other will accept the complete load. Provide chargers that have a nominal output voltage of 130 volts. Provide inverse temperature compensations of plus or minus one percent regulation from no load to full load with plus or minus 10 percent ac voltage variation. Provide continuous, current-limiting features at no more than 140 percent of rated current.
  3. Provide low-voltage dc alarm and ac power failure relays with contacts for remote alarm indication.
  4. Provide automatic load-equalizing devices.
  5. Provide LCD front panel display with voltage and current indication.
  6. Provide LED front panel alarm and status indicators, including:
    - a. Fan Failure
    - b. AC Failure/ AC Available
    - c. Over-Temperature
    - d. Current Limit

- e. Thermal Control
- f. Float/Equalize
- g. Positive and Negative Ground

- 7. Provide fuse protection on ac input and and dc output.
- 8. Provide surge suppressors, ground fault indication and alarm devices.

E. Dc Distribution Panel:

- 1. Provide a 125-volt dc, secondary distribution, circuit breaker panel located as shown on the Drawings, with molded-case circuit breakers as scheduled, having an interrupting capacity of 10000 amperes. Provide a panel with its own door to protect the circuit breakers.

Provide the following alarm functions wired to a labeled terminal strip for remote alarm indication:

- a. Charger No. 1 Failure
- b. Charger No. 2 Failure
- c. Battery Low Voltage
- d. Ac Power Failure
- e. Dc Power Ground Fault

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install all battery systems as indicated and in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 01. Comply with the requirements of NEMA standards, NEC, and applicable ANSI Publications.
- B. Coordination: Coordinate with cabling/wiring, as necessary, to interface the installation of battery charger.
- C. Torque Requirements: Tighten electrical connectors and terminals, including screws bolts and ground connections, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals in accordance with UL Std 486A.
- D. Fuses: Provide required fuses.
- E. Adjustments: Make all necessary adjustments to the equipment to provide complete and satisfactory operation.

### 3.2 FIELD QUALITY CONTROL

- A. **Manufacturer's Representative:** Furnish the services of a factory-trained, experienced, competent, and authorized representative of the manufacturer of the battery equipment to visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation as specified in Division 1. Provide all instruments necessary to conduct the required tests and adjustments. Have the manufacturer's representative utilize prepared comprehensive check sheets covering inspections, and required checks and tests. Furnish copies of these documents executed and signed by the manufacturer's representative. Have the representative present when the equipment is placed in operation. Furnish the representative's services as often as necessary until all problems are corrected and the equipment is installed and operating satisfactorily.
- B. **Certified Report:** Furnish a written report certifying that the equipment (1) has been properly installed, (2) is in accurate alignment, (3) is free from any undue stress imposed by connections or anchor bolts, and (4) has been operated under full load conditions and that it operated satisfactorily.
- C. **Tests and Inspections:** Perform the following tests and inspections: Record all tests and submit a written report for approval with retests as necessary.
1. Inspect battery for physical damage.
  2. Verify system configuration with drawings.
  3. Check that battery ampere-hour rating and charger are adequate for the system.
  4. Check intercell bus link integrity.
  5. Examine the electrolyte level in each cell. Verify that the electrolyte level is between the low and high level lines. If the level is lower than 1/2-inch below the top of the plates, replace the battery since it is considered damaged.
  6. Check the new battery installation on the rack using the manufacturer's recommended spacing between units and that the positive of one unit is connected to negative of the adjacent unit.
  7. To provide a good connection, check the battery terminals and all intercell connector links and cables to be sure they are cleaned and that the no-oxide grease is properly applied according to the manufacturer's instructions.
  8. Measure the resistance of each intercell connection using a 10 amp ductor in accordance with manufacturer's instructions. If the measured resistance value is 10 percent above the average, take corrective measures by tightening, cleaning or re-greasing the connection until its resistance measurement reaches an acceptable level.

9. Measure system charging voltage.
10. Test all battery charger alarm circuits.

### 3.3 GROUNDING

- A. System: Inspect the ground system for compliance with the latest drawings.
- B. Connections: Inspect all ground connections for evidence of looseness and/or corrosion.

### 3.4 CLEANING AND PAINTING

- A. Shop Painting: Paint the battery system as specified in Section 09 90 00.
- B. Field Painting: Touch up scratched and marred surfaces to match with original finishes.

### 3.5 IDENTIFICATIONS

- A. General: Provide identifications meeting the requirements of Section 26 05 53.
- B. Component Identifications: Identify all system components, cables and wires by labels indicating unit numbers, circuit numbers and date of installation.

END OF SECTION

(NO TEXT ON THIS PAGE)

## SECTION 26 33 53

### UNINTERRUPTIBLE POWER SUPPLY SYSTEMS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing and testing three-phase modular uninterruptible power supply (UPS) systems consisting of rectifier/battery charger, solid-state inverter, static transfer switch, manual bypass switch, batteries with associated controls, ac and dc protection, instrumentation and alarms; housed in suitable metal enclosures.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to the Following:
  - 1. Section 01 79 00 - Training
  - 2. Section 26 05 00 - Basic Electrical Materials and Methods
  - 3. Section 26 05 26 - Grounding
  - 4. Section 26 05 53 - Electrical Identification
  - 5. Section 26 05 19 - Wires and Cables - 600 Volts and Below
  - 6. Section 26 05 33 - Electrical Raceway Systems

##### 1.2 REFERENCES

- A. Codes and Standards: The following codes and standards are referred to in this Section as follows:
  - 1. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors
  - 2. UL 1778 - Uninterruptible Power Supply Equipment
  - 3. NFPA 70 - National Electrical Code
  - 4. IEEE 446 - Recommended Practice for Standby Power Systems
  - 5. IEEE C62.41 - Recommended Practice for Surge Withstand ability
  - 6. NEMA PE 1 - Uninterruptible Power Systems
  - 7. OSHA - Occupational Safety and Health Administration
  - 8. Quality System Standard ISO 9001

### 1.3 SUBMITTALS

- A. General: Furnish all submittals, including the following, in accordance with the requirements contained in Division 01.
- B. Product Data and Information: Furnish manufacturers data on all equipment and devices in the assembly, including voltages, number of phases, current ratings, capacities, finishes for all the system components and other relevant data.
- C. Contractors Shop Drawings: Furnish contractors shop drawings for the shop assembled equipment, including the following:
  - 1. Layout drawings of the assembly showing accurately scaled basic equipment sections, auxiliary compartments, combination sections and location of various system components and their interconnection. Show special relationships of assemblies to associated equipment, including plan and front views of the equipment and layout dimensions. Provide a bill of materials.
  - 2. Wiring diagrams for assemblies showing connections to electrical power. Clearly differentiate between shop-installed portions of wiring and field installed portions.
  - 3. Furnish construction drawings for equipment requiring field assembly. Clearly differentiate between shop-assembled portions and field assembled portions.
  - 4. A schematic control diagram for the entire system showing connections to other related systems.
  - 5. Manufacturer's installation, testing and commissioning instruction for the entire system.
- D. Quality Control: Furnish manufacturers test reports and certified performance records of all equipment installed. Furnish field test reports after equipment is installed.
- E. Operations and Maintenance Manuals: Furnish Operations and Maintenance Manuals of all equipment and assemblies in accordance with Division 01.

### 1.4 QUALITY ASSURANCE

- A. Codes: Comply with local codes and all other applicable codes.
- B. Regulatory Requirements: Comply with applicable Regulatory Agency requirements.

## 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials in accordance with the requirements contained in Division 01.

## 1.6 WARRANTY

- A. General: Provide warranty for all equipment and services furnished as described in Division 01 of these Specifications.

## 1.7 SPARE PARTS

- A. General: Provide the following spare parts:
  - 1. One set of each type of fuses.
  - 2. Two batteries of each type and rating.
- B. Packaging: Pack spare parts in containers bearing labels clearly designating contents and related pieces of equipment. Deliver spare parts in original factory packages. Identify all spare parts with information needed for reordering.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are as listed below. Other manufacturers of equivalent products may be submitted for approval for review.
  - 1. Three-phase UPS system.
    - a. ABB Group, TLE Series
    - b. Vertiv/Liebert, EXM Series
    - c. Eaton/Tripplite, SmartOnline Series

### 2.2 SINGLE-PHASE UPS SYSTEMS

- A. Operating Parameters: Provide UPS systems having the following operating parameters:
  - 1. Nominal Power Rating: 40 kW/40 kVA
  - 2. Input Voltage: 480 Volts, 3-phase, 3-wire  $\pm 10$  percent without discharging the battery.
  - 3. Input Power Factor: 99 percent minimum at full load and nominal voltage.
  - 4. Current Distortion (THDi):  $\leq 3\%$  input current THD at full load at nominal input voltage.

5. Rectifier and Bypass Surge Protection: module shall withstand tested according to IEC 62040-2:2016 that requires 1kV L-L and 2kV L-PE
6. Withstand Rating: UPS module shall carry 65kA standard for short circuit withstanding. System has been tested under the guidance of U.L. as to meet National Electrical Code.
7. Output Voltage: 277Y/480 Volts, 3-phase,4-wire.
  - a. Voltage Regulation:  $\pm 1\%$  nominal voltage at balance load.
  - b. Voltage Adjustability:  $\pm 4\%$  adjustable
  - c. Dynamic Regulation:  $\pm 3\%$  from nominal for 0 to 100% step load. Recovering to within 1% in less than 1 cycle.
  - d. Voltage unbalance:  $\pm 3\%$  of nominal for 100% unbalanced loads
8. Phase Imbalance:
  - a.  $120^\circ \pm 1\%$  of nominal for 100% balanced loads.
  - b.  $120^\circ \pm 3\%$  of nominal for 100% unbalanced loads
9. Voltage Harmonic Distortion @Linear Load:  $<3\%$  THD at 100% load
10. Voltage Harmonic Distortion @non-Linear Load:  $<5\%$  THD at 100% load (per - IEC62040)
11. Output Frequency: 60 Hz  $\pm 10$  percent
  - a. Frequency Stability: 60 HZ  $\pm 0.01\%$  free running.
  - b. Phase-lock Window: 60 HZ,  $\pm 4\%$  (adjustable).
  - c. Frequency Slew Rate: 0.1 Hz to 20 Hz/second, selectable in 0.1 Hz increments.
12. Overload Capability: 110 percent for 10 minutes
  - a. Inverter Overload:
    - (1) 105% continuous operation
    - (2) 110% for 10 minutes
    - (3) 125% for 1 minute
    - (4) 150% for 30 seconds

- b. 14. Static Bypass Overload:
  - (1) 110% Continuous (at 25°C Ambient temperature)
  - (2) 150% for 1 minute
- 13. Operate under the following ambient conditions:
  - a. Ambient Temperature: 0 to 30 degrees C (+32 to +86 degrees F)
  - b. Humidity: 0 to 95 percent non-condensing
- 14. Acoustical Noise: less than 65-decibels, A-weighted at 3 feet
- 15. Minimum Battery Backup Time: Batteries shall support the UPS at 100% rated kW load for at least 120 minutes at end of life (EOL run time) at 77°F (25°C).
- 16. Install batteries in a matching cabinet.

B. System Description

- 1. The UPS shall be of transformer-free design, requiring no internal transformer in the main power path for the basic operation of the module.
- 2. System shall be of modular construction, allowing up to six (6) UPS modules to be paralleled in any combination for capacity or redundancy
- 3. Modules shall be easily serviced from the front of the enclosure. Major consumable parts (fans, capacitors, etc.) shall be interchangeable, without the need of replacing the whole Power Block. Cable and conduit connections shall be through the top or bottom of the UPS enclosure and terminations can be made from the front of the UPS.
- 4. The UPS shall be able to supply all required power to full rated output kVA loads with power factor from 0.7 leading to 0.6 lagging.

C. Description of Operation: Design three-phase UPS systems to operate as follows:

- 1. Normal Operation: Power the load continuously from the inverter. Derive the power for the rectifier/battery charger from the ac incoming line to provide dc power to the inverter while simultaneously float charging the battery.
- 2. Emergency: Upon loss of the ac input power, continue to power the load from the inverter without interruption or switching while the battery provides dc power to the inverter.

3. Battery Recharge: Upon restoration of the ac power, power the load continuously from the inverter while the rectifier/battery charger provides dc power to the inverter while simultaneously recharging the battery.
  4. Bypass Mode: Upon failure of the UPS system, transfer the load from the inverter to the ac line using a static-bypass transfer switch.
  5. Maintenance Bypass/Test Mode: Provide a manual make-before-break maintenance bypass switch to isolate the UPS for maintenance and testing.
- D. Rectifier/Battery Charger: Provide rectifier/chargers to convert the input AC power to a regulated dc voltage with the following features:
1. Solid state rectifier/charger of a modular design to facilitate maintenance.
  2. Size the rectifier/charger to serve full load of the inverter and fully recharge the battery within 10 times the rated run time at full load.
  3. Provide fuses to protect the rectifier/charger.
- E. Batteries: Use sealed, maintenance-free, high-discharge rate batteries consisting of lead acid cells. Size batteries for the specified backup time having a minimum end voltage of 1.67 volts per cell.
- F. Inverter: Provide inverters having the following features:
1. Pulse width modulated (PWM) type capable of providing the output power characteristics specified.
  2. Design the inverter of modular assemblies to facilitate maintenance.
- G. Static-Bypass Transfer Switches: Provide solid-state transfer switches rated for continuous duty with the following operational features:
1. Uninterrupted Transfer: Transfer the load to the bypass source without interruption upon sensing any of the following fault conditions:
    - a. Inverter overload
    - b. Inverter failure
    - c. Battery low voltage
  2. Interrupted Transfer: Transfer the load to the bypass source with an interruption not exceeding 0.2 seconds during a fault condition when any of the following occur:
    - a. Bypass voltage exceeds  $\pm 10$  percent of the UPS rated output voltage.
    - b. Bypass frequency exceeds  $\pm 2$  hertz from the UPS rated output frequency.

3. Forward Transfer: Transfer the load from bypass source to the UPS automatically without an interruption when the UPS is operating within its ratings.
- H. Internal Bypass Switches: Provide internal bypass switches for maintenance of the system.
- I. Enclosures: Provide ventilated, free-standing enclosures for the electronic components of the UPS system. Provide separate free-standing battery enclosures.
- J. Controls, Indicators and Alarms
1. Provide each UPS system with a visual display panel indicating the following parameters:
    - a. UPS On-line
    - b. UPS On Battery
    - c. UPS Off-line
    - d. UPS Fault
    - e. Input voltage
    - f. Bypass voltage
    - g. Bypass input frequency
    - h. UPS Output voltage
    - i. UPS Output frequency
    - j. UPS Output current
    - k. UPS Output kVA
    - l. dc Voltage
    - m. Available battery capacity
  2. Provide each UPS system with the following dry contacts rated 10-amperes at 120V ac:
    - a. UPS On-line
    - b. UPS On Battery
    - c. Load On Bypass
    - d. UPS Fault
  3. Provide each UPS system having the following controls and protection:
    - a. ac circuit breaker
    - b. Inverter "ON/OFF" switch
    - c. Manual bypass switch
    - d. Float/equalize switch
    - e. Transfer test switch
    - f. Emergency Power Off switch

K. Communications

1. The UPS shall allow for flexibility in communications. The UPS shall be able to communicate through two communications ports simultaneously; the media of either communications port may change without affecting the operation of the UPS. The use of relay contacts shall not affect the operation of the two communications ports.
2. RS-232/RJ45 port:
  - a. The UPS shall provide at least one RS-232 port, allowing full remote monitoring, control and management of the UPS system. All access to control functions through this port shall be protected from unauthorized access.
  - b. The RS-232 port shall allow access to critical UPS measurements, functions and historical data through the UPS Management Software suite.
3. Connectivity slot: The UPS shall be equipped with Connectivity slot(s) allowing the installation of the following plug-in options:
  - a. Additional Customer Interface Card (CIC) option, providing: six alarm contacts for remote signaling, two inputs for connection of external contact closures and one RS-232 port.
  - b. SNMP/Web adapter option, providing the following functionalities over an Ethernet connection:
  - c. SNMP Agent for integration into SNMP-based Network Management Systems (NMS)
  - d. Web server for remote monitoring using a standard Web browser
  - e. Modbus TCP or 485 slave for integration into Modbus-based Building Management Systems (BMS)
  - f. Configurable alarm notification via e-mail or SNMP Traps
  - g. Network shutdown of controlled servers following prolonged power outages via UPS Management Software suite.
4. Remote monitoring and diagnostics: UPS shall have a secure TCP/IP based RMD feature available as an option. Activation of this feature is standard and no charge for the first 12 months. The feature provides remote monitoring and diagnostics via an in house 24x7 service team, and provides quarterly diagnostics reports, alarm history and power quality trending of the UPS.

L. Identification: Provide identification meeting the requirements of Section 26 05 53.

## 2.3 SOURCE QUALITY CONTROL

- A. General: Provide complete Uninterruptible Power Supply (UPS) systems designed, assembled, wired and tested at the point of manufacture in accordance with the latest NEC (NFPA), NEMA, UL, IEEE and ANSI standards.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install all equipment as indicated, in accordance with manufacturer's written instructions and comply with requirements of NEMA Standards, NEC, project-applicable portions of NECA's Standard of Installation and applicable ANSI Publications.
- B. Coordination: Coordinate with other work including cabling and wiring work as necessary to interface installation of shop assembled equipment with other work.
- C. Torque Requirements: Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals in accordance with UL Standard 486A.
- D. Grounding Connections: Make equipment grounding connections for the shop assembled equipment as indicated on the Drawings. Tighten connections in accordance with UL Standard 486A to assure permanent and effective grounding.
- E. Adjustments: Make all necessary adjustments to the equipment to provide complete and satisfactory operation upon completion of the Contract.

### 3.2 FIELD QUALITY CONTROL

- A. General: Perform field inspection and testing for each UPS system to demonstrate that each unit meets the following:
  - 1. Has not been damaged during transportation and installation.
  - 2. Has been properly installed.
  - 3. Has no mechanical defects.
  - 4. Has been properly connected.

- B. Tests: Perform field tests as follows:
1. Inspect and test the installation with respect to the safety requirements of NEC pertaining to grounding and insulation resistance.
  2. Demonstrate proper operation of each UPS system by simulating conditions.
  3. Repair or replace defective materials at no cost to the (OWNER)
- C. Manufacturer's Field Services: Provide the services of a qualified representative of each manufacturer of the Uninterruptible Power Supply (UPS) systems to inspect the installation of equipment, make any necessary adjustments and instruct the operating personnel about operation, maintenance and provide training as specified in Section 01 79 00.
1. Provide a service engineer when the equipment is placed into operation.
  2. Provide a service engineer at the jobsite as often as necessary until all problems are corrected and the equipment installation and operation are satisfactory.
  3. Following completion of installation and field testing provide training for 12 employees of the OWNER in the proper operation, troubleshooting and maintenance of the equipment as outlined below. Provide training at the OWNER'S facilities at a time agreeable to the OWNER:
    - a. Operational Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.
    - b. Maintenance Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.

END OF SECTION

## SECTION 26 50 00

### LIGHTING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing complete lighting systems as specified and as shown.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 09 21 16 - Gypsum Wallboard System
  - 2. Section 09 51 00 - Suspended Acoustical Ceilings
  - 3. Section 09 96 00 - High Performance Coatings
  - 4. Section 26 05 00 - Basic Electrical Materials and Methods
  - 5. Section 26 05 53 - Electrical Identification
  - 6. Section 26 05 33 - Electrical Raceway Systems
  - 7. Section 26 27 26 - Wiring Devices
  - 8. Section 26 29 33 - Contactors
  - 9. Section 26 30 00 - Control Components and Devices

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. NFPA 70 - National Electrical Code (NEC)
  - 2. UL 924 - Emergency Lighting and Power Equipment

##### 1.3 SYSTEM DESCRIPTION

- A. System Components: Provide all interior and exterior lighting fixtures including all supports, plaster frames, trim rings, outlet boxes, light standards, concrete bases, ground rods, and all accessories and appurtenances required for complete functioning lighting systems, as shown and as specified.
- B. Performance Requirements: Provide lighting systems that adhere to code and are in accordance with manufacturers' recommendations.

##### 1.4 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01.

- B. Manufacturer's Data and Information:
  - 1. Furnish catalog data for all equipment provided under this section including the total input wattage for each type of lighting fixture specified.
  - 2. Furnish complete photometric data reports from an independent testing laboratory with shop drawings for each luminaire. Luminaires submitted without photometric data will not be reviewed.
- C. Shop Drawings: Furnish layout drawings showing arrangement, circuiting, erection requirements of equipment and details of construction and assembly.
- D. Quality Control: Furnish the following:
  - 1. Manufacturers certificates for equipment performance.
  - 2. Manufacturers test reports.
  - 3. Manufacturers installation instructions.
- E. Operation and Maintenance Manuals: Furnish two copies of the operation and maintenance manuals for lighting equipment as specified in Division 01.

#### 1.5 QUALITY ASSURANCE

- A. Codes: Provide materials and workmanship that meet the requirements of the NFPA Standards and the National Electrical Code.
- B. Regulatory Requirements: Provide UL and FMS listed and labeled lighting equipment.
- C. Provide LED fixtures from the Design Lights Consortium (DLC) Qualified Products List (QPL) for the location and application.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 and as follows:
- B. Storage and Protection: Store and protect equipment, components and accessories in accordance with the manufacturer's instructions and in accordance with the requirements of Division 01.

## 1.7 SPARE PARTS

- A. General: Furnish the following spare parts:
  - 1. Fixtures: Provide one lighting fixture of each type for every 40, but not less than one, for each type provided. For LED type, provide 20% spare fixtures.
  - 2. Emergency battery package for LED lighting fixtures: Provide 10 percent, but not less than two, of each type of provided.
  - 3. Provide two sets of special tools that may be required for maintenance of lighting fixtures.
- B. Packaging: Deliver all spare parts neatly wrapped or boxed, indexed and tagged with complete information for use and reordering.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. General: The lighting fixture descriptions and catalog numbers listed in the Lighting Fixture Schedule are used to indicate the acceptable quality, design and distribution characteristics of approved lighting fixtures.
  - 1. Emergency Battery Packages for LED Lighting Fixtures:
    - a. Philips/Bodine
    - b. Radiant Power Corp.
    - c. Siltron
  - 2. Emergency Battery Systems:
    - a. Emerson Network Power/Chloride Industrial Power
    - b. Hubbell/Dual-Lite
    - c. Teledyne/Big Beam
  - 3. Luminaire Quick Disconnects:
    - a. WAGO
    - b. Sta-Kon (Thomas and Betts/ABB Group)

### 2.2 MATERIALS

- A. General: Provide lighting fixtures complete with all required lamps, ballasts, fittings, receptacles, gaskets, globes and diffusers, as shown and scheduled.

- B. Wiring Channel Construction: Construct the wiring channels to permit access to the auxiliaries and sockets for repair or replacement of components without removal of the fixture.
- C. Suspended Ceilings: Provide fixtures suitable for the type of suspended ceilings in which they are installed. Provide trim moldings to conceal exposed parts of a concealed ceiling suspension system.
- D. Plaster Frames: Provide plaster frames for all fixtures recessed in plaster ceilings.
- E. Globes: Provide gasketed, heat and impact-resistant, glass globes for incandescent, compact fluorescent, metal halide and sodium vapor fixtures.
- F. Lamp Holders: Rigidly support screw-type, lamp holders, secure them against turning, and install them in a manner that allows for easy replacement. In general, fixtures designed to accept lamps of different wattages shall have adjustable sockets to allow for variations in lamp light centers. Provide brass, shell-type lamp holders. Aluminum shells will not be accepted.
- G. Insulation: Provide a wire insulation systems and components that are capable of withstanding the temperatures to which they will be subjected in the fixture, while maintaining normal expected ballast life.

## 2.3 COMPONENTS

### A. LED Drivers

1. Provide LED drivers meeting the following requirements:
  - a. Minimum Efficiency: 85%.
  - b. Starting Temperature: - 40 degrees F.
  - c. Input Voltage: 120 – 480 volts.
  - d. Power Supplies: Class I or II output.
  - e. Power Factor: .90 or greater.
  - f. Total Harmonic Distortion: 20% or less.
  - g. Comply with FCC Title 47, CFR Part 18 Non-consumer RFI/EMI Standards.
  - h. Drivers shall be reduction of hazardous substance (ROHS) compliant.
  - i. Surge Protection: Survive 250 repetitive strikes of “C Low” waveforms at 1 minute intervals with less than 10% degradation in

clamping voltage. "C Low" waveforms are as defined in IEEE/ANSI C62.41.2-2002, Scenario 1 Location Category C.

B. LED Sources

1. Provide LED sources meeting the following requirements:
  - a. Operating Temperature Range: - 40 degrees F and 120 degrees F.
  - b. Correlated Color Temperature: As scheduled.
  - c. Color Rendering Index: 65 and greater.

C. Emergency Battery Packages For LED Lighting Fixtures:

1. General: Provide emergency battery packages for the designated LED lighting fixtures as listed in the Lighting Fixture Schedule. Provide a test station suitable for remote mounting. Provide an emergency lighting system that will normally operate from the ac wiring system, with the capability of operating the fixture for a period of 1-1/2 hours during an ac power outage. Provide battery packages listed by UL, and complying with OSHA regulations for emergency lighting.
2. Electronic Assembly: Provide an emergency battery package with an electronic inverter or driver, battery charger, solid-state transfer switches and ON indicating light circuit. Hermetically seal the electronic assembly in a low profile case.
3. Battery Packs: Provide battery packs of the nickel-cadmium, rechargeable type, encased in a low profile case. Under emergency mode, provide batteries with sufficient capacity to provide approximately 40 percent of the rated lumen output of the scheduled fluorescent lamps during the power outage.
4. Wiring: Factory install the electronic assembly and battery pack within the lighting fixture housing.
5. Test Station: Provide a test station consisting of a test button and charger ON indicating light suitable for remote mounting in flush- or surface-mounted outlet boxes. Provide test buttons of spring-loaded-return, normally-on type. Provide an indicating light of the solid-state indicator lamp type.

2.4 EXIT SIGNS

- A. General: Provide fully-automatic, self-contained, battery-pack, LED type exit signs, normally operated from the ac wiring system, but capable of remaining lighted for a period of 1.5 hours during an ac power outage. Provide exit signs suitable for dual voltage input with surge protection suitable for operation on either 120 volts or 277 volts. Equip each sign with nickel cadmium batteries and a totally solid-state

charger which constantly evaluates the state of charge of the batteries and keeps them fully charged. Provide a charger that is capable of fully recharging the batteries in 24 hours, following a discharge. Provide a press-to-test switch located on the bottom of the housing to test the lamps and battery, and an ac indicator lamp to indicate that the charger is functioning and the unit is in operating condition. Provide UL listed exit signs complying with OSHA regulations.

- B. Construction: Provide exit signs having a cast-aluminum housing with field selectable direction arrows, a red, translucent optical diffuser over the LED lamps, single or double-faced, as listed in the Lighting Fixture Schedule or as shown.

## 2.5 OUTDOOR LIGHTING

- A. General: Provide outdoor lighting luminaires as listed in the Lighting Fixture Schedule.
- B. Mounting: Mount outdoor lighting on building exterior as shown.

## 2.6 EMERGENCY BATTERY LIGHTING

- A. General: Provide emergency battery lighting equipment as listed in the Lighting Fixture Schedule capable of providing emergency lighting instantaneously upon the failure or interruption of the normal electric power supply.
- B. Batteries: Provide 12-volt, sealed, maintenance-free, batteries as specified capable of operating 40 watts of light for 1-1/2 hours to 87-1/2 percent of the battery capacity.
  - 1. Charging Systems: Provide solid-state, 2-rate, charging systems consisting of a high-charge rate and a trickle-charge rate. Provide chargers suitable for operation on 120 or 277 volts.
  - 2. Lamps: Provide LED type lamps.
  - 3. Housings: Provide NEMA 12 sealed and gasketed, fiberglass or thermoplastic enclosures.
  - 4. Controls: Provide a test push buttons and ac ON indicating lights.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Packing: Suitably pack and rigidly brace all equipment and protect it against weather, damage and undue strain during shipment.

## 3.2 INSTALLATION

- A. General: Install lighting fixtures and lamps in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1. Locate fixtures to suit the architectural details of the area involved. Coordinate placement with the details indicated on the architectural reflected ceiling drawings or architectural elevations. Install lamps of proper type, wattage and voltage rating in fixtures prior to completion of project. Install all fixtures to comply with applicable provisions of the NEC. Provide fluorescent fixtures "quick disconnects" when not factory installed.
- B. Recessed Fixtures: Install recessed fluorescent fixtures in suspended ceiling openings in conformance with manufacturer's recommendations. Install fixtures with adjustable fittings to permit alignment with ceiling panels. Support recess fixtures using the ceiling suspension system. Provide additional steel work as required to support fixtures. Install recessed fixtures to permit removal from below.
- C. Obstructions: In areas, such as equipment and mechanical rooms, which have obstructions at the ceiling or walls such as ducts, large pipes, groups of pipes, and like items, install fixtures so that maximum utilization of the light is achieved.
- D. Accessories: Provide straps, mounting plates, nipples, plaster rings, brackets and all accessories necessary for proper installation.
- E. Suspended Fixture Support: Support suspended fixtures by approved means, consisting of rods, stems attached to studs, hickies and suitable outlet box cover aligners of the shock-absorbing, vaportight or swivel type having flexible joints permitting fixtures to hang plumb. Install stems using 3/4-inch galvanized steel conduits, unless otherwise specified. Where indicated or required, support fixtures by means of a suspended channel. Provide channels that meet the requirements for the type of conduit provided, as specified in Section 26 05 33. Where the channel is used as the wiring raceway, provide closure strips, end caps and fittings as required for an approved raceway.
- F. Emergency Lighting: Connect emergency light fixtures and exit signs to separate unswitched circuits in the lighting panelboard. Lock these circuit breakers in the closed position.
- G. Test Station: Install the test station for fluorescent fixtures with emergency battery package on the nearest wall or column at 5 feet above finished floor. Surface mount the test stations, except flush mount them in partitioned construction and architecturally finished areas.
- H. Exit Fixtures: In general, mount exit and stair sign fixtures so that the bottom of the fixture will be centered and three inches above the top of the door frame. Variations in the mounting height and horizontal offsets are to be approved by the Engineer.
- I. Nameplates: Install nameplates as specified in Section 26 05 53.

### 3.3 FIELD QUALITY CONTROL

- A. Testing: Test the entire lighting system for continuity and balance after installation and prior to acceptance.

### 3.4 ADJUSTING

- A. Fixtures: Aim and adjust fixtures as shown.
- B. Exit Sign Arrows: Adjust exit sign directional arrows as shown.

### 3.5 OPERATION DEMONSTRATION

- A. Manufacturer's Representative: Furnish the services of an authorized and qualified representative of the manufacturer of the emergency system battery packages for high intensity discharge luminaires as specified in Division 1 and sign and date the manufacturer's warranty book/card on behalf of the manufacturer for the equipment and system components installed.

### 3.6 CLEANING AND PAINTING

- A. Shop Painting: Shop paint equipment as specified in Section 09 96 00.
- B. Steel Surfaces: Prior to final completion of the Work, thoroughly clean all steel surfaces and retouch all scratches and abrasions. Use the same paint as used for shop finishing coats.
- C. Photometric Control Surfaces: Clean photometric control surfaces as recommended by the manufacturer.

END OF SECTION

## SECTION 26 05 00

### BASIC ELECTRICAL MATERIALS AND METHODS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: General requirements for providing basic electrical materials and methods.
- B. Related work specified in other sections includes, but is not limited to, the following:
  - 1. Certain equipment, control devices, conduit and wiring are shown on electrical drawings, but are specified in other sections pertaining to plumbing, heating, ventilating, air conditioning, temperature control systems, process equipment, process control systems and instrumentation. Install and connect these items to the electrical system as indicated or required in accordance with the Contract Documents.
- C. Overall Application of Specifications: This Section applies to all Division 26 sections and to other sections that include requirements for electrical equipment. Irrespective of where the electrical requirements are specified, provide and install all materials necessary for a complete operational system.
- D. Temporary Requirements: This Section applies to any temporary circuits, overcurrent devices, conduit, wiring, and other equipment required during changeover from the existing electrical system to a new electrical system. This Section also applies to temporary rewiring of lighting circuits, power circuits, instruments and devices.

##### 1.2 DEFINITIONS

- A. Corrosive Areas: The following areas are designated corrosive areas:
  - 1. Chemical Storage, Metering, and Handling Rooms
- B. Wet Locations: The following areas are designated wet locations:
  - 1. Below-grade tunnels and vaults.
  - 2. Filter galleries.
  - 3. Rooftops and outdoors.

##### 1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Design requirements are specified in the applicable sections.

- B. Performance Requirements: Performance requirements are specified in the applicable sections.

#### 1.4 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01.

- B. Product Data and Information: Furnish a complete list of electrical equipment and materials to be furnished that shows the manufacturer, catalog number, size, type, capacity, voltage rating and other pertinent information related to each item on the list.

1. Furnish catalog data for the manufacturer's standard equipment and materials. Clearly identify the equipment and devices specifically being proposed on manufacturers' catalog data sheets.
2. Identification: Furnish a complete schedule or listing of system and equipment identification labels with legends.

- C. CONTRACTOR's Shop Drawings: Furnish shop drawings on items manufactured for the Contract.

1. Furnish connection and schematic diagrams for each piece of electrical equipment where applicable. A manufacturer's standard connection or schematic diagram showing more than one method of wiring is not acceptable unless, the intended method is clearly marked.
2. Furnish diagrams that show connections to field equipment. Clearly differentiate between manufacturer's and field wiring.
3. Furnish raceway layout drawings that show conduits, boxes, and panels which contain the conductors to be provided. Include schedules listing conduit sizes, conductor content and identification.
4. Where additions and modifications are made to existing equipment, furnish drawings which clearly identify remaining existing equipment and the new Work.

- D. Coordination Drawings: Furnish coordination drawings that have a scale of 1/4"=1'-0" or larger; that show major elements, components, and systems of electrical equipment as they relate to other systems, installations, and building components. Indicate locations where access space is limited and where sequencing and coordination of installations are required for the efficient flow of the Work, including (but not limited to) the following:

1. Indicate the proposed locations of major raceway systems, equipment and materials. Include the following:

- a. Clearances for servicing equipment, including space for equipment disassembly as required for periodic maintenance.
  - b. Exterior wall and foundation penetrations.
  - c. Fire-rated wall and floor penetrations.
  - d. Equipment connections and support details.
  - e. Sizes and location of required concrete pads and bases.
2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
  3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
  4. Prepare reflected ceiling plans to coordinate the installation of air outlets and inlets, light fixtures, communications systems components, fire alarm devices, sprinklers, and other ceiling-mounted devices.
- E. Record Documents: Furnish record documents, and in addition to the requirements specified in Division 1, indicate installed conditions for:
1. Interior and exterior major raceway systems' sizes and locations; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker sizes and arrangements.
  2. Exposed and concealed equipment locations dimensioned from prominent building lines.
  3. Approved substitutions, and actual equipment and materials installed.
- F. Maintenance Manuals: Furnish maintenance manuals, and in addition to the requirements specified in Division 1, include the following information for equipment items:
1. Functional description, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and catalog numbers of replacement parts. Where a Bill of Materials is provided, include a manufacturers' data sheet for each component and device listed therein.
  2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping,

shutdown, and emergency instructions; and summer and winter operating instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.

#### 1.5 QUALITY ASSURANCE

- A. Codes: Provide all electrical Work in accordance with applicable local codes, regulations and ordinances. If there is a conflict between the requirements specified in the Contract Documents and the codes, follow the more stringent requirements as determined and approved.
- B. Testing: As a minimum, provide standard factory and field tests for each type of equipment. Other tests may be specified in the applicable equipment section.
- C. Labeling: Provide electrical equipment and materials that are listed and approved by Underwriters Laboratories or other OSHA recognized testing laboratories with the testing agency's label attached.
- D. Standard Products: Unless otherwise indicated, provide electrical materials and equipment which are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturer's latest standard design that conforms to these Specifications. Provide the products of the same manufacturer when two or more units of the same class of material and equipment are required.

#### 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 (and as follows:)
- B. Shipping and Packing: Provide materials and equipment suitably boxed, crated or otherwise completely enclosed and protected during shipment, handling, and storage. Clearly label such boxes, crates or enclosures with manufacturer's name, and name of material or equipment enclosed.
- C. Acceptance at Site: Conform to acceptance requirements as required in Division 1.
  1. Repair or replace all materials and equipment damaged by handling and storage as directed at no additional Contract cost.
- D. Storage and Protection: Protect materials and equipment from exposure to the elements and keep them dry at all times. Handle and store to prevent damage and deterioration in accordance with manufacturer's recommendations. Provide

temporary power to space heaters where provided with equipment to prevent condensation from developing.

## 1.7 PROJECT CONDITIONS

- A. General: The Drawings indicate the extent and general arrangement of the principal electrical elements, outlets, devices and circuit layouts. Install and connect all electrical elements and devices to form a complete workable system as required by the Contract Documents, regardless of whether all system components are specifically stated in the Specifications or shown. Provide necessary materials and installation wherever required to conform to the specific requirements of the furnished equipment and for proper installation of the Work.
- B. Physical Layouts: In general, the routing of feeders show general arrangement and are not intended to show exact routing and locations of raceways. Verify actual and final arrangement, equipment locations, and prepare circuit and raceway layouts before ordering materials and equipment. Equipment locations are approximate and are subject to modifications as determined by approved equipment dimensions.
- C. Coordination of Work: Coordinate the Work so that the electrical equipment may be installed without altering building components, other equipment or installations.
- D. Departure from Design: If departures from the design are deemed necessary due to structural conditions, obstructions or other problems, provide details of such departures and the reasons for requesting approval. Submit variations as soon as practical but no later than the submittal of the required raceway layout drawings. Do not depart from the design without written approval.

## PART 2 PRODUCTS

Not Used

## PART 3 EXECUTION

### 3.1 ROUGH-IN

- A. Final Location: Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

### 3.2 ELECTRICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
  - 1. Coordinate electrical systems, equipment, and materials installation with other building components.

2. Verify all dimensions by taking field measurements.
3. Arrange for chases, slots, and openings in other building components as construction progresses to provide for electrical installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in cast-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum possible headroom.
7. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide all required connections for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the ENGINEER for resolution.
9. Where installed exposed in finished spaces, install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components.
10. Provide electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
11. Provide access panels or doors where units are concealed behind finished surfaces.
12. Install systems, materials, and equipment providing right-of-way priority to systems required to be installed at a specified slope.
13. All wiring specified, scheduled, noted or shown is to be installed in conduit unless identified otherwise.

### 3.3 CUTTING AND PATCHING

- A. General: Perform cutting and patching as specified in Division 01. In addition to the requirements specified in Division 1, the following requirements apply:
1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
    - a. Uncover Work to provide for installation of ill-timed Work.
    - b. Remove and replace defective Work.
    - c. Remove and replace Work not conforming to requirements of the Contract Documents.
    - d. Remove samples of installed Work as specified for testing.
    - e. Install equipment and materials in existing structures.
    - f. Locate existing structural reinforcing with a pachometer where core drilled penetrations are required so as not to cut the steel reinforcing.
  2. Cut, remove, and properly dispose of selected electrical equipment, components, and materials as indicated. Included are the removal of electrical items indicated to be removed and items made obsolete by the new Work. Deliver all removed serviceable apparatus to the OWNER as directed.
  3. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
  4. Provide and maintain adequate temporary partitions or dust barriers that prevent the spread of dust and dirt to adjacent areas.
  5. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
  6. Patch finished surfaces and building components using new materials that are compatible with the original installation and applied by experienced installers.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 26 05 10

ELECTRICAL UTILITY COORDINATION AND REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Requirements for arranging and coordinating with the Utility Company for modifications to electrical power service.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 03 31 00 - Cast-In-Place Concrete
  - 2. Section 26 29 23 - Adjustable Frequency Drives
  - 3. Section 26 19 00 - Medium Voltage Adjustable Frequency Drives
  - 4. Section 26 05 73 - Short Circuit and Coordination Study

1.2 SYSTEM DESCRIPTION

- A. Utility Company: ComEd
- B. Utility Company Contact: \_\_\_\_\_ (Provide individual's name)  
Office Telephone \_\_\_\_\_
- C. System Characteristics:
  - 1. 4160Y/2400 Volts
  - 2. 3 Phase
  - 3. 4 Wire
  - 4. Solidly Grounded Neutral
- D. Alterations to System: Addition of two standby engine generators, each rated 4160Y/2400V, 1000 kW/1250 kVA, with closed-transition transfer.

1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 01.

- B. Correspondence: Furnish copies of all correspondence with the Utility Company including available short circuit currents and X/R ratings for each feeder.
- C. Utility Company Drawings: Furnish Utility Company prepared drawings.
- D. Layout Drawings: Furnish the following drawings:
  - 1. Equipment pad details
  - 2. Equipment mounting details.

#### 1.4 QUALITY ASSURANCE

- A. General: Perform Work in accordance with Utility Company's written requirements and standards.

#### 1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify that field measurements are as indicated on Utility Company drawings.

### PART 2 PRODUCTS

#### 2.1 UTILITY METERING

- A. Revenue Meters: Meters will be furnished by Utility Company.
- B. Meter Base: Provide meter base in accordance with the requirements of the Utility Company.
- C. Metering Transformer Cabinet: Provide a metering transformer cabinet in accordance with the requirements of the Utility Company.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

- A. General: Verify that service equipment is ready to be connected and energized.

#### 3.2 PREPARATION

- A. Utility Company Arrangements: Make arrangements with Utility Company to obtain permanent electric service to the Project.
- B. Utility Engineering and Facility Charges: Pay all charges and fees associated with securing both temporary and permanent electrical service for the project. (DELETE IF COVERED UNDER THE GENERAL CONDITIONS OF THE SPECIFICATIONS.)

- C. Utility Company Access: Coordinate location of Utility Company's facilities to provide proper access.
- D. Coordination: Coordinate schedule of Utility Company's facilities with all other work.
- E. (Specific Requirements: Insert any other specifics required by the Utility Company)
- F. Utility Company System Information: Obtain all information required to perform the Harmonic Analysis as specified in Section 16266 and Section 16268 and the Short Circuit and Coordination Study specified in Section 16085.

### 3.3 INSTALLATION

- A. General: Install Electrical Power Service in accordance with the Utility Company's recommendations and approved shop drawings and as specified in Division 01.
- B. Metering Transformer Cabinet and Meter Base: Install metering transformer cabinet and meter base in accordance with the Utility Company requirements and as shown.
- C. Concrete Pads: Provide cast-in-place concrete pads for Utility Company transformers and other equipment.

END OF SECTION

(NO TEXT ON THIS PAGE)

## SECTION 26 05 13

### MEDIUM VOLTAGE CABLES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing single conductor medium voltage cables and accessories as indicated, in accordance with the Contract Documents.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 26 05 00 - Basic Electric Materials and Methods
  - 2. Section 26 05 53 - Electrical Identification
  - 3. Section 26 08 00 - Electrical Testing Requirements

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ASTM B 8 - Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
  - 2. ASTM B 496 - Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors
  - 3. AEIC CS8 - Specifications for Extruded Dielectric Shielded Power Cables Rated 5 through 46 kV
  - 4. UL 1072 - Standard for Medium-Voltage Power Cables
  - 5. IEEE 400 - IEEE Guide for Field Testing of Shielded Power Cable Systems Rated 5kV and Above

##### 1.3 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01 and Section 26 05 00.
- B. Product Data and Information: Furnish physical and electrical catalog data for all cables and cable components and shop drawings for splice kits and terminations.

- C. Quality Control: Furnish certified Shop Test Reports and AEIC Qualification Test Reports for all cable lengths shipped.
- D. Number of Copies: Submit six copies of all certifications and warranties described.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 and as follows:
- B. Handling: Carefully handle all cables to avoid twists and kinks or other damage to the insulation.
- C. Storage: Store cable reels on concrete, 2 x 4 wood lagging or other hard surface. .

#### 1.5 WARRANTY

- A. Written Warranty: Furnish manufacturer's standard written warranty from the cable manufacturer that the cable is free of any factory-incurred defects.
- B. Replacement if Found Defective: In the event that the cable is found defective in design, material, or workmanship within the warranty period of the cable, remove and replace the defective portion of the cable with another cable meeting the original design specifications. Provide the replacement cable with the same warranty as the replaced cable at no additional cost to the OWNER.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Medium voltage cable
    - a. Prysmian Group
    - b. The Okonite Company
    - c. Kerite by Marmon Utility LLC

#### 2.2 MATERIALS

- A. General: Provide single medium voltage power cable consisting of stranded copper conductors, conductor screen, insulation, insulation screen, metallic shield and outer jacket, suitable for use in wet and dry locations in conduit and underground concrete encased ducts. Provide cables rated 105 degrees C for continuous operation, 140 degrees C for emergency overload operation and 250 degrees C for short circuit

conditions, UL listed as Type MV-105 in accordance with UL 1072 and manufactured in accordance with AEIC CS8.

- B. Conductors: Provide soft drawn, annealed and uncoated copper conductors with 98 percent minimum conductivity in accordance with the requirements of ASTM B 8 with Class B stranding or compact stranding meeting the requirements of ASTM B 496. Provide conductor sizes as scheduled and as required.
- C. Conductor Screen (Shield): Provide conductor screen of an extruded layer of semiconducting, thermosetting compound.
- D. Insulation: Provide conductor insulation other than black or grey in color of a compound based on a thermosetting ethylene-propylene elastomer extruded in tandem with and inseparably bonded to the conductor screen. Provide insulation resistant to heat, moisture, impact, ozone and electrical discharge. Provide the insulation thickness as shown below:
  - 1. For nominal 4160-volt applications
    - a. Voltage rating 5000/8000 volts
    - b. Insulation thickness 140 mils
    - c. Insulation level 133 percent at 5000 volts
- E. Insulation Screen (Shield): Provide insulation screen of an extruded semiconducting compound. Provide insulation screen that is easily removed without requiring the use of heat or special tools.
- F. Metallic Shield: Provide 5-mil thick helically applied coated copper tape shield over insulation screen with a 20 percent minimum overlap.
- G. Outer Jacket: Provide an outer jacket of heavy-duty thermoplastic black polyvinyl chloride (PVC).

## 2.3 COMPONENTS

- A. Splice Kit: Provide splice kits and terminations specifically designed for the application as recommended by the cable manufacturer.
- B. Connections: Provide splice and connections made up with closed end compression connectors and terminal lugs. Provide fittings and compression tools of the circular or hexagonal compression type rated for the voltage of the cable.

## 2.4 SOURCE QUALITY CONTROL

- A. General: Perform the following shop tests in accordance with the requirements of AEIC and furnish certified test reports for all cable lengths shipped.
  - 1. Qualification tests
  - 2. High voltage AC and DC tests

3. Insulation resistance test
  4. Partial discharge test
- B. Test Reports: Furnish certified test report for all cable lengths shipped.

### PART 3 EXECUTION

#### 3.1 PREPARATION

- A. Conduit Preparation: Mandrell all new and existing conduits and duct lines before installation and swab to remove accumulated moisture and debris before cables are pulled.

#### 3.2 INSTALLATION

- A. General: Install all medium voltage cables in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.
- B. Initial Pulls: Use lines of limited stretch to pull wire and cable into conduits. Do not use flat steel tapes and steel cables.
- C. Lubricants: Provide cable lubricants recommended by the manufacturer when pulling the cables into ducts and conduits.
- D. Pull Setup: Provide complete cable pulling setup, including winches, cable reel, support frames, turning sheaves, guides, and the like.
- E. Tension Meters: Connect a pulling tension meter to the pulling setup. Arrange the pulling equipment and apply pulling methods so that pulling tensions do not exceed the manufacturer's permissible limits for the cable furnished.
- F. Cable Groupings: Arrange cables securely tied, neatly bundled, and racked in manholes.
- G. Splices: Do not make splices within the conduit system. Do not make splices within handholes or manholes unless approved.
- H. Fireproofing: Fireproof all medium voltage cables installed in manholes and pullboxes. Provide fireproofing with approximately 30 mils thick by 3 inches wide fireproofing tape and applied tightly around each cable spiral in one-half lapped wrapping or in a butt jointed wrapping with a second wrapping covering joints of the first wrapping. Smooth irregularities in cables, such as at splices, with insulating putty before applying fireproofing tape. Install the tape with coated side toward the cable to extend not less than one inch into conduit. Install a random wrapping of glass cloth electrical tape around installed fireproofing tape to prevent unravelling. Provide fireproofing tape consisting of a flexible, conformable fabric with one side

coated with a flame retardant, flexible, polymeric coating or a chlorinated elastomer. Provide tape that is noncombustive and noncorrosive to the cable sheath.

- I. Terminators: Install medium voltage termination as recommended by the cable manufacturer.
- J. Lug Bolting: Provide connections at terminals, devices and bus bars made up of a flat Belleville or equal washer, and a locknut.
- K. Unacceptable Connections: Do not use indenter type compression fittings. Mechanical splices or lugs are not acceptable.

### 3.3 IDENTIFICATION OF CIRCUITS

- A. General: Identify all cables in accordance with the requirements contained in Section 26 05 53 and as follows.
- B. Color Code: Color code the cables with the following color code scheme.

Phase A	-	Brown, 1 band
Phase B	-	Orange, 2 bands
Phase C	-	Yellow, 3 bands
Neutral	-	White
Ground	-	Green

- C. Coding Tape: When using color coding tape apply the tape with overlapping turns for a minimum length of 2 inches starting 2 inches back from the termination point.

### 3.4 FIELD QUALITY CONTROL

- A. Inspection: Arrange inspection of the cable (including splices and terminations) installation by the manufacturer. Furnish manufacturer's certificate that the cable was installed property.
- B. Field Tests: Arrange the performance of following field tests in presence of the ENGINEER after terminations have been made up, but before final connections are made to equipment terminals.

1. Cable continuity test using a test light or a buzzer.
2. Cable insulation level (high voltage DC) test using approved DC HI-POT equipment in accordance with IEEE 400 for the voltage rating and insulation thicknesses given below; by an independent testing agency:

Voltage Rating	Insulation Thickness	dc Test Voltage	Time of Application
8000 volts	140 mil	44 kV	15 minutes

Voltage Rating	Insulation Thickness	dc Test Voltage	Time of Application
15,000 volts	175 mil	55 kV	15 minutes
15,000 volts	220 mil	65 kV	15 Minutes

END OF SECTION

## SECTION 26 05 19

### WIRES AND CABLES 600 VOLTS AND BELOW

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing all wires and cables rated at 600 volts and below for complete electrical systems as shown.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 26 05 00 – Basic Electrical Materials and Methods
  - 2. Section 26 05 53 – Electrical Identification
  - 3. Section 26 80 00 – Electrical Testing Requirements

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ASTM B3 - Standard Specifications for Soft or Annealed Copper Wire
  - 2. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
  - 3. UL 44 - Thermoset-Insulated Wires and Cables
  - 4. UL 83 - Thermoplastic-insulated Wires and Cables
  - 5. UL 2196 - Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control, and Data Cables
  - 6. NEMA WC-70 / ICEA S-95-658 - Power Cables Rated 2000 Volts Or Less For The Distribution Of Electrical Energy
  - 7. NFPA 70 - National Electrical Code (NEC)
  - 8. TIA/EIA 568-C.2 - Balanced Twisted-Pair Telecommunication Cabling and Components Standard

### 1.3 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01 and Section 26 05 00.
- B. Product Data and Information: Furnish manufacturer's catalog data for each type of wire and cable furnished.

### 1.4 QUALITY ASSURANCE

- A. General: Furnish wire and cable in accordance with applicable IEEE and NEMA standards and meeting the applicable requirements of the NEC and UL.
- B. Tests: Furnish factory tested cables prior to shipment in accordance with ICEA standards for the insulation specified.

### 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle wire and cable in accordance with the manufacturer's instructions and as specified in Division 01.
- B. Storage: Store cable reels on concrete, 2x4 wood lagging, or other hard surface. Do not store reels flat.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Wire and Cable
    - a. Southwire Company
    - b. The Okonite Company
    - c. Prysmian Group/General Cable Corporation
  - 2. Instrumentation Cable
    - a. Belden
    - b. Dekoron Wire and Cable
    - c. The Okonite Company
  - 3. Fire Alarm Cable
    - a. Belden
    - b. General Cable Corporation

4. Multiconductor Cable
  - a. The Okonite Company
  - b. Southwire Company
5. Wire Connectors
  - a. Thomas & Betts/ABB Group
  - b. 3 M/Electrical Products Division
  - c. Ideal Industries
6. Color Coding Marker
  - a. W. H. Brady Company
  - b. Thomas & Betts/ABB Group

## 2.2 MATERIALS

- A. Conductors: Provide soft drawn or annealed copper stranded conductors with 98 percent minimum conductivity, meeting requirements of ASTM B 8. Solid No. 12 and No. 10 AWG meeting requirements of ASTM B 3 may be used in lighting fixture and convenience outlet wiring.
- B. Insulation: Provide wires and cables with insulation as follows:
  1. Power, control and lighting wiring:
    - a. Single Conductor: Provide NEC Type XHHW/XHHW-2 Cross-linked Polyethylene (XLPE)insulation.
    - b. Multiconductor Cables: Insulate individual conductors with 15 mils of polyethylene or PVC and 4-mil nylon jacket. Wrap the conductors with type binder and an outer jacket not less than 45 mils of PVC. Use ICEA Method 1 for color coding wires.
  2. Instrumentation Wiring: The manufacturers' name and catalog number shown below are for the purpose of establishing quality and general configuration.
    - a. Two conductor or single pair: Stranded No. 16 AWG wire, 600 volt polyethylene insulation, twisted conductors, tinned copper drain wire, overlapped metalized tape overall shield providing 100 percent shield coverage and outer jacket of PVC. Dekoron Cat. No. 2X52-69610.
    - b. Three Conductor: Stranded No. 16 wire, 600 volt polyethylene insulation, twisted conductors, tinned copper drain wire, overlapped

metalized tape overall shield providing 100 percent shield coverage and outer jacket of PVC. Okonite Cat. No. 267-38-3401.

- c. Multiple Pairs or Triads: Provide individually shielded pairs or triad of stranded No. 16 AWG wire with overall shield. Insulate each wire for 600 volts with 15 mils of PVC and a 4-mil nylon jacket. Assemble pairs or triads with tinned copper drain wire and metalized tape shield providing 100 percent shield coverage. Cable pairs or triads together with tinned copper drain wire and overall metalized tape shield.
3. Data (Local Area Network) Cable: The manufacturers' name and catalog number shown below are for the purpose of establishing quality and general configuration.
    - a. Category 6: Provide cable having third party verification to TIA/EIA 568-C.2-1 Category 6 requirements and constructed of four pair of solid No. 23 AWG solid copper wire, 300 volt polyolefin insulation, film tape separator and outer jacket of black industrial grade sunlight and oil resistant PVC. Belden Cat. No. 7940A.
  4. Fire Alarm Cable: Provide cables compatible with the fire alarm system specified in Section 28 31 00. The manufacturers' name and catalog numbers shown herein are for the purpose of establishing quality and general configuration.
    - a. Plenum Cable: Provide NEC Type FPLP cable consisting of two solid conductor No. 16 AWG, 300 volt fluorinated ethylene propylene insulation, tinned copper drain wire, overlapping metalized tape overall shield providing 100 percent shield coverage and red Flamarrest outer jacket. Belden Cat. No. 6220FK.
    - b. Riser Cable: Provide NEC Type FPLR-CIC cable consisting of two solid conductor No. 16 AWG, 300 volt silicone rubber insulation with tinned copper drain wire, overlapping metalized tape overall shield providing 100 percent shield coverage and red FRPE outer jacket. Belden Cat. No. 5220FZ.
    - c. General Purpose Cable: Provide NEC Type FPL cable consisting of two or four solid conductor No. 16 AWG, 300 volt foam high density polyethylene insulation with tinned copper drain wire, overlapping metalized tape overall shield providing 100 percent shield coverage and red PVC outer jacket. Belden Cat. No. 5220FJ and 5222FJ.
    - d. Provide cables that are fire resistive rated in accordance with UL 2196.
    - e. Provide wire marking meeting the requirements of NEC Article 760.

- C. Printed Data on Covering: Provide the following information printed on the surface of all wires and cables at regular intervals throughout the entire length.
  - 1. Manufacturer or trade name.
  - 2. Size of conductor.
  - 3. Type of insulation.
  - 4. Voltage classification.

## 2.3 WIRE CONNECTIONS AND CONNECTING DEVICES

- A. Connectors for No. 10 AWG and Smaller: Provide insulated compression type butt connectors.
- B. Connectors for No. 8 AWG and Larger: Provide UL, Inc. listed compression type tube connectors for parallel or butt splices. Provide companion preformed plastic insulating covers or tape to provide insulation equal to conductor insulation.
- C. Miscellaneous Connectors: Provide pre-insulated spring connectors for lighting and receptacle splices and pigtails.
- D. Solderless Lugs: Provide solderless terminal lugs for stranded and multiple solid conductors at connection to terminals or use UL listed crimp tool compression style lugs.
- E. Control Wire Terminations: Provide spade lug or pressure type control conductor connection terminations for control wiring terminations. Provide lug bolting at devices or bus bars with a flat washer, a Belleville washer and a locknut.

## 2.4 COLOR CODING

- A. General: Use a vinyl impregnated tape resistant to oil, dirt and heat for conductor color coding.

# PART 3 EXECUTION

## 3.1 INSTALLATION

- A. General: Swab new and existing conduits to be used to clear debris and remove moisture before conductor installation. Install conductors in raceways with no splices in conduits and between boxes.
- B. Pulling Equipment: Pull conductors using proper equipment without exceeding manufacturer's recommendation for maximum pulling tension. Protect conductor insulation jacket at all times from twists, kinks, scrapes, punctures and other damage. Replace damaged conductors. Pull wires and cables into ducts and conduit without the use of lubricants, except where such use is necessary and approved. Use UL

listed lubricating compound compatible with the conductor insulated jacket and raceway.

Use lines of nylon or polypropylene, propelled by carbon dioxide, or compressed air, to snake or pull wire and cable into conduits. Do not use flat steel tapes or steel cables.

- C. Conductor Support: Support conductors in vertical risers with woven grips to prevent loading on conductor connectors.
- D. Seals: Provide a seal between the conductor and conduit for conduits entering buildings or from areas where the temperature change may cause condensation or moisture. Provide a non-hardening, removable, seal compatible with conductor insulation. Seal the conduits after the conductors are in place.
- E. Identification: Identify all cables as specified in Section 26 05 53.
- F. Color Coded Tape: Apply color coding tape at all terminations and splices with overlapping turns for a minimum length of two inches, starting two inches back from the termination point. Provide color code tape in all boxes and manholes.
- G. Provide color coding throughout the entire network for service, feeder, branch, control and low energy signal circuit conductors. Use the following color code for conductors.

COLOR CODING	
<u>SYSTEM</u>	<u>COLORS</u>
208/120 Three phase	Phase A - Black Phase B - Red Phase C - Blue Neutral - White Ground - Green
480/277 Three phase	Phase A - Brown Phase B - Orange Phase C - Yellow Neutral - White Ground - Green
Control and low- energy signal	Hot - Red Neutral - White Ground - Green
Gas and Fire De- tection Systems	See Specification 28 31 00 – Signaling and Alarm

COLOR CODING	
SYSTEM	COLORS
Instru- mentation	Gray
2-wire grounded dc system (negative grounded)	Positive - Red Negative (Neutral) - White
2-wire grounded dc system (positive grounded)	Positive (Neutral) - White Negative - Black
3-wire grounded dc system	Positive - Red Neutral - White Negative - Black

- H. Terminations: Leave a minimum of six inches of free conductor at each connected outlet and a minimum of nine inches at unconnected outlets.
- I. NEC Requirements: Install wiring in accordance with applicable provisions of National Electrical Code, local codes having jurisdiction, and as indicated.
- J. Conductor Sizing: Size conductors in accordance with the NEC, local codes having jurisdiction and the following:
1. Size for branch lighting circuits so that the greatest voltage drop between lighting panel and center of load does not exceed two percent at rated load.
  2. Size conductors to limit the maximum conductor temperature to less than 75 degrees C, except where specifically stated otherwise.
  3. Use minimum conductor sizes as follows:
    - a. Power and lighting branch circuits, No. 12 AWG.
    - b. 120-volt control circuits, No. 14 AWG.
    - c. Instrumentation and signal wiring, 2 or 3 conductors No. 16 AWG stranded shielded.
  4. Conductor Ampacity Adjustment Factors:
    - a. For installations in ambient temperatures other than 30 degrees C, adjust the conductor ampacity based on NEC Table 310.15(B)(2)(a).

- b. For installations of raceways or cables exposed to sunlight on or above rooftops, utilize ambient temperature adjustment per NEC Table 310.15(B)(3)(c).
- 5. Size conductors as shown or as required by the actual load to be served, whichever is larger.
- K. Splicing: Install continuous cables without splices in all duct systems.
- L. Instrumentation wiring:  
Install instrumentation wiring as follows:
  - 1. Wherever possible provide continuous instrumentation wiring without splices from field device to instrument. Where connections are required, make all connections in terminal boxes.
  - 2. Terminate instrumentation wiring at terminal blocks only.
  - 3. Where instrumentation wire is required to be connected in a terminal box, provide an isolated terminal for each shield.
  - 4. Ground instrumentation shields and drain wires only at the panel end of loop only.
  - 5. Install clear, heat-shrink, seamless tubing over exposed shields and drain wires in all terminal boxes, junction boxes, panels and field devices.
- M. Hazardous Areas: Seal all conduits at boundaries of hazardous areas in accordance with the National Electrical Code, local codes having jurisdiction, and as indicated.
- N. Accuracy of Information: The number and sizes of wires and conduits indicated are for guidance only and are not necessarily the correct number and sizes necessary for actual equipment installed. Install as many wires and conduits of the required size as necessary for a complete electrical system, and provide adequately for the equipment actually installed.

### 3.2 CONDUCTOR IDENTIFICATION

- A. Labeling: Label each wire at both termination points and at each splice point in junction boxes. Carry individual conductor or circuit identification throughout, with circuit numbers or other identification clearly stamped on terminal boards and printed on directory cards in distribution cabinets and panelboards.
- B. Identification: Identify each wire in junction boxes and cabinets by means of plastic slip-on wire marker.

- C. Plastic Tags: In manholes, identify each wire by laminated plastic tag located so it can be easily seen in accordance with Section 26 05 53.
- D. Color Coordination: Connect circuit conductors of the same color to the same phase throughout the installation.

### 3.3 WIRE AND CABLE CONNECTIONS TO EQUIPMENT

- A. General: Provide electrical connections to all equipment in strict accordance with the manufacturer's approved wiring diagrams, the Plans, or as approved. Repair or replace any damaged equipment resulting from erroneous connections.

### 3.4 CONNECTOR AND TERMINAL LUG INSTALLATION

- A. UL Requirements: Install all connectors and terminal lugs in accordance with UL requirements and manufacturer's recommendations.

### 3.5 FIELD QUALITY CONTROL

- A. Insulation Tests: Test all feeders after installation but before final connections are made.
- B. Continuity Tests: Test all power conductors and 20% of all control conductors to demonstrate proper cable connection.
- C. Perform tests in accordance with the requirements of Section 26 08 00.
- D. Test Results: Perform all tests and submit certified test results. Replace and retest any conductors that fail the tests.

END OF SECTION

(NO TEXT ON THIS PAGE)

## SECTION 26 05 26

### GROUNDING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing a complete grounding system and alterations to the existing grounding system as specified and shown. Grounding includes but is not limited to: electric equipment enclosures, raceway systems, transformers, unit substations, switchgears, switchboards, motor control centers, panelboards, ground grid systems, grounding rods, grounding conductors, bonding jumpers, water pipe connections, and structure metal frames as required.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 26 41 00 - Lightning Protection Systems
  - 2. Section 26 05 00 - Basic Electrical Materials and Methods
  - 3. Section 26 05 33 - Electrical Raceway Systems
  - 4. Section 26 05 19 - Wires and Cables - 600 Volts and Below
  - 5. Section 26 08 00 - Electrical Testing Requirements

##### 1.2 REFERENCES

- A. Codes and Standards: The following codes and standards are referred to in this Section:
  - 1. NFPA 70 - National Electrical Code (NEC)

##### 1.3 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01.
- B. Product Data and Information: Furnish manufacturer's catalog data for the following:
  - 1. Grounding and grounded conductors
  - 2. Grounding connectors, clamps and bushings
  - 3. Grounding rods
  - 4. Bonding jumpers
- C. Shop Drawings: Furnish shop drawings showing the locations and length of grounding rods. Denote the size and material used for grounding rods. Furnish details pertaining to the installation of grounding electrode conductors, grounding

and grounded conductors, grounding connections, grounding enhancement materials and the ground grid for buildings, structures, lighting units, manholes and handholes.

- D. Quality Control: Furnish a field report stating the results of the system ground impedance test.

#### 1.4 QUALITY ASSURANCE

- A. Codes and Standards: Construct a complete grounding system in accordance with applicable ANSI, IEEE Standards, the NEC and local codes.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.

- 1. Grounding and Grounded Conductors

- a. Okonite Company
- b. Southwire Company

- 2. Ground Plates

- a. Burndy/ Hubbell Incorporated O-Z Gedney/Emerson Industrial Automation
- b. Eritech Grounding Products
- c. Thomas & Betts/ABB Group

- 3. Grounding Rods

- a. Harger Lightning Protection, Inc.
- b. Thompson Lightning Protection, Inc.
- c. Carolina Galvanizing Utility Products Division
- d. Eritech Grounding Products
- e. Superior Grounding Systems

- 4. Ground Rod Access and Test Well Box

- a. Hubbell Power Systems – Quazite

- b. Oldcast Precast, Inc.
- c. Thompson Lightning Protection

## Eritech Grounding Products

### 2.2 MATERIALS

- A. General: Provide conductor sizes as shown or required.
- B. Materials: Provide conductors in accordance with the requirements specified in Section 26 05 19.
- C. Bare conductors: Provide bare copper conductor where buried in earth, embedded in concrete or exposed.
- D. Insulated Conductors: Provide copper conductor with green color insulation rated at 600 volts where installed in conduits or other enclosed raceways.

### 2.3 CONNECTORS

- A. Grounding Clamps and Bolted Connectors: Provide grounding clamps and bolted connectors suitable for devices or cables being connected.
- B. Ground Plates: Provide two-hole, cast, copper alloy, ground plates suitable for installation in concrete. Fabricate the ground plates with two ½-inch diameter threaded holes and a 4/0 stud for connection to the grounding system.
- C. Welding: Provide the exothermic welding process for buried, concealed and accessible connections to structural members, ground rods, and case grounds. Clean and paint welds embedded in the ground or encased in concrete with asphalt base paint.
- D. Bolted Connectors: Provide bolted connectors for grounding to ground buses and equipment.
- E. Pipe Grounding: Provide copper, brass, or bronze grounding clamps for grounding pipes. Do not provide strap type clamps.
- F. Grounding Bushings: Provide grounding bushings for conduits where conduits are not effectively grounded by firm contact to the grounded enclosure.

### 2.4 GROUNDING RODS

- A. Length and Size: Provide grounding rods 3/4-inch in diameter and 10 feet long.
- B. Grounding Rod Material: Copper-clad Stainless steel.

## 2.5 GROUND ROD ACCESS AND TEST WELL BOXES

- A. Interior Locations: Cast iron box with open bottom set in concrete floor measuring a minimum of 12 inches in diameter by 18 inches deep with engraved/stamped cover reading "GROUND ELECTRODE".
- B. Exterior Locations: Precast concrete or polymer concrete junction box with open bottom, UL listed, Tier 22 in accordance with ANSI/SCTE 77, with engraved/stamped cover reading "GROUND ELECTRODE".

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General:
  - 1. Install conductors to preclude exposure to physical damage.
  - 2. Install connections firm and tight.
  - 3. Arrange conductors and connectors without placing strain on the connections.
  - 4. Bury equipment grounding conductors as shown, or at a minimum of 12 inches below grade.
  - 5. Bring loops or taps up for connection to equipment or other items to be grounded.
  - 6. Install an insulated grounding conductor in all conduits.
  - 7. When raceways are used to contain and protect grounding conductors, install in accordance with Section 26 05 33 and NEC.
  - 8. Where conductors are installed in nonmetallic raceway, provide the grounding conductor in addition to the neutral wire, sized in accordance with NEC or as scheduled.
  - 9. Perform exothermic welding with properly sized molds.
- B. Grounding Rod Installation:
  - 1. Install grounding rods as shown with the top of the rod a minimum of 12 inches below grade.
  - 2. Drive grounding rods into permanently moist soil.

3. Provide additional ground rod sections as required to reach permanently moist soil.
  4. Provide junction box without bottom for access to grounding rod and conductor where shown.
- C. Equipment Grounding: Ground each piece of electrical equipment using a conductor in the raceway feeding the equipment in accordance with NEC.
1. Unless specified otherwise, connect transformer enclosures and neutrals to the grounding system. Connect the neutral ground connection at the transformer terminal. Make the connection from the ground grid to the ground bus and enclosures of switchboards, switchgears and motor control centers, lighting and distribution panelboards, and control, relay and instrumentation panels.
  2. Provide two separate, independent, diagonally opposite connections for power transformers so removal of one connection will not impair continuity of the ground system. Provide ground plates that are imbedded in the concrete pad so that transformers can be removed without damaging grounding system. Install a copper ground connect between ground plates and the transformers.
- D. Grounding Conductors: Connect the grounding conductor between the equipment and the grounding system. Where a ground bar is furnished with the panelboard, connect the grounding conductor to the bar.
- E. Miscellaneous Grounding: Provide grounding for the following:
1. Ground receptacles and switches and their metal plates through positive ground connection to the yoke/strap, outlet box and grounding system grounding wire installed in the conduit.
  2. Ground racks, supports, frames, covers and metal parts in manholes or handholes, controllers, motor frames, surge capacitors, arrestors, lighting fixtures, metal structures, exposed noncurrent carrying metal, mechanical equipment, hoist beams, cranes and similar items.
  3. Provide ground connections to equipment using ground plates imbedded in the concrete pad so that the equipment can be removed without damaging grounding system. Provide a copper ground connection between ground plates and the equipment.
  4. Ground motor shaft protection for motors operating on adjustable frequency drives where provided.

### 3.2 FIELD QUALITY CONTROL

- A. Tests: Conduct a witnessed test to determine the ground impedance for the entire system using a ground loop impedance tester. Provide a maximum impedance of 2

ohms at any point of the test. Add additional grounding rods if necessary to meet this requirement.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 26 05 33

### ELECTRICAL RACEWAY SYSTEMS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing electrical raceway systems as indicated, in accordance with the Contract Documents.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 09 96 00 – High Performance Coatings
  - 2. Section 26 05 00 - Basic Electrical Materials and Methods
  - 3. Section 26 05 43 - Underground Electrical Distribution System

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ANSI C80.1 - Rigid Steel Conduit
  - 2. ANSI C80.3 - Electrical Metallic Tubing,
  - 3. ANSI C80.5 - Specifications for Aluminum Rigid Conduit
  - 4. ANSI C80.6 - Electrical Intermediate Metal Conduit
  - 5. ANSI/NFPA 70 - National Electrical Code
  - 6. NEMA RN1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
  - 7. NEMA TC2 - Electrical Polyvinyl Chloride (PVC) Conduit
  - 8. UL 1 - Standard for Flexible Metal Conduit
  - 9. UL 6 - Standard for Rigid Metal Conduit-Steel
  - 10. UL 360 - Standard for Liquid-Tight Flexible Steel Conduit
  - 11. UL 651 - Standard for Schedule 40 and 80 Rigid PVC Conduit

- 12. UL 797 - Standard for Electrical Metallic Tubing-Steel
- 13. UL 1242 - Standard for Intermediate Metal Conduit-Steel
- 14. NFPA 70 - National Electrical Code (NEC)
- 15. Federal Specification WW-C-540C - Conduits, Metal, Rigid (Electrical, Aluminum)
- 16. Intertek ETL SEMKO PVC-001 - High Temperature H2O PVC Coating Adhesion Test Procedure

### 1.3 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01 and Section 26 05 00.

### 1.4 QUALITY ASSURANCE

- A. Codes: Provide all materials and workmanship in accordance with the requirements of the National Electrical Code and local codes having jurisdiction.
- B. Regulatory Requirements: Provide UL listed components.
- C. Installers of PVC coated rigid steel conduit are to be factory certified.

### 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Rigid steel and intermediate metal conduits and electrical metallic tubing:
    - a. Allied Tube and Conduit
    - b. Wheatland Tube Company/JMC Steel Group
    - c. Nucor Tublar Products
  - 2. PVC coated steel conduits fitting and boxes:

- a. Plasti-Bond/Perma-Cote/KorKap-Robroy Industries
  - b. Ocal – Thomas & Betts Corp.ABB
  - c. Perma-Cote Industries
3. Aluminum Conduits:
- a. Allied Tube and Conduit
  - b. Wheatland Tube Company/JMC Steel Group
  - c. Sapa Extrusions North America
4. Liquidtight and flexible steel conduit:
- a. Electri-Flex Company
  - b. The International Metal Hose Co.
  - c. Southwire
  - d. Anamet Electrical, Inc.
  - e. Thomas & Betts /ABB Group
5. Conduit Fitting and Connectors
- a. Appleton /Emerson Industrial Automation
  - b. ABB Group
  - c. Eaton’s Cooper Crouse-Hinds
  - d. O-Z Gedney/Emerson Industrial Automation
  - e. Hubbell - Killark
  - f. AdaletPLM/Scott Fetzer Company
6. Boxes and Enclosures:
- a. Appleton /Emerson Industrial Automation
  - b. Raco/A Hubbell Company
  - c. Eaton’s Cooper Crouse-Hinds
  - d. Thomas & Betts/ABB Group
  - e. Hoffman
  - f. Hope Electrical Products Company
  - g. O-Z Gedney/Emerson Industrial Automation
7. Strut Channel and Fittings
- a. Allied Tube and Conduit
  - b. Eaton’s Cooper B-Line Systems, Inc.
  - c. Thomas & Betts /ABB Group-SuperstrutEnduro Composites Inc.
  - d. Strut Tech Systems
  - e. Unistrut

8. Fire Stop System
  - a. 3M/Electrical Products Division
  - b. Acoustical Solutions Inc.
  - c. Nelson Fire Stop Products/Emerson Industrial Automation
  
9. Terminal Blocks
  - a. Phoenix Contact
  - b. ABB - Entrelec
  - c. Weidmuller

## 2.2 RACEWAYS

- A. General: Provide minimum 3/4-inch raceways.
  
- B. Raceway Requirements: Provide raceways meeting the following requirements:
  1. Provide rigid steel, heavy wall, hot-dip galvanized in accordance with the requirements of UL-6 and ANSI C80.1.
  2. Provide intermediate metal hot-dip galvanized conduit in accordance with the requirements of UL1242 and ANSI C80.6.
  3. Provide electrical metallic tubing hot dip galvanized conduit in accordance with the requirements of UL 797 and ANSI C80.3.
  4. Provide PVC coated rigid steel in accordance with the requirements for rigid steel raceway herein and with 40 mils bonded PVC exterior coating meeting requirements of UL-6 and NEMA RN1. Provide PVC coated rigid steel conduit that is listed and performance verified to ETL PVC-001 for 200 hours. Provide a nominal 2 mil urethane interior coating and a clear urethane coating over the galvanized threads.
  5. Provide rigid heavy wall aluminum alloy 6063T-1 conduit in accordance with the requirements of UL 6, Federal Specification WW-C-540C and ANSI C80.5.
  6. Provide rigid nonmetallic Schedule 40 PVC in accordance with requirements of NEMA TC2 and UL 651 with solvent cement joints.
  7. Provide rigid nonmetallic Schedule 80 PVC electrical conduit in accordance with the requirements of UL Standard 651 and NEMA Standard TC2 with solvent cement joints.
  8. Provide liquidtight flexible single strip steel, hot-dip galvanized conduit with PVC jacket in accordance with requirements of UL 1. Provide a continuous copper bonding conductor wound spirally between convolutions on the inside

of the conduit meeting requirements of UL 360 for conduit sizes 1-1/4-inch and smaller.

9. Provide flexible steel conduit constructed of continuous interlocked, zinc coated steel strip in accordance with the requirements of UL 1. Provide in a minimum 1/2 inch electrical trade size.

## 2.3 FITTINGS

- A. General: Provide fittings of similar material as raceways.
- B. Fittings Requirements: Provide fittings meeting the following requirements:
  1. Set screw or indenter type fittings are not acceptable. Provide threaded connectors for all rigid or intermediate metal conduits.
  2. Provide gland compression type fittings for all electrical metallic tubing. Provide insulated type connectors.
  3. Provide insulated connectors for liquidtight flexible conduit.
  4. Expansion/Deflection Fittings:
    - a. Provide a deflection and expansion coupling for rigid and intermediate metal conduits that have a 3/4 inch movement in all directions from normal and a 30 degree angular deflection. Provide coupling that includes internal bonding jumper.
  5. Bushings
    - a. Provide insulated nonmetallic bushing rated 105 degrees C for all installations where bonding is not required.
    - b. Provide insulated metallic grounding and bonding bushing rated 150 degrees C where bonding is required.

## 2.4 WALL AND FLOOR PENETRATIONS

- A. Watertight:
  1. For conduit penetrations in new exterior walls or floors provide watertight sealing sleeves consisting of a steel sleeve with pressure ring and clamps.
  2. For conduit penetrations in existing walls or floors, provide watertight sealing bushing consisting of a neoprene sealing ring between two PVC coated steel pressure discs. Provide stainless steel captive screws for sealing ring compression.

B. Fire-proofing Through Fire Rated Construction:

1. Provide a permanent fire stop system for all penetrations through fire-rated walls, partitions and floors.
2. Design fire stop system to maintain the integrity of the wall or floor assembly for its rated time period.
3. Arrange fire stop system to allow normal pipe movement without being displaced.
4. Do not utilize asbestos in fire stop systems.
5. Provide an intumescent fire stop system when exposed to flame or heat.

2.5 BOXES AND CABINETS

A. Outlet Box Requirements:

1. Provide cast aluminum boxes for aluminum conduit systems.
2. Provide galvanized cast iron boxes for galvanized rigid steel and intermediate metal conduit systems.
3. Provide nonmetallic boxes and covers in PVC conduit systems.
4. Provide PVC coated boxes and covers in PVC coated conduit systems.
5. Provide boxes located in Class I, Division 1 hazardous areas meeting NEMA 7 requirements.
6. Provide corrosion-resistant fiberglass reinforced polyester boxes with stainless steel hardware in corrosive areas as defined in Section 26 05 00 or as shown.
7. Provide watertight gasketed covers held with nonferrous screws for all cast metal boxes.

B. Junction and Pull Box Requirements:

1. Provide cast aluminum boxes with mounting lugs, threaded hubs and gasket covers for surface mounted boxes
2. Provide fabricated sheet metal boxes when cast metal box weight exceeds 50 pounds. Construct box from 1/8-inch thick galvanized sheet steel or aluminum with sides return channel flanged around cover opening. Provide angle or channel supporting frame. Provide continuously welded and ground smooth seams. Provide mounting lugs and threaded conduit hubs.

3. Provide cast steel or fabricated 10-gauge Type 316 stainless steel for boxes either partially or fully encased in concrete. For partially encased boxes provide sides return channel flanged around cover opening. For fully encased boxes provide flush covers. Provide continuously welded and ground smooth seams. Provide mounting lugs and threaded conduit hubs.
4. Provide watertight gasketed covers held with stainless-steel captive screw slot bolts.
5. Provide two padlocking hasps for boxes containing medium voltage cables.
6. Provide steel barriers in all boxes that isolates instrumentation wiring from all other wiring systems
7. Provide fabricated boxes located indoors in non-corrosive areas and conditioned spaces -meeting NEMA 12 requirements.
8. Provide all boxes located outdoors, in corrosive areas or where otherwise indicated meeting NEMA 4X, 316 stainless steel requirements.
9. Provide boxes located in Class I, Division 1 hazardous areas meeting NEMA 7 requirements.

C. Terminal Box Requirements:

1. Provide minimum 12 gauge stainless steel fabricated box with mounting lugs, floor stand, and hinged doors.
2. Provide the door with continuous piano hinge and 3 point lockable latch. Provide print pocket on inside of door.
3. Provide back plate fabricated from 12 gauge minimum steel with white enamel finish for mounting terminals and wire troughs.
4. Provide wire troughs consisting of plastic ducts with snap slot design and removable covers. Run all wiring within wire troughs.
5. Furnish a schedule of terminals with the following information
  - a. Source
  - b. Type of Signal
  - c. Function
6. Provide removable jumpers to allow operation of the equipment.
7. Separate analog terminals from all other terminals.

8. Provide number of terminals shown. Where the number of terminals are not shown, provide sufficient terminals for each wire entering the terminal box plus 20 percent but not less than 10 spare terminals.
9. Terminals:
  - a. All catalog numbers refer to Phoenix Contact Type for the purpose of establishing the standard of quality and general configuration desired.
  - b. Provide symmetrical type steel mounting rails, NS-35.
  - c. Analog Signals: Provide terminals in enclosed housing suitable for wires from 22 to 12 AWG rated 600 volts with gray body, knife disconnect and test connection socket on both sides of disconnect, Phoenix Contact Type UK 5-MTK-P/P.
  - d. Control and Alarm Signals: Provide terminals suitable for wires from 24 to 10 AWG rated 18 amperes at 600 volts, blue body, Phoenix Contact Type UK5N BU.
  - e. 120-Volt Power Wiring: Provide terminals suitable for wires from 18 to 10 AWG rated 30 amperes at 600 volts, hot (black body), neutral (white body), ground (green body), Phoenix Contact Type UK5N BK, UK5N WH & UK5N GN, respectively.
10. Enclosures:

Provide enclosures meeting the same NEMA criteria for the various areas as specified under Junction and Pullboxes.

## 2.6 SUPPORTING DEVICES

- A. Raceway Supports: Provide raceway supports meeting the following requirements:
  1. Do not use perforated straps or plumbers tape for conduit supports.
  2. Provide expansion bolts or inserts for fasteners in concrete, toggle bolts for hollow masonry or frame construction, and preset inserts for prestressed concrete.
  3. Conduit Straps and Backs:
    - a. For metallic conduits, provide steel or malleable iron.
    - b. For nonmetallic and PVC coated conduits, provide PVC coated malleable iron with stainless steel anchors and bolts.

4. Conduit Hangers
  - a. For metallic conduits, provide steel adjustable conduit hangers or clevis hangers.
  - b. For nonmetallic and PVC coated conduits, provide PVC coated adjustable conduit hangers with stainless steel hardware.
5. Beam Clamps:
  - a. For metallic conduits, provide malleable iron with steel bolt.
  - b. For nonmetallic and PVC coated conduit, provide PVC coated malleable iron with stainless steel bolt.
6. Trapeze Hangers:
  - a. For metallic conduits provide 12 gauge 1-1/2-inch square steel channels with steel channel straps to secure conduits.
  - b. For nonmetallic or PVC coated conduit, provide either PVC coated 12 gauge 1-1/2-inch square steel channels or 1-5/8-inch square fiberglass channels. Provide PVC coated straps with stainless steel bolts for securing conduits.
  - c. Provide addition channels welded together to limit the deflection to 1/240th of span.
7. Threaded Rod
  - a. Provide threaded rod with the minimum size as follows:
    - (1) Conduit Hangers
      - (a) 3/4-inch to 1-1/2-inch conduit: 1/4-inch thread rod
      - (b) 2-inch to 3-1/2-inch conduit: 3/8-inch thread rod
      - (c) 4-inch and larger: 1/2-inch thread rod
    - (2) Trapeze Hangers: Provide thread rod of sufficient size to support the load. Provide a minimum of 3/8-inch thread rod.
  - b. For Metallic Conduit Systems: Provide continuous threaded galvanized steel rod.

- c. For Nonmetallic or PVC Coated Conduit Systems: Provide continuous threaded stainless steel rod.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. General: Install electrical equipment and material of the size, type and general routing as shown or required.
- B. Coordination with Reinforcing: Install raceway, fittings, boxes and cabinets free from direct contact with reinforcing steel.
- C. Alignment: Provide fasteners, anchor bolts, anchorage items and supports as required to insure proper and rigid alignment. Attach equipment with fasteners sized according to size and weight of the equipment and the thickness of the supporting surface.
- D. Aluminum Coating: Where aluminum is placed in contact with dissimilar metal or concrete, separate contact surfaces with gasket, nonabsorptive tape or coating as specified in Section 09 96 00 to prevent corrosion.
- E. Grounding: Make metallic raceways electrically and mechanically continuous and ground as required. Install conduits continuous between outlets, boxes, cabinets and panels.

### 3.2 INSTALLATION

- A. General: Unless otherwise indicated, install conduits exposed, parallel or perpendicular to building floors, ceilings and walls, to avoid interference with other work. In architecturally finished areas, conceal conduits within finished walls, ceilings and floors. Cut conduits square and deburr the cuts to the same degree as the conduit manufacturer. Fasten conduit securely to outlets, junction, pull and terminal boxes. Provide caps and seals to prevent the entrance of foreign material and moisture during installation and before pulling wire.
  - 1. Where conduit size is not shown, provide conduits one size larger than indicated in Table 4, Chapter 9 of the NEC.
  - 2. Saw cut aluminum conduit to prevent reduction in internal area.
  - 3. Support raceways concealed above suspended ceilings from the slab above suspended ceiling in same manner as exposed raceways. Do not support raceways from suspended ceiling supports.
  - 4. Keep conduit at least six inches away from high temperature piping, ducts, flues and surfaces. For mounting on concrete and masonry surfaces provide

a minimum of 1/4 inch air space between conduit and mounting surface. Support and fasten conduit to building structural members spaced in accordance with electrical codes. Support conduit at least every eight feet or less in accordance with NEC requirements.

5. When two or more exposed conduits are in the same general routing, provide parallel installation with symmetrical bends and for three or more provide trapeze hangers. Size trapeze hangers with space for 25 percent additional conduits.
  6. Make changes in direction with bends or fittings. Use factory-made bends or elbows wherever possible. Make field bends and offsets with a hand bender or conduit-bending machine. Provide a bending radius not less than 36-inches for conduits containing medium voltage cables.
  7. Run conduit in buildings with no more than the equivalent of three 90 degree bends between pull points. Provide no more than 125 feet of conduit runs between pull points. Provide pull boxes where shown, specified or wherever required to install conductors and to meet the above requirement.
  8. Install pull and junction boxes in accessible locations with working space in front of and around the installation. Obtain approval to locate boxes in finished areas.
  9. Install an expansion fitting when a conduit crosses a structural expansion joint.
  10. Unless otherwise approved, install conduits to cross at right angles to building structural expansion joints.
  11. Where approved for encased installation, install conduits in slabs as close to the middle of concrete slabs as practicable without disturbing reinforcement. Do not use conduit with an outside diameter exceeding one-third of the slab thickness. Do not place conduits closer than three diameters on centers, except at cabinet locations where the slab thickness is increased.
  12. Pitch conduits to outlet boxes to avoid trapping moisture. Where dips are unavoidable in exposed conduit runs, install drain fitting at low point.
- B. Conduit Material Types: Provide conduit as follows:
1. Provide aluminum conduit in all exposed indoor and outdoor installations, except as described below.
  2. Provide rigid steel conduits in all installations concealed in structures, concrete encased within structures or under structures.

3. Provide electrical metallic tubing in all installations above suspended ceilings and in partition constructed walls.
  4. Provide rigid steel conduits for all instrumentation, and electronic equipment signal wiring in all exposed or concealed noncorrosive installations.
  5. Provide rigid nonmetallic Schedule 40 conduits underground, concrete encased or direct buried, unless specifically detailed otherwise.
  6. Corrosive and Wet Locations
    - a. Corrosive and Wet locations are defined in Section 26 05 00 or as shown:
    - b. Provide PVC coated rigid steel conduit in all installations in corrosive locations.
- C. Connections to Equipment
1. Provide double locknuts and bushing for all boxes, enclosures and cabinets located in dry areas.
  2. Provide watertight hub fittings for all boxes, enclosures and cabinets located below grade or in wet, damp or corrosive areas.
  3. Provide rigid conduit connection where equipment is fixed and not subject to adjustment, mechanical movement or vibration. Provide union fittings to permit removal of equipment without cutting or breaking conduit.
  4. Provide liquidtight flexible conduit connection where equipment is subject to adjustment, mechanical movement or vibration.
  5. Provide flexible steel conduit connections to lighting fixtures installed in accessible suspended ceilings.
  6. Coat all threads in steel conduit runs with zinc dust in oil or other corrosion-preventive compound before making connections.
  7. Coat all threads in aluminum conduit runs with graphite or other corrosion preventive compound.
- D. Underground Conduits: Provide underground conduits meeting the requirements of Section 26 05 43.
- E. Penetrations: Make concealed penetrations for single conduits not more than 1/4-inch larger than the diameter of the conduit. Make penetrations through walls, ceilings and floors other than concrete for exposed conduits not more than 1/4-inch

larger than the diameter of the conduit. Fill the voids around conduit with caulking compound and finish the surface the same as the wall, ceiling or floor.

1. Where a conduit enters through a concrete roof or membrane waterproofed wall, floor or ceiling, provide a watertight sealing sleeve that can be tightened from one or both sides. If the sealing sleeve is not placed with the concrete, core drill the proper size hole to provide a mechanically watertight installation.
  2. Where a conduit enters through a concrete non-waterproofed wall, floor or ceiling, provide a (Schedule 40), (galvanized steel) sleeve and fill the space between the conduit and sleeve with a plastic expandable compound. If the sleeve is not placed with the concrete, drill the hole not less than 1/2-inch and not more than one inch larger than the sleeve, center the sleeve and grout the sleeve for the total depth of penetrated concrete with non-shrink grout, polyurethane or silicone sealant.
- F. Spare Conduit: Provide spare conduits for future use as shown or required. Provide a minimum 200 pound strength nylon pull line in each spare conduit and identify the origin and termination of the conduit at each end. Terminate spare conduits in equipment, boxes or by couplings plugged flush with the inside of building surfaces.
- G. Boxes: Provide boxes of the proper dimensions for the size and quantity of conductors enclosed.
1. For boxes mounted on steel, concrete and masonry surface, provide a minimum 1/4-inch non-metallic spacer to hold the box away from the surface.
  2. Provide pressed metal boxes in all partition constructed walls.
  3. Provide separate support for boxes and bolt units to buildings with expansion anchors, toggle bolts or appropriate screws. For lighting fixture outlet boxes, provide supports adequate to support the weight of the fixture to be mounted on the box.
  4. Remove debris including dust, dirt, wire clippings and insulation from the interior of boxes. Replace boxes with open conduit holes. Repair or replace damaged boxes as directed.
  5. Unless otherwise indicated, mount outlet boxes flush with the finished wall or ceiling with the long axis vertical. Unless otherwise shown or specified, provide mounting heights measured from the finished floor to centerline of the outlet box as follows:
    - a. For switches: 3'-2". Mount the box for lighting switches on the strike side of the door.

- b. For duplex convenience outlets: Finished areas 12 inches and unfinished areas 2 feet.
- c. For clock receptacles outlets: 8 feet.
- d. For fixtures and equipment: As shown.
- e. For desk telephone outlets: 12 inches.
- f. For wall telephone outlets: 48\* inches.

### 3.3 CLEANING AND PAINTING

- A. Field Painting: Paint conduits meeting the requirements of Section 09 96 00.
- B. Touch Ups: Touch up all PVC coatings on conduit, fittings and boxes where scratched, marred or otherwise compromised during handling and installation per the manufacturer's instructions.

END OF SECTION

## SECTION 26 05 53

### ELECTRICAL IDENTIFICATION

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing materials for the identification of electrical equipment, components, conduits, cables and wiring, and furnishing and installing safety signs.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 09 96 00 – High Performance Coatings
  - 2. Section 26 05 00 - Basic Electrical Materials and Methods

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ANSI C2 - National Electrical Safety Code (NEC)
  - 2. ANSI Z535.1 - Safety Color Code
  - 3. ANSI Z535.2 - Environmental and Facility Safety Signs
  - 4. ANSI Z535.3 - Criteria for Safety Symbols
  - 5. OSHA - Occupational Safety and Health Act

##### 1.3 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01.
- B. Product Data and Information: Furnish manufacturers' catalog data for safety signs, nameplates, labels and markers.
  - 1. Furnish manufacturers' instructions indicating applicable conditions and limitations of use, storage, handling, protection, examination and installation of product.
- C. CONTRACTOR's Record Drawings: Furnish CONTRACTOR's record drawings accurately showing the actual location and elevation of underground ducts, handholes and manholes at the completion of the Project.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01.

#### 1.5 SPARE PARTS

- A. General: Furnish the following spare parts.
  - 1. Ten safety signs of each size and wording.
- B. Packaging: Package spare parts in containers bearing labels clearly identifying the contents. Provide all spare parts with information needed for reordering. Deliver spare parts in original factory packaging.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. W. H. Brady Company
  - 2. Seton
  - 3. Thomas & Betts/ABB Group

#### 2.2 MATERIALS AND COMPONENTS

- A. General: Provide identification materials listed and classified by UL or tested by an acceptable Electrical Testing Company certifying the equivalence of the materials to UL listing requirements and OSHA approved.
- B. Laminated Plastic Nameplates: Provide engraved three layer laminated plastic nameplates with black letters on white background and fastened with corrosion-resistant screws. Do not use mounting cement for fastening nameplates.
  - 1. Provide nameplates with 1-inch high lettering for switchgears, switchboards, motor control centers, control panels, relay panels, contactor panels, panelboards, and similarly grouped equipment, transformers and disconnect switches.
  - 2. Provide nameplates with 1/2-inch high lettering for individual components of a group such as main breakers, switchgear units, switchboard units, motor control center units and similar devices.

3. Provide nameplates with 1/4-inch high lettering for remote motor controllers, control stations, relays and similar equipment.
  4. Provide nameplates for each motor identifying service or function and lettering of an appropriate size to suit each motor.
  5. Provide approved laminated directories of circuits with typewritten designations of each branch circuit in each panelboard.
  6. Provide smaller lettering for a neat, legible nameplate where the amount of lettering causes excessively large nameplates.
- C. Wire Markers: Identify wire bundles and each individual wire.
1. Wire bundles: Provide a brass or rigid fiber identifying tag attached with nylon self locking "Ty-Raps".
  2. Wire identification markers: Provide a printed white, heat-shrink, seamless tubing type with black bold lettering for wires size No. 10 AWG and smaller. Provide a printed self-laminating white, vinyl type with black bold lettering for wires No. 8 AWG and larger.
- D. Conduit Marking Paint: Provide conduit marking paint meeting the requirements of Section 09 90 00.
- E. Safety Signs: Provide safety signs in accordance with OSHA standard meeting the requirements of ANSI C2, ANSI Z535.1, ANSI Z535.2 and ANSI Z535.3.
1. Provide safety signs manufactured from vinyl having a minimum thickness of 60 mils with red and black letters and graphics on a white background.
  2. Size: 10 inches by 14 inches except signs 7-inch by 10-inch may be provided where the larger size cannot be applied.
  3. Mount safety signs using corrosion-resistant screws. Do not use mounting cement.
- F. Working Space Floor Markers
1. Provide paint or tape to mark the working space on the floor at electrical equipment.
    - a. Tape: 2-inch wide, 5-mil pressure-sensitive vinyl tape, black and white stripes with clear vinyl overlay. Manufacturer: 3M Safety Stripe Tape 5700.
    - b. Paint: Black and white to be applied in 2-inch wide stripes or checkers. Refer to Specification Section 09 96 00 – High Performance Coatings.

## G. Working Space Labels

1. Provide labels indicating required working clearance at electrical equipment that is likely to require examination, adjustment, servicing, or maintenance while energized.
  - a. Material: Self-adhesive polyester with pressure-sensitive adhesive back. Outdoor labels shall be suitable for a high-UV environment.
  - b. Dimensions: Approximately 6-3/4 x 2 inches.
  - c. The top line on the label is to read "NOTICE" in a 48 point white italic font letters on a safety blue background.
  - d. Provide message wording in a 24 point black or safety blue font letters on a white background.
    - (1) Message wording for 208Y/120-volt equipment: "KEEP AREA IN FRONT OF THIS ELECTRICAL EQUIPMENT CLEAR FOR 3 FEET. OSHA-NEC REGULATIONS."
    - (2) Message wording for 480-volt and 480Y/277-volt equipment: "KEEP AREA IN FRONT OF THIS ELECTRICAL EQUIPMENT CLEAR FOR 3-1/2 FEET. OSHA-NEC REGULATIONS."
    - (3) Message wording for 4160Y/2400-volt equipment: "KEEP AREA IN FRONT OF THIS ELECTRICAL EQUIPMENT CLEAR FOR 4 FEET. OSHA-NEC REGULATIONS."
  - e. Manufacturer: Brady, Brother, Seton.

## H. Underground Warning Tape

1. Provide underground warning tape for underground cables, conduits and duct banks.
2. Use 6 inch wide, 0.004 inch thick, polyethylene underground warning tape with black lettering and background colors as follows:
  - a. Electric: Red.
  - b. Telephone/Data: Orange.
3. Provide lettering that indicates the type of buried service.
  - a. Electric: "CAUTION ELECTRIC LINE BURIED BELOW"

b. Telephone/data: "CAUTION TELEPHONE LINE BURIED BELOW"

4. Manufacturer: Utility Safeguard, LLC.

## PART 3 EXECUTION

### 3.1 PREPARATION

A. Surface Preparation: Degrease and clean surfaces to receive nameplates, labels and marking paint.

### 3.2 INSTALLATION

A. General: Install nameplates on the front of equipment, parallel to the equipment lines and secured with corrosion resistant screws. Caulk all screw holes with clear silicone caulk prior to attaching nameplates on NEMA 4X enclosures.

1. Install laminated nameplates identifying:

- a. Each electrical equipment enclosure
- b. Individual equipment and devices

B. Wire Markers: Identify wire bundles and each individual wire with identification tags as follows:

1. Wire Bundles: Install an identifying tag engraved with the conduit number where conduits enter motor control centers, switchgear, switchboards, control panels, terminal boxes and the like.
2. Wire identification markers: Provide wire identification markers on each wire at all termination points.
  - a. On power and lighting circuits: The branch circuit or feeder number as indicated on drawings
  - b. On control circuits terminated in motor control centers, switchgears, control panels and alike: The field device and terminal number of the opposite end connection.
  - c. On control circuits at each field device: The panel or compartment number and terminal number of the opposite end connection.
3. Oversize wire markers so that after heat shrinking the wire marker can be rotated on the wire. Rotate wire markers so that wire identification number is visible.

C. Conduit Markers: Paint colored marking bands on each conduit that is longer than 6 feet at intervals of 20 feet on centers to identify the wiring voltage system contained in the conduit or for identifying the different conduit systems as follows:

1. 4,160-Volt System
2. 480-Volt System
3. 208/120-Volt System
4. 240/120-Volt System
5. 24/48/125-Volt dc System
6. SCADA Network
7. Fire Alarm System
8. Telephone System
9. Paging System
10. Security System

D. Safety Signs: Provide safety signs as follows or as shown including existing locations and equipment not signed per current industry standards and being modified or reused under this Contract:

1. Type DS-1
  - a. Wording: "DANGER - BATTERY CHARGING AREA, NO SMOKING"
  - b. Location: Within 3 feet of all station battery racks.
2. Type DS-2
  - a. Wording: "DANGER - ELECTRICAL EQUIPMENT, AUTHORIZED PERSONNEL ONLY"
  - b. Location: At each entrance to electrical rooms, and enclosed outdoor electrical equipment.
3. Type DS-3
  - a. Wording: "DANGER - HIGH VOLTAGE, KEEP OUT"

- b. Location: At each entrance to electrical rooms, and enclosed outdoor electrical equipment operating at over 600 Volts. Also, on the sides of fences or walls which enclose outdoor equipment operating at over 600 Volts.

4. Type DS-4

- a. Wording: "DANGER - HIGH VOLTAGE"
- b. Location: Outside all equipment operating at over 600 Volts.

5. Type DS-5

- a. Wording: "DANGER - POWERED FROM MORE THAN ONE SOURCE"
- b. Location: Outside all equipment that operates from more than one power source.

6. Type DS-6

- a. Wording: "NOTICE - KEEP DOOR CLOSED"
- b. Location: On all doors with another safety sign installed.

7. Type DS-7

- a. Wording: "CAUTION - CONTROLS & INTERLOCKS POWERED FROM MULTIPLE SOURCES"
- b. Location: On all control panel doors.

E. Working Space Floor Markers

- 1. Install floor marking tape or paint on the floor at the locations listed below to indicate working space required by the NEC.
  - a. Front and rear of each medium-voltage switchgear.
  - b. Front of each medium-voltage transformer.
  - c. Front and rear of each free-standing low-voltage switchgear or switchboard section.
  - d. Front of each low-voltage transformer, switchboard, panelboard, industrial control panel, motor control center, enclosed circuit breaker, safety switch, and motor controller enclosure including those furnished with mechanical equipment.

- e. Any other equipment likely to require examination, adjustment, servicing, or maintenance while energized.
2. Dimensions of working space area are to be as follows:
    - a. Width: the greater of the width of the equipment or 30 inches.
    - b. Depth:
      - (1) Systems 600V and Below: In accordance with NEC Table 110.26(A)(1)
      - (2) Systems Over 600V: In accordance with NEC Table 110.31
  3. Thoroughly prepare floor surface to receive tape or paint.
  4. Where marking tape is used, outline working space with tape then infill with diagonal tape stripes placed 6 inches on center.
  5. Where paint is used, cover working space area with alternating 3 to 6 inch wide black and white diagonal stripes.

#### F. Working Space Labels

1. Provide working space labels at the following locations positioned at the optimal height for reading when standing facing the equipment:
  - a. Front and rear of each medium-voltage switchgear.
  - b. Front of each medium-voltage transformer.
  - c. Front and rear of each freestanding low-voltage switchgear or switchboard section.
  - d. Front of each low-voltage transformer, panelboard, industrial control panel, motor control center, enclosed circuit breaker, safety switch, and motor controller enclosure, including those furnished with mechanical equipment.
  - e. Any other equipment likely to require examination, adjustment, servicing, or maintenance while energized

#### G. Underground Warning Tape

1. Install underground warning tape in the trench above underground conduit(s), 1 foot below the finish grade.

END OF SECTION

## SECTION 26 05 60

### ELECTRICAL REQUIREMENTS FOR SHOP-ASSEMBLED EQUIPMENT

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing, installing and testing shop-assembled equipment as indicated, in accordance with the Contract Documents. Shop-assembled equipment panels and other items may be specified under the driven equipment sections and/or on the contract drawings and may require external field connection to ancillary devices and other system components for interlocks and alarms. Provide all field wiring as required by the system and equipment specified under the driven equipment sections. This field wiring may not be specified or shown. This equipment includes but is not limited to the following:

1. Air conditioning units
2. Heat pumps
3. Miscellaneous control equipment
4. Overhead doors
5. Pump and fan equipment
6. Sump pump and sewage ejector pump equipment
7. Temperature control systems

- B. Related Work Specified in Other Sections, But is Not Limited to, the Following:

1. Section 03 31 00 - Cast-in-Place Concrete
2. Section 09 96 00 - High Performance Coatings
3. Section 26 05 00 - Basic Electrical Materials and Methods
4. Section 26 05 19 - Wires and Cables - 600 Volts and Below
5. Section 26 05 26 - Grounding
6. Section 26 05 33 - Electrical Raceway Systems
7. Section 26 05 53 - Electrical Identification
8. Section 26 05 73 - Short Circuit and Coordination Study
9. Section 26 05 80 - Electric Motors
10. Section 26 27 26 - Wiring Devices
11. Section 26 29 23 - Adjustable Frequency Drives
12. Section 26 29 53 - Control Components and Devices

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

2. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.
3. UL 508A - Industrial Control Panels
4. NEC Article 409 - Industrial Control Panels
5. NFPA-70E - Standard for Electrical Safety in the Workplace

### 1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Provide the Shop Assembled equipment using Components and Appurtenances meeting the requirements specified in Division 26. Provide shop assembled equipment constructed and labeled to meet the requirements of all referenced and otherwise applicable codes and standards.

### 1.4 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01.
- B. Product Data and Information: Furnish manufacturer's data on all equipment and devices in the assembly, including voltages, number of phases, current ratings, capacities and other relevant data.
- C. Shop Drawings: Furnish shop drawings for the shop-assembled equipment, including the following:
  1. Layout drawings of the assembly showing accurately scaled basic equipment sections, auxiliary compartments and combination sections. Show special relationships of assemblies to associated equipment, including plan and front views of the equipment. Furnish a device summary.
  2. Furnish wiring diagrams for assemblies that show connections to electrical power. Clearly differentiate between shop-installed and field installed wiring.
  3. Furnish construction drawings for equipment requiring field assembly. Clearly differentiate between shop-assembled and field assembled elements of the assembly.
  4. A manufacturer's standard connection diagram or schematic showing more than one method of connection is not acceptable unless, the intended method is clearly identified.
  5. Furnish short circuit ratings on control panels and data demonstrating the rating is appropriate for the available fault current in accordance with NEC Article 409 and UL 508A.

- D. Quality Control: Furnish manufacturer's test reports and certified performance records of all equipment installed. Furnish field test reports after equipment is installed.

## 1.5 QUALITY ASSURANCE

- A. Codes: Comply with local codes and all other applicable codes.
- B. Regulatory Requirements: Comply with applicable Regulatory Agency requirements.
- C. Certification: Certify that the panels' construction complies with the following:
  - 1. List and label panel in compliance with UL-508A.
  - 2. Label panel with its' designed and constructed Short Circuit Current Rating (SCCR) indicating compliance with UL 508.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01.

## PART 2 PRODUCTS

### 2.1 FABRICATION

- A. General: Provide shop-assembled equipment as standard products manufactured by companies regularly engaged in the manufacture of such equipment.
- B. Provide panels constructed as follows:
  - 1. Minimum of #12 AWG copper control wires at 120V.
  - 2. Minimum of #14 AWG copper control wires at 24V.
  - 3. Where main terminal and/or intermediate distribution blocks are used, provide blocks suitable for copper cables with ampere ratings at the rated voltage and related UL Short Circuit Current Rating (SCCR)/Ampere Interrupting Current Rating (AIC) as specified herein.
  - 4. Isolate or barrier 120/24V(LV) controls from 208 through 600V (HV) line voltage equipment and wiring.
  - 5. Isolate all HV equipment and wiring in the main control panel using wireways and internal sub-enclosures so as to allow the opening of the main control

panel under “Work Permit” conditions to access low voltage component enclosures without being exposed to the (HV) equipment and wiring.

6. Provided a main control panel main breaker listed per UL-489.
    - a. Less than 400A: thermal magnetic fixed trip or adjustable where available for the particular size furnished.
    - b. 400A and larger: electronic solid state adjustable trip.
  7. Where 3-phase magnetic motor starters are included, provide in combination with a motor circuit protector sized for the applicable horsepower.
  8. Provide a warning label to read “WARNING-CONTROL VOLTAGE MAY BE PRESENT AFTER OPENING MAIN DISCONNECT” where control voltages are present from an external source.
  9. Provide minimum Short Circuit Current Ratings (SCCR) as follows:
    - a. LV control enclosures – 5KAIC
    - b. HV enclosures as follows:
      - (1) 208V, 3-phase – 22KAIC
      - (2) 480V, 3-phase – 35KAIC
  10. Increase minimum SCCR ratings to satisfy the requirements of the Projects Power System Study at no additional cost.
- C. Factory Assembled Requirements: Provide control panels for shop-assembled equipment as complete factory assembled units that require only external connections for installation including main disconnect and all electrical features necessary for the proper operation of the units.
- D. Controls:
1. Motors 1/2 Hp and Larger:
    - a. Provide motors suitable for 480-volt, 3-phase, 60-hertz operation, with all controls at 115 volts or less.
    - b. Provide a combination circuit breaker along with all required control transformers, relays, timers, heaters and other necessary incidentals to form a complete functioning unit.
    - c. Provide NEMA Size 1 or larger starters.

2. Motors less than 1/2 Hp:
    - a. Provide motors suitable for 120-volt, single phase operation.
    - b. Provide manual motor starter with neon pilot light.
  3. Provide all controls and equipment as specified in Section 26 30 00.
- E. Control Components: Install principal control components in NEMA 250 rated enclosures as follows:

AREA	ENCLOSURE
Above grade indoor	NEMA 12 - Industrial
Outdoor and below grade elevation indoor	NEMA 4 - Watertight
Corrosive areas as defined in Section 26 05 00 or as shown.	NEMA 4X - Watertight and corrosion-resistant (stainless steel) (fiberglass-reinforced thermal setting polyester formulation) with stainless steel external hardware. Provide all external operators made of the same materials as that of the enclosures

- F. Miscellaneous Controls:
1. Provide float switches, pressure switches, limit switches, thermostats and other auxiliary control devices to satisfy the intended service.
  2. Provide contacts rated at 10-amperes, 120 volts, 60-hertz ac, unless otherwise specified.
  3. Provide limit switches that function in accordance with contact development charts.
- G. Panel Accessories:
1. Provide panels with auxiliary heaters, fans or integral air conditioners as specified for specific equipment.
  2. Provide corrosion inhibitors and breather assemblies to prevent corrosion and condensation within NEMA 4 and 4X rated panels.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install shop-assembled equipment as indicated, in accordance with manufacturer's written instructions.
- B. Coordination: Coordinate cabling and wiring as necessary to interface installation of shop-assembled equipment.
- C. Torque Requirements: Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals in accordance with UL Standard 486A.
- D. Grounding Connections: Make equipment grounding connections for the shop-assembled equipment as specified and shown. Tighten connections in accordance with UL Standard 486A to assure permanent and effective grounding.
- E. Adjustments: Make all necessary adjustments to the equipment to provide complete and satisfactory operation upon completion of the Contract.
- F. Power Supplies: Provide an external power supply where required for panel integral air conditioners.

### 3.2 CLEANING AND PAINTING

- A. Shop Painting: Paint the shop-assembled equipment enclosures as specified in Section 09 96 00.
- B. Field Painting: Clean and touch up scratched and marred surfaces to match original finish.

END OF SECTION

## SECTION 26 05 73

### SHORT CIRCUIT, COORDINATION, AND ARC FLASH STUDY

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements outlining the parameters of the short circuit, coordination, and arc flash study being performed by the Engineer and the Contractor's responsibilities relating to furnishing of information, implementation of protective device settings.
- B. Related work specified in other sections includes, but is not limited to, the following:
  - 1. Section 26 08 00 - Electrical Testing Requirements
  - 2. Section 26 12 16 - Substation Medium-Voltage Transformers
  - 3. Section 26 12 00 - Pad-Mounted Transformers
  - 4. Section 26 13 00 - Medium Voltage Switchgear
  - 5. Section 26 23 00 - 480 Volt Switchgear
  - 6. Section 26 24 13 - 480 Volt Switchboards

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. IEEE 242, "IEEE Recommended Practices for Protection and Coordination of Industrial and Commercial Power Systems"
  - 2. IEEE 399, "IEEE Recommended Practices for Industrial and Commercial Power Systems Analysis"
  - 3. IEEE 1584 – "IEEE Guide for Arc Flash Hazard Calculations"
  - 4. NFPA 70 - National Electrical Code (NEC)
  - 5. NFPA 70E – Standard for Electrical Safety in the Workplace
  - 6. OSHA 29 CFR 1910 – "OSHA General Industry Book"

##### 1.3 SYSTEM DESCRIPTION

- A. Final Conditions: The software model used for the performance of the study will be developed based on the approved equipment data and shop drawings and final information of the cable lengths for this project.

B. Responsibilities:

1. Performance of the short circuit, coordination, and arc flash study for the distribution system will be the responsibility of the Engineer.
2. The Contractor will be responsible for providing the necessary data relating to electrical apparatus provided or otherwise modified under this Contract that is needed to build the model.
  - a. Provide to the Engineer the following data to complete the studies including:
    - (1) Final, approved shop drawings for all new equipment
    - (2) Cable sizes and lengths for each circuit installed under the scope of work.
3. The Engineer will provide the Contractor the recommended settings for overcurrent devices and protective relays.
4. The Contractor will implement all recommended adjustments and settings per the recommendations of the study
5. The Engineer will be responsible for furnishing required arc flash hazard warning labels based upon the outcome of the arc flash study and install arc flash hazard warning labels prior to equipment start-up and testing.
6. The Engineer will provide the recommended settings and arc flash hazard warning labels within 31 consecutive calendar days following receipt of complete data submittal.
7. Contractor is responsible to coordinate timing of submittal required under this Section to ensure recommended settings and arc flash hazard warning labels are received prior to start-up and testing.

1.4 SUBMITTALS

A. General: Furnish all submittals, including the following, as specified in Division 01.

1. Provide all the necessary data to the Engineer relating to electrical apparatus provided or otherwise modified under this Contract that is needed to build the study model.
2. Following Approved (or Approved Subject to Corrections Noted) status of all new equipment and raceway routing shop drawings, compile data necessary for input to the model into a single informational submittal.
  - a. Table indicating cable sizes and lengths.

b. List of where to find applicable information in approved submittals. Provide submittal number and page number for reference to required data. Required data is listed below.

- (1) Medium Voltage Switchgears
  - (a) Relays
  - (b) Circuit Breaker
  - (c) Fuses
  - (d) Bus Ratings
- (2) Low Voltage Switchgears
  - (a) Circuit Breakers
  - (b) Bus Ratings
- (3) Medium Voltage Motor Control Centers
  - (a) Relays
  - (b) Circuit Breakers
  - (c) Fuses
  - (d) Bus Ratings
- (4) Low Voltage Motor Control Centers
  - (a) Circuit Breakers
  - (b) Bus Ratings
- (5) Panelboards
  - (a) Circuit Breakers
  - (b) Bus Ratings
- (6) Transformers
  - (a) kVA
  - (b) Impedance (%Z)
- (7) Automatic Transfer Switches
  - (a) Device Ratings
- (8) Generators
  - (a) Power Factor
  - (b) kVA/kW
  - (c) Subtransient Impedance

- (9) Motors (Over 50HP)
  - (a) Subtransient Impedance
  - (b) Power Factor
  - (c) Efficiency
  - (d) Horsepower
- (10) Cables
  - (a) Sizes
  - (b) Lengths
  - (c) Sets
  - (d) Insulation Type

## PART 2 PRODUCTS

Not used

## PART 3 EXECUTION

### 3.1 PROTECTIVE DEVICE SETTINGS

- A. Receive from the Engineer a copy of the Coordination Study and implement all recommended settings for overcurrent devices and protective relays prior to equipment start-up and testing.

### 3.2 ARC FLASH HAZARD STUDY

- A. The Engineer will furnish arc flash hazard warning labels and install labels prior to equipment startup and testing.

END OF SECTION

SECTION 26 05 80  
ELECTRIC MOTORS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Requirements for electric motors as specified.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 09 96 00 – High Performance Coatings
  - 2. Section 26 05 00 - Basic Electrical Materials and Methods
  - 3. Section 26 05 33 - Electrical Raceway Systems
  - 4. Section 26 05 53 - Electrical Identification
  - 5. Section 26 35 33 - Power Factor Correcting Capacitors
  - 6. Section 26 05 26 - Grounding

1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. AFBMA 10 - Metal Balls
  - 2. NEMA CP1 - Shunt Capacitors
  - 3. NEMA MG1 - Motors and Generators
  - 4. NFPA 70 - National Electrical Code (NEC)

1.3 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01 and Section 26 05 00.
- B. Product Data and Information: Furnish manufacturer's catalog data for each motor.
- C. Shop Drawings: Furnish shop drawings for each motor detailing arrangement, wiring, conduit boxes, and motor application.
- D. Certificate of Compatibility: For each motor controlled by an adjustable frequency drive, furnish a certificate that the motor is compatible with the adjustable frequency drive and the driven equipment load.
- E. Quality Control: Furnish test reports for motors as follows:
  - 1. Certified standard commercial test reports for motors 5 hp through 200 hp.

2. Actual shop test reports for motors over 200 hp.
  3. Witnessed test reports as specified.
- F. Operations and Maintenance Manuals: Furnish operation and maintenance manuals for all motors as specified in Division 1.
- 1.4 QUALITY ASSURANCE
- A. Codes: Comply with all local and applicable codes.
  - B. Regulatory Requirements: Comply with the requirements of the Regulatory Agencies having jurisdiction over this Project.
- 1.5 DELIVERY, STORAGE AND HANDLING
- A. General: Deliver, store and handle all products and materials as specified in Division 01.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  1. General Electric Company
  2. Magnetek
  3. Baldor/ABB Group
  4. Siemens
  5. U.S. Motors
  6. TECO/Westinghouse Motor Company
  7. Hyundai Ideal Electric Co.
  8. Aegis/ElectroStatic Technology Inc. (Bearing Protection Ring)

### 2.2 MATERIALS

- A. General: Provide motors and accessories with the equipment as specified under the equipment sections.

- B. Motor Requirements: Unless otherwise specified, provide motors as follows:
1. Polyphase motors of the high energy efficiency and high power factor type.
  2. Motor nameplate horsepower as specified for the driven equipment.
  3. Motors that operate continuously over the entire load range of the driven equipment without loading motor in excess of nameplate rating and its specified temperature limit.
  4. For motors rated ½ hp to 200 hp operating at 460 volts, 3-phase, 60-hertz, provide squirrel cage induction type.
  5. For motors less than ½ hp, provide 115-volt, single phase, 60-hertz type.
  6. Motors that are suitable for continuous operation with a line voltage variation within ± 10-percent of rated voltage.
  7. Motors that operate continuously in a 40 degrees C ambient.
  8. Inverter duty motors when powered from an adjustable frequency drive.
  9. Provide a certificate of compatibility signed by both the motor and ground ring manufacturer confirming the ground ring being installed per the manufacturer's requirements with no detriment to proper motor operation.
- C. Frequent Start Requirements: Provide motors for frequent starting as specified.

## 2.3 MECHANICAL PROTECTION

- A. Indoor Locations:
1. For motors located in dry, clean and well-ventilated areas provide open drip-proof type.
- B. Outdoor Locations: For motors located outdoors, provide a totally-enclosed, fan-cooled type with removable drain plug.
- C. Submersible Locations: For motors that operate submerged or operation in a location for the potential to be submerged, provide a completely sealed submersible motor.

## 2.4 BOXES

- A. General: Provide oversized conduit boxes on motors to facilitate conductor installation and auxiliary components as required.
1. Provide separate boxes for motor power leads, accessory terminals and RTD leads.

2. Make conduit box NEMA enclosure ratings compatible with motor enclosures.
3. Where shown, provide additional space in the power terminal box for the mounting and wiring of the current transformers furnished under the motor protection system.

## 2.5 NEMA DESIGN AND INSULATION

- A. Design Classification: Provide NEMA Design B, unless otherwise specified with NEMA Class F moisture resistant insulation and NEMA Class B, 80 degrees C temperature rise at rated nameplate load.
- B. Variable Speed Operation: Provide insulation to protect against adverse effects of a nonsinusoidal waveform.

## 2.6 WINDINGS

- A. General: Provide copper windings unless otherwise specified.

## 2.7 BEARINGS

- A. Ball and Roller Bearings: Use antifriction ball or roller type bearings at manufacturer's option, unless otherwise specified.
- B. Regreasable Bearings: Use regreasable bearings with support side thrust loadings, with an AFBMA B-10 bearing life rated at least 100,000 hours, based on a reliability of 90 percent.

## 2.8 SERVICE FACTOR AND LOADINGS

- A. Service Factor: Provide 1.15 service factor for sinusoidal voltage waveforms and 1.0 for nonsinusoidal voltage waveforms unless otherwise specified. Where motors with a 1.0 service factor are furnished, provide motors rated at least 15 percent greater than required brake horsepower.
- B. Shaft Loading: Provide steady state shaft loading not to exceed 100 percent of full load rating under maximum load, excluding the service factor, unless otherwise specified.

## 2.9 SPEED

- A. General: Provide motor speed as specified or as shown for the driven equipment.
- B. Multispeed: Provide multispeed motors as specified for the driven equipment.

- C. Adjustable Speed: Provide inverter duty motors specifically designed and rated for use with the adjustable speed device furnished.

2.10 TORQUE

- A. General: Provide breakdown torque of 200 percent or more of motor full load torque.
- B. Locked Rotor: Provide locked rotor torque of 80 percent or more of motor full load torque.
- C. Inertia: Provide necessary WK<sup>2</sup> data for special loads to coordinate with motors.
- D. Special Motors: Supply special motors where torque requirements exceed standard design.

2.11 SLIDE RAILS AND SOLE PLATES

- A. General: Provide slide rails and sole plates as required for proper installation.

2.12 SINGLE PHASE FRACTIONAL HORSEPOWER MOTORS

- A. Small Motor Requirements: Provide capacitor or open split phase start, for smaller than 1/2 hp motors unless otherwise specified.

2.13 THREE-PHASE MOTORS

- A. Induction Motors: Provide horizontal or vertical squirrel cage induction motors for continuous duty with full voltage starting except as otherwise specified.

2.14 EFFICIENCY

- A. General: Provide motors one horsepower and larger meeting the requirements as stated in Table 12-12, Full Load Efficiency for NEMA Premium Efficiency Electric Motors, in NEMA MG 1, Part 12.

2.15 POWER FACTOR

- A. General: Provide motors having the following minimum power factor ratings:

Motor Power Factor - Minimum		
	Percent	
Horsepower	At 1800 RPM Power Factor	At 1200 RPM Power Factor
1	74.3	69.7
1-1/2	76.5	62.0
2	70.3	70.1

Motor Power Factor - Minimum		
Horsepower	Percent	
	At 1800 RPM Power Factor	At 1200 RPM Power Factor
3	79.9	73.7
5	83.8	75.8
7-1/2	82.4	78.2
10	85.0	76.4
15	85.0	81.1
20	84.6	81.9
25	84.5	82.0
30	84.2	82.5
40	84.2	83.3
50	85.0	84.9
60	86.8	85.7
75	86.6	86.0
100	88.3	86.4
125	89.3	85.8
150	88.5	87.5
200	88.5	87.9

- B. Power Factor Correction: Provide motors 75-hp and larger with capacitors to correct the no-load power factor to unity in accordance with Section 26 35 33. Do not provide capacitors for motors controlled by adjustable frequency drives or started by solid-state reduced voltage starters.

Provide capacitors in accordance with the latest NEMA CP-1.

#### 2.16 NOISE

- A. General: Limit motor machine noise to sound power levels listed in NEMA MG 1-12.

#### 2.17 ACCESSORIES

- A. Identification: Provide identification meeting the requirements with Section 26 05 53.
- B. Space Heaters: Where specified or shown, provide motor space heaters to prevent moisture condensation when the motor is not operating. Provide space heaters suitable for 115-volt, single phase, 60-hertz operation.
- C. Resistance Temperature Detectors (RTDs): Where specified or shown, provide motor bearing and winding RTDs of the 100-ohm platinum, three-wire type.

- D. Thermal Detectors: Where specified or shown, provide motor winding temperature switches or thermal devices.

## 2.18 SOURCE QUALITY CONTROL

- A. Shop Tests: Perform actual job motor shop tests for motors over 200 hp. Include standard commercial and additional tests listed below, and special tests listed in other sections.
- B. Standard Commercial Tests: Perform the following tests in accordance with NEMA standards.
  - 1. No load running current and speed
  - 2. Locked rotor current
  - 3. Dielectric routine tests
  - 4. Motor efficiency tests
  - 5. Motor power factor tests
- C. Additional Testing: Perform the following additional tests in accordance with NEMA standards.
  - 1. Winding resistance
  - 2. Bearing inspection
  - 3. Power factor at full, 3/4 and 1/2 load
  - 4. Efficiency at full, 3/4 and 1/2 load
  - 5. Motor starting torque
  - 6. Bearing currents testing per manufacturer's specifications
  - 7. Motor frame grounding

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install motors in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1. Make all necessary adjustments to equipment to provide a complete operational system.

- B. Install additional grounding connections where shaft grounding protection is applied.

### 3.2 FIELD QUALITY CONTROL

- A. Inspections and Tests: Perform field preliminary and final inspection and testing for motors as specified in Division 01 and as follows:

- 1. Preliminary Inspection:

- a. Demonstrate that each motor has been properly connected.
- b. Check for proper rotation by bumping prior to connecting motor to driven equipment.

- 2. Final Test:

- a. Measure motor applied voltage and current with equipment operating at full load.
- b. Operate equipment as specified.

### 3.3 CLEANING AND PAINTING

- A. Shop Painting: Paint the motors in accordance with the requirements of Section 09 96 00.
- B. Field Painting: Clean and touch up marred surfaces to match the original finish.

END OF SECTION

## SECTION 26 08 00

### ELECTRICAL TESTING REQUIREMENTS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for field acceptance testing of materials and equipment provided under various other sections to determine suitability for installation and energization. Requirements of field testing and certification of electrical equipment and materials provided under various other sections to assess their equivalence to UL Inc. listing/labeling.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 26 05 13 - Medium Voltage Cables
  - 2. Section 26 05 26 - Grounding
  - 3. Section 26 05 60 - Electrical Requirements for Shop-Assembled Equipment
  - 4. Section 26 13 00 - Medium Voltage Switchgear
  - 5. Section 26 22 00 - General Purpose Dry Type Transformers
  - 6. Section 26 24 16 - Panelboards
  - 7. Section 26 29 23 - Adjustable Frequency Drives
  - 8. Section 26 12 16 - Medium Voltage Transformers
  - 9. Section 26 05 19 - Wires and Cables – 600V and Below
  - 10. Section 26 23 00 - 480 Volt Switchgear

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ANSI/NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
  - 2. ANSI/NETA MTS - Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems
  - 3. NIST - National Institute of Standards and Technology

##### 1.3 SUBMITTALS

- A. General: Furnish all submittals including the following, as specified in Division 01 and Section 26 05 00.
  - 1. Acceptance Testing Reports: Furnish acceptance testing reports for all equipment and materials. Include the following information:

- a. Summary of the test
  - b. Description of material or equipment tested
  - c. Description of test including acceptable test values
  - d. Test results
  - e. Analysis of test results with recommendations
2. UL Testing: Furnish standard test parameters in accordance with the acceptable codes and standards for all the equipment and materials tested for equivalence to UL listing.
  3. UL Test Reports and Certificates: Submit for approval test reports and certificates for all equipment and materials tested for equivalence to UL listing.

## PART 2 PRODUCTS

### 2.1 TESTING COMPANIES

- A. Acceptable Testing Companies: Acceptable testing companies are as listed below:
  1. MET Electrical Testing Co. Inc.
  2. ASET Power Systems Services Inc.
  3. Electric Power Systems Inc.
  4. Electro-Test and Maintenance Inc.
  5. High Voltage Maintenance Corp.
  6. UL Underwriters Laboratories Inc.
  7. Other OSHA and NETA approved testing facilities

### 2.2 SOURCE QUALITY CONTROL

- A. Tests: Furnish all testing and certification in accordance with the latest NETA, ANSI, IEEE and NEMA Standards to meet the UL requirements, NFPA Standards and NEC.
- B. Test Equipment: Furnish all testing equipment, cables and appurtenances required to perform all tests and certifications in accordance with the following:
  1. Use instruments that have been calibrated, to assure that they are within rated accuracy in accordance with NIST.

2. Select test instruments that are appropriate for the variable being measured.

### PART 3 EXECUTION

#### 3.1 UL TESTING AND CERTIFICATION

- A. General: Furnish the test reports and certifications for UL equivalence prior to acceptance of all materials and equipment requiring such tests and certifications.

#### 3.2 ACCEPTANCE TESTING

- A. General: Furnish acceptance test reports prior to acceptance of all materials, equipment and installations requiring such tests.

END OF SECTION

(NO TEXT ON THIS PAGE)

## SECTION 26 09 13

### ELECTRICAL MONITORING SYSTEM

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing and installing a electrical monitoring system that interfaces with the plant SCADA ethernet system as specified and shown. The system consists of installing all intercommunication wiring, programming, remote monitoring and protecting devices, ethernet bridge and startup services.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 01 79 00 - Training
  - 2. Section 26 13 00 - Medium Voltage Switchgear
  - 3. Section 26 23 00 - 480 Volt Switchgears
  - 4. Section 26 24 16 - Panelboards
  - 5. Section 26 14 00 - Medium Voltage Motor Controllers
  - 6. Section 26 33 00 - Battery Systems
  - 7. Section 26 32 13 - Packaged Engine Generator Systems
  - 8. Section 26 05 00 - Basic Electrical Materials and Methods
  - 9. Section 26 12 16 - Medium Voltage Transformers
  - 10. Section 26 05 19 - Wire and Cable - 600 Volts and Below

##### 1.2 SYSTEM DESCRIPTION DESIGN REQUIREMENTS:

- A. Were required, provide systems consisting of bridges to translate communications received from electrical equipment into ethernet compatible communications. This equipment includes but is not limited to the following:
  - 1. 480 Volt Switchgears
  - 2. Battery Systems
  - 3. Generator Systems
  - 4. Medium Voltage Motor Controllers
  - 5. Medium Voltage Switchgears
  - 6. Panelboards
  - 7. Transformers

##### 1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 01 and Section 26 05 00.

- B. Product Data and Information: Provide catalog data for all associated equipment and devices.
- C. Shop Drawings: Provide shop drawings customized for the project to include the following:
  - 1. Drawings showing dimensions, arrangement, elevations, identification of components.
  - 2. Bill of materials including manufacturer's name and catalog number.
  - 3. System description including an overview of the system provided with detailed description of system architecture. A customized system diagram showing location of all gateways and assemblies/devices to be connected to the system and types of wiring required.
  - 4. Interconnecting wiring diagrams
  - 5. Ethernet bridge system addresses, memory map and instruction booklets.
- D. Operation and Maintenance Manuals: Provide operation and maintenance manuals as specified in Division 1.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, and handle all products and materials as specified in Division 01.
- B. Storage and Protection: Store all equipment and materials in a dry, covered, heated and ventilated location. Provide any additional measures in accordance with manufacturer's instructions.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Ethernet Bridge
    - a. Eaton/Cutler-Hammer
    - b. General Electric Company
    - c. Allen Bradley

## 2.2 ETHERNET BRIDGE

- A. Enclosure: Provide rigid, NEMA 12, gasketed enclosure.
- B. Description of Operation: The ethernet bridge provides the necessary modules to translate status and/or control information from microprocessor based metering systems, microprocessor based overload protection, microprocessor based protective relays and internal solid state control logic located in various items assembled equipment such as motor control centers, adjustable frequency drives and switchgears into an Ethernet compatible signal.

## 2.3 SOURCE QUALITY CONTROL

- A. Tests: Shop test each bridge in accordance with IEEE standards.
  - 1. Operational Tests: After the equipment has been completely assembled, perform operational tests to determine the general operating conditions and circuit continuity.
- B. Device Address: Factory set the address of each device.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install the ethernet bridge adjacent to the RTU panel in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 01.

### 3.2 OPERATION DEMONSTRATION

Manufacturer's Service Representative: Provide the services of a qualified factory-trained service engineer to assist in installation, start-up, field testing, calibration, placing into operation and provide training, as specified in Section 01 79 00.

- 1. Provide service engineer when the equipment is placed into operation.
- 2. Provide service engineer at job site as often as necessary until all problems are corrected and the equipment installation and operation are satisfactory.
- 3. Following completion of installation and field testing provide training for 12 employees of the OWNER in the proper operation, troubleshooting and maintenance of the equipment as outlined below. All training will be at the OWNER'S facilities at a time agreeable to the OWNER:
  - a. Operational Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.

- b. Maintenance Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.
- B. Provide a service engineer at the job site as often as necessary to assist in the programming of the SCADA system in accessing the memory map of each device.
- C. Operation and Maintenance: Provide operation and maintenance instructions as specified in Division 01.

END OF SECTION

## SECTION 26 11 13

### MEDIUM-VOLTAGE TRANSFORMERS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing and testing substation transformers complete and ready for operation, including all accessories and appurtenances with shop and field tests necessary for a complete installation.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 09 96 00 - High Performance Coatings
  - 2. Section 26 05 00 - Basic Electrical Materials and Methods
  - 3. Section 26 05 26 - Grounding
  - 4. Section 26 05 53 - Electrical Identification
  - 5. Section 26 08 00 - Electrical Testing Requirements
  - 6. Section 26 23 00 - 480 Volt Switchgear

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. IEEE C57.12.00 - General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformer
  - 2. IEEE C57.12.91 - Test Code for Dry-Type Distribution and Power Transformers
  - 3. NFPA 70 - National Electrical Code (NEC)
  - 4. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors
  - 5. IEEE C57.12.01 - General Requirements for Distribution, Power and Regulating Transformers
  - 6. ANSI C57.12.28 - Switchgear and Transformers, Pad-Mounted Equipment - Enclosure Integrity
  - 7. ANSI C57.12.50 - Requirements for Ventilated Dry-Type Distribution Transformers, 1-500 kVA Single-Phase and 15-500 kVA Three-Phase, with High Voltage 601-34,500 Volts, Low Voltage 120-600 Volts

8. ANSI C57.12.51 - Requirements for Ventilated Dry-Type Power Transformers, 501 kVA and Larger Three-Phase, with High Voltage 601-34,500 Volts, Low Voltage 208Y/120-4160 Volts
9. ANSI C57.12.55 - Conformance Standard for Transformers - Dry-Type Transformers Used in Unit Installations, Including Unit Substations
10. IEEE C57.12.56 - Standard Test Procedure for Thermal Evaluation of Insulation Systems for Ventilated Dry-Type Power and Distribution Transformers
11. IEEE C57.12.58 - Guide for Conducting a Transient Voltage Analysis of a Dry-Type Transformer Coil
12. IEEE C57.12.59 - Guide for Dry-Type Transformer Through-Fault Current Duration
13. IEEE C57.12.70 - Terminal Markings and Connections for Distribution and Power Transformers
14. IEEE C57.12.80 - Standard Terminology for Power and Distribution Transformers
15. IEEE C57.12.91 - Standard Test Code for Dry-Type Distribution and Power Transformers,
16. IEEE C57.94 - Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type General Purpose Distribution and Power Transformers
17. IEEE C57.96 - Guide for Loading Dry-Type Distribution and Power Transformers (ANSI).
18. IEEE C57.105 - Guide for Application of Transformer Connections in Three-Phase Distribution Systems
19. IEEE C57.124 - Recommended Practice for the Detection of Partial Discharges and the Measurement of Apparent Charge in Dry-Type Transformers
20. UL 1562 - Transformers, Distribution, Dry-Type - Over 600 Volts
21. DOE 2016 - DOE 10 CFR Part 431 Efficiency Standards; published in the Federal Register on April 18, 2013
22. Natural Resources Canada, Canada Energy Efficiency Act, Energy Efficiency

- 23. NEMA 210 - Secondary Unit Substations
- 24. NEMA ST 20 - Dry-Type Transformers for General Applications

1.3 SYSTEM DESCRIPTION

A. General: Provide substation transformers made up of factory-built standardized units, dry type, self-cooled, completely dead front, totally enclosed and freestanding, with side wall mounted primary and secondary terminations, including accessories, controls and metering with auxiliary compartments and interconnections as shown.

B. Rating: Provide Transformers with the following ratings:

- 1. Primary Voltage 4.16 kV
- 2. Primary Connection Delta
- 3. Secondary Voltage 480/277 volts
- 4. Secondary Connection Wye 4 wire (with insulated ground)
- 5. Insulation Class 155°C or higher
- 6. kVA 1,000/1,333 kVA OA/FA
- 7. BIL 60 kV
- 8. Impedance 5.75 ± 7-1/2 percent
- 9. Phase(s) 3
- 10. Hertz 60

1.4 SUBMITTALS

A. General: Furnish all submittals including the following, as specified in Division 01 and Section 26 05 00.

B. CONTRACTOR's Drawings: Furnish working drawings customized for the project transformers including the following:

- 1. Manufacturer's data showing service voltages, number of phases, kVA ratings, inrush factor, voltage taps, temperature rise, BIL, weight, support points and standard accessories.
- 2. Layout drawings showing accurately scaled basic equipment sections and openings for cable and conduit. Include plan and front views.
- 3. Interconnection diagrams with equipment external to the transformer clearly shown.
- 4. Wiring diagrams showing voltage taps and high and low voltage connections.
- 5. Bill of Materials.
- 6. Catalog data for all accessories and appurtenances.

7. Shop test procedures complete with instrument calibration data.
  8. Spare parts list.
- C. Operation and Maintenance: Furnish transformer operation and maintenance manuals as specified in Division 1.
- D. Source Quality Control: Furnish the following:
1. Manufacturers certificates for insulation rating, temperature rise, impedance and high potential tests of the primary and secondary connections.
  2. Certified copies of the factory and shop test results.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 and as follows:
- B. Packing: Suitable pack all structures and equipment to be rigidly braced and protected against weather, damage and undue strain during shipment.

#### 1.6 SPARE PARTS

- A. General: Furnish the following spare parts:
1. Any other parts or material that may be necessary for the proper maintenance and operation of the transformers.
  2. Three 12-ounce spray cans of the final finish for touch-up
- B. Special Tools: Provide a set of special wrenches as required for each transformer.
- C. Packaging: Plainly tag and mark spare parts for identification and reordering. Properly box and wrap spare parts to prevent deterioration. Completely identify the contents of the box on the outside with suitable labels.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
1. Substation Transformer
    - a. Hammond Power Solutions

- b. Eaton's Cooper Power Systems
- c. ABB Power T&D Company Inc.
- d. Square D /Schneider Electric

## 2.2 SUBSTATION TRANSFORMER

- A. General: Provide transformers and accessories and appurtenances designed, assembled and tested in accordance with applicable IEEE, ANSI and NEMA standards. Provide all electrical equipment suitable for operation at their standard nameplate ratings in accordance with applicable IEEE and ANSI standards.
- B. Provide suitable structural base members to permit plumb and level installation of the substation transformer on its concrete pad.

## 2.3 CAST COIL TYPE DRY TRANSFORMER

- A. General: Provide the transformer with top mounted primary and secondary terminations.
- B. Construction: Provide transformers of a solid-cast, dry-type, mounted in a suitable, ventilated indoor enclosure.
- C. Temperature Rise: Provide average temperature rise of the transformer windings not to exceed 80 degrees C when the transformer is operated at full nameplate rating. Furnish a transformer capable of carrying 100 percent of nameplate kVA rating in a 40 degrees maximum, 30 degrees C average ambient as defined by IEEE C57.12.01.
- D. Taps: Provide two 2-1/2 percent full-capacity above normal and two 2-1/2 percent full-capacity below normal primary taps.
- E. Windings: Provide copper conductors for both the high voltage (HV) and low voltage (LV) windings. Separately cast each HV and LV windings as one rigid tubular coil, arranged coaxially. Fully reinforce each coil with glass cloth and cast under vacuum to provide complete, void-free resin impregnation throughout the entire insulation system. Reinforcement with suspended particulate matter (filled-resin) is not acceptable. Support coils by cast epoxy bottom supports and space blocks and spring loaded top blocks in order to absorb thermal expansion and contraction of the coils. Rigid mechanical connection between HV and LV coils will not be accepted.
- F. Windings Absorption and Storage: Provide windings to not absorb moisture, and suitable for both storage and operation in adverse environments, including prolonged storage in 100 percent humidity at temperature from -40 degrees C to +40 degrees C. Provide the transformer that are capable of immediately being switched on after such storage periods without requiring predrying.
- G. Ventilation: Provide all ventilating openings in accordance with NEMA and NEC standards for ventilated enclosures.

- H. Enclosure Base: Provide transformer base that permits rolling or skidding in any direction, and equip with jacking pads designed to be flush with the transformer enclosure.
- I. Forced Air Cooling: Include provisions for future fan cooling system automatically controlled by sensors placed in the LV air ducts to increase the transformer capacity by 33 percent. Provide cooling system that consists of fans, control wiring, controller with test switch, current limiting fuses, indication lights, alarm silencing relay, and necessary push buttons to properly control the system. Derive the power for the fan cooling system from a 240 volt, single phase control power transformer located in the primary termination compartment.
- J. Monitoring: Provide High temperature alarm thermostats in each phase, with normally-open contacts, wired in series and connected to the plant SCADA system. Alarm setpoint shall be 130 degrees C.
- K. Sound Level: Not exceeding the allowable values in NEMA ST 20.
- L. Testing: Conduct the following tests in accordance with IEEE C57.12.91:
  - 1. Ratio
  - 2. Polarity
  - 3. No-Load Loss
  - 4. Excitation Current
  - 5. Impedance
  - 6. Full Load Loss
  - 7. Applied Potential
  - 8. Induced Potential

## 2.4 WIRING

- A. General: Provide completely assembled transformers, wired, and tested at the factory, including buses, connections, insulators, cleats, terminals, and terminal blocks. Insulate all current carrying parts. Run all low voltage wiring in high voltage compartments in conduit or in metal wiring troughs. Provide terminal blocks with approved covers and mounted so that the wires to them can be grouped and laced together in a neat and workmanlike manner. Provide cup washers for wires No. 12 and smaller and solderless lugs for larger sizes. Provide a sufficient number of terminal connections, including 15 percent of spare terminals, for all control and instrument wiring. Provide No. 14 AWG stranded copper or larger, insulated with NEC Type SIS for 600 volts for all low voltage wiring.
- B. Multi-Voltage Primary Tap Connections: Where specified to be provided, confirm that the factory installed conductors used for internal winding connections are sized for the voltage shown to be used initially on the Contract Drawings.

## 2.5 TEMPERATURE RISE

- A. General: Do not exceed the temperature rise of switching devices within the enclosure as permitted by the standards for such devices and measured over the average ambient. Provide temperature rise of buses and connections not exceeding 35 degrees C over the average air temperature inside the enclosure.

## 2.6 IDENTIFICATION

- A. General: Provide the substation transformer with a nameplate identifying the circuit or unit controlled. Identify all switches, meters, instruments, and other features as specified in Section 26 05 53.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Arrange the transformer equipment as shown, and suitable for installation in the spaces as shown without appreciable revision to other equipment, foundation arrangements and structures.
- B. Conformance: Install transformer assembly as indicated, in accordance with manufacturer's written instructions and with recognized industry practices; comply with NEMA Standards, NEC, applicable ANSI Publications and local codes.
- C. Coordination: Coordinate with other work including cabling/wiring work to interface installation of transformer assembly.
- D. Torque Requirements: Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening requirements for equipment connectors. Where manufacturers' torquing requirements are not included, tighten connectors and terminals in accordance with UL Standard 486A.
- E. Grounding Connections: Make equipment grounding connections for the transformers and appurtenances. Tighten connections in accordance with UL Standard 486A for permanent and effective grounding.
- F. Adjustments: Make all necessary adjustments to the equipment to provide complete and satisfactory operation upon completion of the Contract.
- G. Neutral Connections: Make suitable provisions for connections to the neutral cables from the transformer secondary and to the ground cables from the grounding system.

### 3.2 FACTORY TESTING

- A. The following factory tests shall be performed on each transformer provided under this section. All tests shall be in accordance with the latest version of ANSI, NEMA and IEEE standards including IEEE C57.12.90:
1. Polarity
  2. Resistance measurements of all windings on the rated voltage connection of each unit and at the tap extremes
  3. Ratio tests on the rated voltage connection and on all tap connections
  4. Polarity and phase-relation tests on the rated voltage connections
  5. No-load loss at rated voltage on the rated voltage connection
  6. Exciting current at rated voltage on the rated voltage connection
  7. Impedance and full load loss at rated current on the rated voltage connection of each unit and on the tap extremes
  8. Applied potential test
  9. Induced potential tests
  10. Full wave and reduced wave impulse tests
  11. Temperature test(s) shall be made on all units.
  12. Final inspections and quality checks
- B. In addition, the manufacturer shall provide certification for all design and other tests listed in C57.12.00, including verification that the design has passed short circuit criteria per ANSI C57.12.00 and C57.12.90.
- C. The manufacturer shall provide three (3) certified copies of factory test reports.
- D. Factory tests as outlined above shall be witnessed by the Owner's representative:
1. The Contractor shall notify the Owner's representative two (2) weeks prior to the date the tests are to be performed.
  2. The Contractor shall be responsible for all associated costs including but, not limited to all transportation, lodging, meals and miscellaneous expenses for three Owner representatives.

### 3.3 FIELD QUALITY CONTROL

- A. **Manufacturer's Representative:** Provide a factory-trained, authorized representative of the manufacturer as specified in Division 1. Provide all instruments necessary to conduct required tests and adjustments. Have the manufacturer's representative utilize prepared comprehensive check sheets covering inspections, checks and tests required for the assembly of the product. Submit copies of these documents executed and signed by the manufacturer's representative. Have the representative present when the equipment is placed in operation. Provide representative service as often as necessary until all problems are corrected and the equipment is installed and operating satisfactorily.
- B. **Certified Report:** Furnish a written report certifying that the equipment (1) has been properly installed, (2) is in accurate alignment, (3) is free from any undue stress imposed by connecting piping or anchor bolts, and (4) has been operated under full load conditions and that it operated satisfactorily.
- C. **Testing:** Furnish an AC or DC 5-minute high potential test applied after the installation is complete for all substation equipment. Provide test voltages in accordance with the IEEE and NEMA Standards for the voltage class of equipment and components to be tested. Provide tests for all bus, cable, wire, switches, breakers, transformer, and control devices.
- D. **Test dielectric inhibited oil to ASTM D 877, using 25,000 minimum breakdown voltage, after installation and before energization from system.**

### 3.4 CLEANING AND PAINTING

- A. **Shop Painting:** Paint the substation transformers as specified in Section 09 96 00.
- B. **Field Painting:** Touch-up scratched and marred surfaces to meet the requirements of Section 09 90 00.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 26 13 00

### MEDIUM VOLTAGE SWITCHGEAR

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing 5 kV class, metal-clad, indoor switchgear as indicated, in accordance with the Contract Documents.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 01 79 00 - Training
  - 2. Section 09 96 00 - High Performance Coatings
  - 3. Section 26 05 00 - Basic Electrical Materials and Methods
  - 4. Section 26 05 26 - Grounding
  - 5. Section 26 05 53 - Electrical Identification
  - 6. Section 26 08 00 - Electrical Testing Requirements
  - 7. Section 26 05 73 - Short Circuit and Coordination Study
  - 8. Section 26 05 13 - Medium Voltage Cables
  - 9. Section 26 05 33 - Electrical Raceway Systems
  - 10. Section 26 05 43 - Underground Electrical Distribution System
  - 11. Section 26 05 10 - Utility Coordination and Requirements
  - 12. Section 26 33 00 - Battery Systems
  - 13. Section 26 09 13 - Electrical Monitoring System
  - 14. Section 26 29 53 - Control Components and Devices

##### 1.2 REFERENCES

- A. General: Codes and standards referred to in this Section are:
  - 1. IEEE C37.90 - IEEE Standard Surge Withstand Capabilities Tests for Relays and Relay Systems Associated with Electric Power Apparatus
  - 2. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors
  - 3. CSA C22.2 #31 - Switchgear Assemblies
- B. Material and Installation Workmanship Requirements: Provide all materials and workmanship meeting the requirements of NFPA standards and codes.

- C. Design and Testing Requirements: Provide all switchgear components designed, manufactured and tested in accordance with the latest NEMA, IEEE and ANSI standards; and be UL or CSA listed.
- D. Installation Requirements: Install the switchgear assemblies meeting the requirements of NEC and local Electrical Codes.

### 1.3 SUBMITTALS

- A. General: Provide all submittals customized for the project, including the following, as specified in Division 01 and Section 26 05 00.
- B. Product Data and Information: Provide manufacturer's catalog data and bill of material for the switchgear assemblies, identifying major components and accessories of the system. Provide rating data, type, model, service voltages, number of phases, current ratings, interrupting capacities as well as function and sequence of operation of the control, protection and sensing equipment.
- C. Provide manufacturers' one line diagrams schematic control diagrams and interconnection diagrams with terminals for connection to equipment external to the switchgear assemblies.
- D. Shop Drawings:
  - 1. Provide manufacturers' layout drawings of the switchgear assemblies showing accurately scaled stationary structures and the basic equipment sections in Plan View, Elevations and Sections.
  - 2. Provide manufacturers' wiring diagrams for switchgear assemblies showing the space allocated for connections to incoming power feeders and outgoing distribution feeders. Clearly indicate the portion of wiring and cabling to be manufacturer installed and the portions to be field installed.
  - 3. Provide instruction booklets and time-current curves for each protective relay supplied.
  - 4. Provide microprocessor-based metering system and overload protection systems address, memory map and instruction booklets.

### 1.4 QUALITY CONTROL

- A. Test Reports: Provide the manufacturer's certified shop test report for the switchgear.

### 1.5 OPERATIONS AND MAINTENANCE MANUALS

- A. General: Provide operation and maintenance manuals including spare parts list for the switchgear assembly as specified in Division 01.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 and Section 26 05 00 (and as follows:)
- B. Storage and Protection: Store all equipment and materials in a dry, covered, heated and ventilated location. Provide any additional measures in accordance with manufacturer's instructions.

## 1.7 SPARE PARTS

- A. General: Provide the following spare parts:
  - 1. All parts recommended by the manufacturer in published literature as spare parts. As a minimum, provide the following:
    - a. Six replacement lenses for each color of indicating lights
    - b. Three current transformers of each type and rating
    - c. Two potential transformers of each type and rating
    - d. Twelve potential transformer primary fuses
    - e. Twelve potential transformer secondary fuses
    - f. One microprocessor three-phase protective relay of each type furnished.
    - g. One ANSI 86 relay
    - h. One ANSI 87 relay complete in a protective case of each style furnished
    - i. One circuit breaker control switch
    - j. One ammeter switch
    - k. One voltmeter switch
    - l. Twelve dc control power fuses for each size required
    - m. One transfer truck with arrangement for lifting and removing circuit breakers from the switchgear
    - n. Three manual circuit breaker closing devices
    - o. Two pairs of fuse tongs for potential fuses

- p. Two sets of control jumpers
  - q. One test cabinet complete with secondary disconnecting contacts, control relay, breaker control station
  - r. One neon tube test stick with neon tubes and ground cable and clamp
  - s. One ground test device as specified herein
  - t. One hand crank for breaker withdrawal and insertion
  - u. Three 12-ounce spray cans of the final finish for touch-up
- B. Packaging: Pack spare parts in containers bearing labels clearly indicating contents and related pieces of equipment. Deliver spare parts in original factory packages. Identify all spare parts with information needed for reordering.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
- 1. Medium Voltage Switchgear
    - a. Eaton/Cutler-Hammer Type Vac Clad-W
    - b. Square D/Schneider Electric Type Masterclad
    - c. ABB Type Advance
  - 2. Protective Relays
    - a. Schweitzer Engineering Laboratories
    - b. GE Grid Solutions/Multilin
    - c. ABB Power T&D Company Inc.
    - d. Basler
  - 3. Microprocessor Based Protective Relays and Metering Systems
    - a. Eaton/Cutler-Hammer IQ DP-4000
    - b. Square D/Schneider Electric Powerlogic
    - c. GE Grid Solutions/ Multilin
  - 4. Power Transducers
    - a. Ametek Power Instruments/Scientific Columbus Type Exceltronic
    - b. Ametek Power Instruments/Rochester Instrument Systems

## 2.2 ELECTRICAL CONDITIONS

### A. Design

1. Provide all components required for complete functioning units as specified and as shown using factory built standardized type, completely dead front, totally enclosed and freestanding units. Each unit comprises a stationary structure and a removable element.
2. Design, manufacture, and test in accordance with the latest NEMA, IEEE and ANSI Standards.
3. Furnish the required number of units to provide the necessary controls and metering as shown and specified.

B. Distribution System: The switchgear will be connected to a 4160-volt, 3-phase, 60-hertz, 3-wire, solidly grounded power system.

## 2.3 COMPONENTS

### A. Stationary Structure: Fabricate the stationary structure of the switchgear as follows:

1. Fabricate the unit out of welded structural steel members, together with formed or fitted sections of smooth 11-gauge sheet steel for front and rear hinged panels. Fabricate side panels from a minimum of smooth 13-gauge sheet steel.
2. Dimensions: Approximately 26h inches wide, 96 inches deep, and 95 inches high.
3. Form completely enclosed compartments for various combinations of vacuum circuit breaker and auxiliary equipment.
4. Provide sufficient structural strength supporting all the equipment mounted within, withstand the handling and shipment of the units, maintaining the proper alignment, and be rigid and freestanding.
5. Provide a formed front door panel for each compartment consisting of concealed type hinges or pins and two or three point latch with cylinder locks with common keying. Furnish four keys.
6. Provide bolted covers for rear access to cable terminals.
7. Reinforce panels as required to retain alignment and to support instruments, relays, and control equipment mounted thereon.
8. Provide removable plates to permit access to all compartments individually.

9. Isolate circuit breaker, buses, instrument transformers and incoming or outgoing cables with separate compartments formed by sheet steel barriers.
10. Seal all openings in the barriers between compartments.
11. Provide suitable ventilation for the individual compartments to keep the temperature of devices and buses within the permissible temperature limits as specified by the Standards.
12. The stationary structure includes the insulated buses, the fixed portion of primary disconnect devices, insulated connections, instrument transformers, control devices and fuses.
13. Provide grounded automatic safety shutters to close the high voltage openings when the circuit breaker is moved to the disconnected position.
14. Furnish a positioning mechanism for moving the removable circuit breaker to or from the connected position.
15. Install guides for proper alignment of all engaging parts during movement of the circuit breaker between the connected or disconnected position.
16. Insulate and isolate the control equipment and wiring from primary conductors and devices.
17. Design the stationary structure and circuit breakers to be interchangeable with every other circuit breaker of the same rating.
18. Extend the dc control wiring across all units of the switchgear.
19. Fully isolate the main bus compartment from the breaker compartment and from the compartment enclosing instrument transformers, cable terminations, and accessories.
20. Provide main buses rated not less than 1200 amperes rms consisting of rigidly supported insulated copper bars of suitable design and cross-sectional area to satisfactorily carry the rated current without exceeding the temperature rise as specified in the IEEE and NEMA standards.
21. Base current-carrying capacity of the bus on the actual service conditions, including skin and proximity effect, insulation, steel enclosure, and ambient temperature of 40 degrees C.
22. Insulate the bus using a flame-retardant, track-resistant fluidized bed epoxy material, designed for 5 kV service, over the entire length and able to withstand the ANSI 60-hertz standard production test voltage of 19 kV and

impulse test of 60 kV. Install the epoxy insulation with a high resistance conducting surface in contact with the bus to give a void free system to eliminate corona damage to the bus insulations.

23. Connect the bus with suitable bus clamps or bolts with lock washers.
24. Silver plate the copper bars at current-carrying connections.
25. Insulate all standard bus joints with preformed insulating boots secured by nylon hardware. Insulate nonstandard joints with tape and insulating compound.
26. Equip each switchgear unit with a 1/4-inch by 2-inch bare copper ground bus with a momentary rating at least equal to the highest momentary rating of the circuit breaker. Extend the ground bus the entire length of the structure and comply with all applicable codes and regulations.
27. Ground each stationary unit directly to the ground bus.
28. Provide suitable lug terminals on the ground bus for connections to the station grounding system.
29. Construct and arrange the stationary structure so that circuit breakers, main buses, instrument transformers, and control are completely isolated from each other within the same section and that sections are isolated from adjoining sections.
30. Furnish steel floor channels suitable for embedding into the concrete floor for leveling and anchoring the switchgear. Drill and tap the floor channels as required. Provide bolts, nuts, and washers for anchoring the switchgear to the channel.
31. Provide key interlocks where noted on the Contract Drawings. Where multiply lineups of like equipment are provided, interlock keys are to be keyed unique to each lineup. Where multiple interlock functions are to be provided in a common lineup, the interlock keys for each function are to be uniquely keyed.
32. Provide viewing windows for infrared inspection of terminations and bus connections without removal of covers. Coordinate window size and placement with internal components to be imaged and obstacles such as barriers.

B. Switchgear Enclosure:

1. Design the switchgear for installation indoors.

- C. Removable Element: Design the removable element as follows.
1. Horizontal-drawout type designed for use with metal-clad switchgear.
  2. Manufactured by the switchgear manufacturer.
  3. Vacuum break type circuit breaker complete with operating mechanism, removable portion of primary and secondary disconnecting devices, mechanical interlocks and local control wiring.
  4. Install control wiring in conduit or other suitable enclosure.
  5. Design circuit breakers to be freestanding when removed with suitable casters or wheels for moving.
  6. Isolate circuit breakers from all other primary equipment.
  7. Arrange circuit breakers so that they may be completely disconnected from the line and bus for test and inspection.
  8. Equip the circuit breaker assembly with mechanical interlocks to prevent moving the circuit breaker in the stationary structure without tripping open.
  9. Arrange the circuit breaker so it is not possible to close it either electrically or manually when the circuit breaker is at any point between the operating and the test position, or while the interlock is engaged.
  10. Isolate the breaker by moving it to the disconnected position.
  11. Allow the breaker to be removed from the structure.
  12. Provide provisions for padlocking the circuit breaker in the open, disconnect or test position.
  13. Manufacture the removable element in jigs which will accurately locate the contacts, holding devices and interlocks. Use similar jigs in the construction of the stationary structure. Check each removable element for complete interchangeability.
  14. Provide self-aligning female and male multicontact devices for the control connections between the stationary equipment and the removable breaker.
  15. Furnish a polarized plug and receptacle on a control cable to permit test operation of the breaker when in the disconnected position, unless the switchgear design provides a test position which permits the breaker to be operated with the primary disconnecting contacts open and the secondary contacts in the normal position.

16. Provide cell switches to allow testing of the breaker in the test position without affecting or tripping any other breaker.
17. Design the removable element to operate with a test cabinet specified hereinafter.

D. Power Circuit Breakers: Provide power circuit breakers as follows:

1. Rate at 1200 amperes symmetrical continuous, at 4.76 rms kV.
2. Provide a 3-phase interrupting rating of 40 kA at a nominal 4.16 kV on a standard Close-Open 15-second Close-Open duty cycle.
3. Provide an interrupting time not to exceed 5 cycles on a 60-cycle basis for all values of fault interrupting currents.
4. Provide breaker contacts composed of silver-to-silver or equivalent.
5. Provide circuit breakers that are capable of carrying the rated full load current continuously without exceeding the temperature rise, as specified in the latest IEEE and ANSI standards.
6. Provide circuit breakers that successfully withstand the 60-hertz production test voltage of 19 kV, and an impulse test voltage of 60 kV.
7. Coordinate circuit breaker insulation with the switchgear insulation, suitable for service on a nominal 5 kV system.
8. Provide each breaker with a mechanically and electrically trip-free stored energy operating mechanism, pump-free control relay, operation counter, trip coil, position indicator, and multistage auxiliary switch with three sets of spare normally-open and normally-closed contacts.
9. Closing Voltage: 100 to 140 volts on 125-volt dc system
10. Tripping Voltage: 70 to 140 volts on a 125-volt dc system
11. Arrange each breaker to allow manual operation for maintenance purposes only.

E. Switchgear Insulation Classes and Dielectric Test:

1. Provide the switchgear equipment that conforms to the 5 kV insulation class.
2. After assembly, subject the equipment and the secondary and control wiring to demonstrate the capability of withstanding the ac high potential tests as

specified by the IEEE and NEMA standards for the specific system insulation classes.

F. Mechanical and Thermal Limits:

1. Provide equipment capable of withstanding mechanically and thermally short circuit currents equivalent to the corresponding interrupting ratings of the breakers.

G. Switchgear Connections and Terminals:

1. Construct all current-carrying connections to the main buses of copper with suitable capacity and conform to the requirements of the main bus insofar as bracing, insulation, temperature limits and the like are concerned.
2. Connect current transformers in such a way that the transformers may be removed and changed without damaging the connection.
3. Use flexible cable insulated for 5 kV service for potential transformer leads.

H. Instrument Transformers:

1. Current Transformers

- a. Dry type current transformers, designed for indoor service in metal-clad switchgear, and rated as shown.
- b. Provide sufficient thermal and mechanical capacity to withstand the maximum momentary current rating of the circuit breaker.
- c. Use solderless clamp type shorting terminal blocks for secondary connections.
- d. Properly identify the polarity of all current transformers with standard marking symbols.
- e. Use window-type current transformers for ground-sensing where shown.
- f. Provide the accuracy of current transformers suitable for the instruments and meters specified using the normal burdens of the various devices, and not less than ANSI Standard requirements.

2. Potential Transformers

- a. A dry type, suitable for indoor service in metal-clad switchgear, single-phase, 60-hertz, 120 volts.

- b. Provide potential transformers that fit into and coordinate with the complete switchgear units, and with the instruments, relays, meters, and devices specified.
- c. Rate the potential transformers not less than 150-volt-amp on an accuracy basis and 700-volt-amp on a thermal basis.
- d. Provide the potential transformers that withstand a secondary short circuit for at least one second.
- e. Provide the transformers meeting the requirements of the ANSI Standard accuracy classifications.
- f. Withstand an impulse test voltage of 60 kV.
- g. Provide two primary bushings with full insulation.
- h. Install potential transformers on a suitably designed drawout carriage with primary and secondary disconnect device, grounding device, and accessories in conformance with IEEE and NEMA standards.
- i. Provide current-limiting type primary fuses.
- j. Provide secondary fuses for the protection of potential transformers.

I. Grounding:

- 1. Ground current and potential transformer secondaries with a copper conductor not smaller than No. 10 and connecting to the ground bus.
- 2. Ground potential transformer primaries, where shown or required with a copper conductor not smaller than No. 6 insulated for line-to-line voltage, and terminated at the ground bus.
- 3. Provide connections to the bus so that it can be easily disconnected and isolated for proof testing.
- 4. Install each ground wire as a continuous run without intervening splices or terminal blocks.
- 5. Ground secondary circuits of metering and relaying transformers at one point only.
- 6. Effectively ground meter, relay and instrument transformer cases.

J. Protective Relays:

1. Provide multi-functional microprocessor based three-phase protective relays that provide protection functions as described on the drawings.
2. Provide relays with true RMS sensing that operates from the 5-ampere secondary output of current transformers.
3. Provide relays with ANSI 50/51N protective functions for each of the three (3) phases, and ANSI 50/51N or 50/51G ground fault protection functions as shown. Provide ground elements that utilizes residual, zero sequence, or ground source connection schemes, or be deactivated.
4. Provide relays with separate programmable setting for phase and ground current transformers with primary current ratings from 5 through 5,000 amperes.
5. Provide relays with phase and ground protection curves that are independently field selectable and programmable with or without load from the following type of curves:
  - a. IEEE: Moderately inverse, very inverse, extremely inverse
  - b. IEC: A, B, C, or D
  - c. Thermal: Flat,  $I_t$ ,  $I_t^2$ ,  $I_t^4$
  - d. Selectable short delay pick-up and short delay time settings
  - e. Instantaneous phase over-current trip - field programmable pick-up points from 1.0 to 25 times current transformer primary rating or set to NONE.
  - f. Provide a field selectable (ON or OFF) discriminator circuit that operates when phase instantaneous over-current trip has been set to NONE, to protect against currents exceeding 11 times current transformer primary rating, only when the breaker is closed.
6. Provide a relay with two field configurable type "a" contacts.
7. Provide a built-in alphanumeric display capable of displaying the following information:
  - a. Individual phase currents
  - b. Ground current
  - c. Cause of trip
  - d. Magnitude and phase of current causing trip
  - e. Peak current demand for each phase and ground since last reset
  - f. Current transformer primary rating
  - g. Programmed phase and ground set-points.
8. Provide a relay having integral manual testing capability for both phase and ground

9. Provide an addressable communication card capable of transmitting all data over a two-wire network to the Plant SCADA System as specified in Section 26 09 13.
  10. Provide a relay with Alarm and/or Trip contacts do not change state if power is lost or an under-voltage occurs. Provide contacts that only cause a trip upon detection of an over-current or fault condition based upon programmed settings.
  11. Provide a relay suitable for operating on control power with a nominal input voltage of 125 volts dc
  12. Provide Relays of the following types
    - a. Type FPR – Feeder Protection Relay: Schweitzer SEL-751 or equal.
    - b. Type BDR – Bus Differential Relay: Schweitzer SEL-487B-1 or equal
    - c. Type GPR – Generator Protection Relay: Schweitzer SEL-700G or equal.
    - d. Type TPR – Transformer Protection Relay: Schweitzer SEL-787-2 or equal.
- K. Lockout Relays: Provide hand reset type lockout relays (IEEE/ANSI Device 86) where indicated on the drawings. Provide, Electroswitch Type WL, GE Grid Solutions Type HEA, or equal.
- L. Lightning Arresters and Surge Capacitors:
1. Provide each incoming service with lightning arresters and surge capacitors.
  2. Provide Intermediate type lightning arresters of the metal oxide varistor (MOV) type rated 4.5 kV designed for 3-phase switchgear applications.
  3. Provide 3-pole surge capacitors designed for switchgear applications.
- M. Control Devices:
1. Provide control switches of the standard rotary, multistage type suitable for the use specified.
  2. Provide circuit breaker control switches suitable for use with red and green indicating lamps, and provide with indicating targets.
  3. Provide rectangular or round miniature LED type indicating lamps with resistors designed for 125-volt dc.

4. Provide the following:
  - a. Other controls which may be required for moving the breaker to and from the operating position
  - b. Auxiliary relays, switches and mechanisms required for the particular manufacture of the breaker
  - c. Operation counter
  - d. Manually operated trip bar or lever
  - e. Provision for manual closing
  
- N. Microprocessor-Based Metering and Protection System: Provide a microprocessor-based metering and protection system having the following features:
  1. UL recognized component meeting IEEE C37.90.
  2. Housed in an enclosure suitable for door mounting.
  3. Derive control power from metered line.
  4. Auto ranging metering of the following values:
    - a. Ac amperes in each phase, 0.5 percent accuracy
    - b. Ac voltage, phase-to-phase, phase-to-neutral, 0.5 percent accuracy
    - c. Watts, 1 percent accuracy
    - d. Vars, 1 percent accuracy
    - e. Power factor, 2 percent accuracy
    - f. Frequency, 0.5 percent accuracy
    - g. Watt demand, 1 percent accuracy with programmable 5-, 10-, 15-, 30-minute intervals
    - h. Watt-hours, 1 percent accuracy
    - i. Percent total harmonic distortion through the 31st harmonic
  5. Protection system of the following functions:
    - a. Voltage phase loss, less than 50% nominal line voltage

- b. Current phase loss, less than 1/16 of the largest phase
  - c. Voltage phase unbalance, 5 to 40% in 5% increments
  - d. Phase voltage reversal
  - e. Overvoltage, 105 to 140% in 5% increments
  - f. Undervoltage, 95 to 60% in 5% increments
  - g. Time delay for overvoltage, undervoltage, and phase unbalance, zero to twenty seconds in one second intervals.
- 6. Separate Form C (NO/NC) trip and alarm outputs contacts rated 10 amperes at 115-volt ac or 30-volt dc resistive.
  - 7. Addressable communications card capable of transmitting all data over a two-wire network to the Plant SCADA System as specified in Section 26 09 13.
- O. Power Transducers:
- 1. Provide voltage, current, watt, var, frequency and power factor transducer in accordance with the following:
    - a. Solid state devices.
    - b. Output: 4-20 ma into a 750 ohm load.
    - c. Provisions for zero and span adjustment with 0.25 percent accuracy.
    - d. Input power: Operate on external 125 volts dc, or derive their power supply from input signals.
    - e. Calibrate power factor transducer between 50 percent lag and 50 percent lead.
    - f. Provide watt and var transducers designed for 3-phase, 3 wire system.
- P. Wiring
- 1. Completely assemble, wire and test each switchgear section at the factory, including buses, connections, insulators, cleats, terminals, and terminal blocks.
  - 2. Insulate all current-carrying parts.

3. Route all secondary wiring in high voltage compartments in conduit or metal-covered wiring troughs.
4. Route all secondary wiring in the front of secondary compartments in wiring troughs and terminate at approved molded type terminal blocks with numbered marking strips, conveniently located with respect to the control conduits.
5. Provide terminal blocks mounted so that the wires on them can be grouped and laced together.
6. Mark and identify all wiring in accordance with the manufacturer's wiring diagrams.
7. Label control wiring with an identification tag that indicates the terminal number of the opposite end connection.
8. Include wire labels on schematic control and wiring diagrams.
9. Provide spade connectors for wires No. 12 and smaller and solderless lugs for larger sizes. Provide full ring lugs on all current transformer circuits.
10. Provide sufficient number of terminal connections, including 15 percent spare terminals, for all control and instrument wiring.
11. Provide No. 10 AWG stranded copper or larger with NEC Type SIS insulation for all current transformer secondary wiring.
12. Provide No. 14 AWG stranded copper or larger with NEC Type SIS insulation for all secondary wiring.
13. Provide a fused switch or circuit breaker for the control power supply in each breaker compartment.

Q. Identification:

1. Provide identification of the switchgear and its components as specified in Section 26 05 53.
2. Install nameplates for devices located on doors so they are readable to a person 5'-8" tall standing 3'-0" in front of the equipment.
3. Locate nameplates so that they are readily associated with items labeled.
4. Where nameplates are installed on removable relay or device doors, install a nameplate within the relay or device.

5. Where nameplates are located on other compartments than those served, add additional engraving to identify units served.
- R. Automatic Transfer Controller:
1. Provide a PLC-based automatic transfer controller in a separate vertical section of the switchgear to perform open-transition transfer between the two utility power sources.
  2. Coordinate the operation of the Switchgear and Automatic Transfer Controller with the Generator Master Control Panel:
    - a. Provide output contacts from the Automatic Transfer Controller to the Generator Master Control Panel to call the generator system to start or stop.
    - b. Accept input signals from the Generator Master Control Panel to monitor running status of the generators.
    - c. Accept input signals from the Generator Master Control Panel input circuit breakers to allow the Generator Master Control panel to synchronize the generators onto the bus and close the generator input circuit breakers at the switchgear.
  3. Provide automatic sequencing between the following normal operation modes:
    - a. Both Utility Sources energized (Normal Operating Condition)
    - b. Utility Source A energized, Utility Source B de-energized, ties closed to power all buses.
    - c. Utility Source A energized, Utility Source B de-energized, Bus 2 de-energized. (Service on Bus 2 or Tie Breaker)
    - d. Utility Source B energized, Utility Source A de-energized, ties closed to power all buses.
    - e. Utility Source B energized, Utility Source A de-energized, Bus 1 de-energized. (Service on Bus A or Tie Breaker)
    - f. Utility Source A energized, Utility Source B de-energized, Generators powering Bus 2.
    - g. Utility Source B energized, Utility Source A de-energized, Generators powering Bus 1.
    - h. Both Utility Sources de-energized, Generators powering Bus 1 and Bus 2.

- i. Both Utility Sources de-energized, Generators powering Bus 1, Bus 2 de-energized.
  - j. Both Utility Sources de-energized, Generators powering Bus 1, Bus 2 de-energized.
  - k. All sources de-energized.
4. Manual Operation
- a. Provide hardwired interlocks between circuit breakers to allow safe manual operation through all normal modes and required intermediate steps.

#### 2.4 REMOTE CONTROL PANEL (MIMIC PANEL)

- A. Provide a remote mounted control panel for monitoring and control of the switchgear. Panel shall have the following features:
  - 1. Floor or wall mounted painted steel enclosure
  - 2. Open/close selector switch for each circuit breaker
  - 3. Open, close and tripped indicating lights for each circuit breaker
  - 4. Mimic (one-line) diagram of the switchgear integrating the above selector switches and indicating lights
  - 5. Powered from switchgear control power source(s)
- B. Provide all interconnecting wiring between switchgear and remote control panel.

#### 2.5 SOURCE QUALITY CONTROL

- A. Tests: Provide the following tests and installation procedures in accordance with Section 26 08 00.
  - 1. Relay Testing: Perform the manufacturer's standard protective relay production and test procedures. The tests may be witnessed by the ENGINEER at the option of the OWNER.
  - 2. Shop Tests and Inspection. Completely assemble switchgear equipment in the manufacturer's plant for inspection and witness tests. Test the switchgear in accordance with the IEEE and ANSI standards for this class of equipment. Include shop tests to determine general operating condition and circuit continuity, high potential test and other standard tests for that particular class of equipment.

Notify the ENGINEER of the proposed date of testing a minimum of ten working days prior to the test.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install all medium voltage switchgear in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 01.
- B. Conformance: Install switchgears as indicated, in accordance with manufacturer's written instructions and with recognized industry practices. Comply with requirements of NEMA standards, NEC, and applicable ANSI Publications.
- C. Leveling and Anchoring: Provide steel channels in the concrete floor for leveling and anchoring the switchgear. Anchor the switchgear to steel channels bolts, nuts and washers.
- D. Coordination: Coordinate with other work, including cabling/wiring, as necessary to interface switchgear installation.
- E. Torque Requirements: Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals in accordance with UL Std 486A.
- F. Fuses: Provide fuses in each switchgear as required.
- G. Protective Relay Parameters: Set the protective relays in accordance with the protective coordination study specified in Section 26 08 00
- H. Ground Connections: Make equipment grounding connections for the switchgears as indicated on the drawings. Tighten connections in accordance with UL Standard 486A for permanent and effective grounding.
- I. Adjustments: Make all necessary adjustments to the equipment to provide complete and satisfactory operation.

### 3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Representative: Provide a factory-trained experienced, competent, and authorized representative of the switchgear manufacturer to visit the site of the work; inspect, check, adjust if necessary, and approve the equipment installation and provide training as specified in Section 01 79 00. Provide all instruments necessary to conduct required tests and adjustments. Have the manufacturer's representative

utilize prepared comprehensive check sheets covering inspections, checks and tests required for the assembly of the switchgear. Submit copies of these documents executed and signed by the manufacturer's representative. Have the representative present when the equipment is placed in operation. Provide representative services as often as necessary until all problems are corrected and the equipment is installed and operating satisfactorily.

- B. Certified Report: Furnish a written report certifying that the equipment
  - 1. Has been properly installed
  - 2. Is in accurate alignment
  - 3. Is free from any undue stress imposed by connections or anchor bolts, and
  - 4. Has been operated under full load conditions and that it operated satisfactorily
- C. SCADA Programming: Provide service engineer at the job site as often as necessary to assist in the programming of the SCADA system for accessing the memory map of each device.
- D. Field Tests: Perform the following tests and inspections. Record all tests and submit a written report for approval. Retest as necessary.
  - 1. Check all breakers, relays, meters, power and control fuses and auxiliaries for proper size, rating, and location. Clean control panels, cubicles, and aisles and remove all shipping materials.
  - 2. Inspect equipment and each breaker and report installation or shipping damage, loose materials, shipping blocks or contamination.
  - 3. Inspect installation location and report any unfavorable environmental conditions that require correction.
  - 4. Torque test bus connections where field joints are made.
  - 5. Test key interlock systems to demonstrate proper function.
  - 6. Check that all panel circuits are numbered and tagged: Panel door legends are engraved and installed as per drawings.
  - 7. Check equipment to determine that it is level, secured to foundations and that doors operate properly.

8. Test insulation of all control and relay circuits to ground with a suitable megohmmeter. Take suitable precautions where electronic devices, instruments and instrument transformers are involved.
  9. Field Proof Test. After installation, but before any external connections are made to the switchgear, subject the switchgear to a 10-minute high potential test applied on the stationary gear and breakers. Use a test voltage of 75 percent of the standard factory production tests.
  10. Test all bus, cable, wire and other equipment operating at the service voltage that is energized by closing the incoming main line breakers. Perform test witnessed by the ENGINEER.
  11. Test protective relays to verify settings and determine proper operation.
- E. Training: Following completion of installation and field testing provide training for 12 employees of the OWNER in the proper operation, troubleshooting and maintenance of the equipment as outlined below. All training will be at the OWNER'S facilities at a time agreeable to the OWNER:
1. Operational Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.
  2. Maintenance Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.

### 3.3 GROUNDING

- A. General: Inspect ground system for compliance with the latest drawings.
- B. Connections: Inspect all ground connections for evidence of looseness and/or corrosion.

### 3.4 CLEANING AND PAINTING

- A. Shop Painting: Paint the switchgear as specified in Section 09 96 00.
- B. Field Painting: Touch up scratched and marred surfaces to match with original finishes.

### 3.5 IDENTIFICATION

- A. General: Provide identifications meeting the requirements of Section 26 05 53.
- B. Component Identification: Identify all system components, cables and wires by labels indicating unit numbers, circuit numbers and date of installation.

- C. Work Mats: Thoroughly clean the floor in front of the switchgear and install the rubber work mats.

END OF SECTION

## SECTION 26 14 00

### MEDIUM VOLTAGE MOTOR CONTROLLERS

#### PART 1 GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Requirements for providing medium voltage motor controllers.
2. Requirements for modifications to existing medium voltage motor control center.
3. Requirement for performing maintenance activities on existing medium voltage motor control centers at the Water Plant.
  - a. Main Switchgear - Westinghouse AmpGard
  - b. Low Lift Pumping Station MCC - Westinghouse AmpGard
  - c. High Lift Pumping Station MCC - Westinghouse AmpGard

###### B. Related Work Specified in Other Sections Includes, But is Not Limited to the Following:

1. Section 01 79 00 - Training
2. Section 09 96 00 - High Performance Coatings
3. Section 26 05 00 - Basic Electrical Materials and Methods
4. Section 26 05 19 - Wire and Cables - 600 Volts and Below
5. Section 26 05 13 - Medium Voltage Cables
6. Section 26 05 53 - Electrical Identification
7. Section 26 05 26 - Grounding
8. Section 26 30 00 - Control Components and Devices
9. Section 26 09 13 - Electrical Monitoring System
10. Section 26 08 00 - Electrical Testing Requirements
11. Section 26 05 73 - Short Circuit and Coordination Study

##### 1.2 REFERENCES

###### A. General: Codes and standards referred to in this Section are:

1. IEEE C37.90 - IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus
2. IEEE C37.46 - American National Standard Specifications for Power Fuses and Fuse Disconnecting Switches

3. ANSI/NEMA ICS6 - Enclosures for Industrial Controls and Systems
4. NEMA ICS 1 - General Standards for Industrial Control Systems
5. NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies
6. UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors
7. UL 347 - High Voltage Industrial Control Equipment
8. ANSI/NETA MTS - Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems
9. NFPA 70B - Standard for Electrical Equipment Maintenance

### 1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Provide equipment capable of operating in an ambient temperature range of 0 to 40 degrees C and humidity of up to 90 percent noncondensing.
  1. Provide medium voltage motor controllers of the 5-kV class designed for operation on a 4160-volt, 3-phase, 60-Hertz, 3-wire, grounded neutral power system.
  2. Provide motor controllers with current limiting fuses for control and protection of 4000-volt, 3-phase, 60-Hertz induction motors.
  3. Provide control devices suitable for operation at 120-volts, 60-Hertz, unless specifically noted otherwise.
  4. Arrange the equipment for convenient and ready accessibility from the front for inspection and maintenance of devices, terminals, and wiring.

### 1.4 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Section 26 05 00.
- B. Product Data and Information: Provide manufacturers' catalog data and bill of material for the medium voltage motor control center assemblies. Identify major components and accessories of the system including rating data, type, model, service voltages, number of phases, current ratings and interrupting capacities.

- C. Shop Drawings: Provide shop drawings customized to the project for medium voltage motor controllers that include the following:
1. Outline drawings showing dimensions, arrangement, elevations, identification of components and a nameplate schedule for all units.
  2. Interconnecting wiring diagrams, where required.
  3. Individual schematic and wiring diagrams for each compartment.
  4. One-line diagrams.
  5. Obtain and enter full performance details on all motors and other equipment being served on the shop drawings.
  6. Provide instruction booklets and time-current curves for each circuit breaker supplied.
- D. Maintenance and Testing Plan: Provide detailed list of planned maintenance and testing activities for each motor control center listed in 1.1 A.3:
1. Checklist of all systems and components receiving maintenance service, demonstrating compliance with the requirements of referenced standards.
  2. Where test results consist of numerical measured values, indicate expected range for each test.
- E. Quality Control: Provide the following test reports and certificates as specified in Division 01:
1. Qualifications of Third-Party Testing Firm performing Maintenance Testing
  2. Certified shop test reports for medium voltage motor controllers and related components. Provide a written notice a minimum of 15 days prior to shop tests for inspection and witnessing by the ENGINEER.
  3. Detailed field test reports of all tests indicating specified test performed, discrepancies found, and corrective actions taken.
  4. Furnish manufacturer's certificates for medium voltage motor controllers.
  5. Detailed list of Proposed Corrective Maintenance Work, with itemized costs.
- F. Operation and Maintenance Manuals: Furnish operation and maintenance manuals as specified in Division 1.

## 1.5 QUALITY ASSURANCE

- A. Codes: Manufacture all motor controllers in accordance with NEMA ICS 2 and UL Standard No. 347.
  - 1. Manufacture and install each motor control center in accordance with the NEC and local codes.
- B. Provide a UL Label on each vertical section of each motor control center.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store, and handle all products and materials as specified in Division 01.
- B. Shipping and Packing: Provide all structures, equipment and materials rigidly braced and protected against weather, damage, and undue strain during shipment.
- C. Storage and Protection: Store all equipment and materials in a dry, covered, heated and ventilated location. Provide any additional measures in accordance with manufacturer's instructions.

## 1.7 SPARE PARTS

- A. General: Provide the following spare parts:
  - 1. Two complete sets of replacement power fuses for each size and rating
  - 2. Complete set of replacement fuses for all control power transformers
  - 3. Complete set of replacement fuses for low voltage circuits
  - 4. One current transformer of each type and rating
  - 5. Two of each type of control or latching relay
  - 6. Two complete replacements of all LED type indicating lamps used in the installation
  - 7. Two sets of replacement indicating light lenses of each color provided
  - 8. One control station of each type provided
  - 9. Two insulated handle fuse pulling tools
  - 10. One each of each type of printed circuit board
  - 11. One complete spare power cell of each type and size used

12. One keypad of each type used
  13. Three 12-ounce spray cans of the final finish for touch-up
- B. Packaging: Pack spare parts in containers bearing labels clearly identifying the contents. Deliver spare parts in original factory packages. Identify all spare parts with information needed for reordering.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
1. Solid State Reduced Voltage Starters
    - a. Benshaw
    - b. Eaton/Cutler Hammer
    - c. Motortronics
  2. Modifications to Medium Voltage Motor Control Center
    - a. Eaton
  3. Motor Protection Systems
    - a. Eaton/Cutler Hammer MP-3000
    - b. GE Grid Solutions Multilin
    - c. Schweitzer Engineering Laboratories
  4. Microprocessor Based Protective Relays
    - a. Eaton/Cutler Hammer IQ-4000
    - b. Square D/Schneider Electric Power logic
    - c. GE Grid Solutions/ Multilin
    - d. Schweitzer Engineering Laboratories
  5. Power Transducers
    - a. Ametek Power Instruments/Scientific Columbus Type Exceltronic
    - b. Ametek Power Instruments/Rochester Instrument Systems

## 2.2 MODIFICATIONS TO EXISTING MEDIUM VOLTAGE MOTOR CONTROL CENTER

### A. Description:

1. Modify existing spare motor starter unit as required for use as input breaker for mobile generator connections, including new latching contactor, protective relay, and servicing.
2. Modify two existing feeder units as required to accommodate increased capacity requirements.

## 2.3 MAINTENANCE SERVICES

### A. Perform maintenance services at the main motor control centers serving the following locations:

1. North Standpipe, 2536 Gross Point Rd, Evanston
2. South Standpipe, 640 Hartrey Ave, Evanston

### B. Perform all periodic maintenance and testing described in NFPA 70B for the following:

1. Motor Control Center Assembly, according to NFPA 70B, Chapter 12.
2. Fuses, according to NFPA 70B, Chapter 16.
3. Grounding and Bonding, according to NFPA 70B, Chapter 20.
4. Motor Control Equipment, according to NFPA 70B, Chapter 28.
5. Protective Relays, according to NFPA 70B, Chapter 35.

### C. Maintenance testing shall be performed by a third party testing firm, and shall meet the requirements of Section 26 08 00 and ANSI/NETA MTS.

### D. Submit a list of proposed corrective work for approval.

### E. Upon approval, perform corrective work under the allowances described in Section 01 29 00.

## 2.4 MEDIUM VOLTAGE MOTOR CONTROLLERS

### A. Basic Construction: Provide totally enclosed, dead-front, rigid, NEMA 12 self-supporting and freestanding structures, arranged for front mounting as shown.

1. Construct the units from welded structural steel and full finished sheet steel with a minimum thickness of 12 gauge.

2. Form, reinforce and arc-weld together to provide rigid, self-supporting structures giving a complete dead front assembly.
  3. Provide structures with a bottom design that permits tack-welding or bolting to the supporting floor channels. Provide steel floor channels suitable for embedding into the concrete floor for leveling and anchoring of motor control center.
  4. Provide controller enclosures with separate low voltage and high voltage compartments.
  5. Arrange and barrier the compartments to allow personnel entry to the low voltage compartment without being exposed to high voltage.
  6. Rigidly support the primary buses with insulating material of high dielectric and mechanical strength.
  7. Provide silver plated and bolted connections to the primary buses.
  8. Brace the primary buses to mechanically and thermally withstand the full effect of short circuit currents equivalent to the interrupting ratings of the interrupter switches furnished with the switchgear.
  9. Provide a 1/4-inch by 2-inch, bare-copper ground bus extending the full width of the complete assembly.
  10. Provide lugs on the ground bus for terminating copper ground cables.
  11. Provide buses in the end units of the completed assembly, capable of being easily extended in the future.
  12. Provide individual flanged doors on the compartments with latches and hinges capable of holding the door closed during maximum fault conditions.
  13. Provide access to cable compartments via removable steel plates.
  14. Provide cable compartments of sufficient size to terminate medium voltage cables of the type specified under Section 26 05 13.
  15. Provide solderless, high-voltage terminal lugs.
- B. Solid State Reduced Voltage Starter: Provide solid-state, reduced-voltage starters consisting of an isolation switch, current limiting fuses, main contactor, bypass contactor, solid state power assembly and microprocessor control logic providing closed-loop current ramp for smooth and stepless motor acceleration and deceleration.
1. Rating:

- a. Input Power: 4160 volts, 3-phase  $\pm 10$  percent, 60 Hz.
  - b. Overload Rating: 500 percent of starter FLA for 30 seconds and 125% continuous.
  - c. Short Circuit Amps: 50,000 amperes rms symmetrical
  - d. Efficiency: greater than 99 percent with or without bypass
2. Provide door interlocks to keep doors from being opened with power applied.
  3. Design the electrical components for front accessibility only.
  4. Provide main and bypass contactors of the vacuum type, fixed-mounted style rated as required for the load served.
  5. Design the bypass contactor to bypass the SCRs after starting and while the starter is operating at full voltage.
  6. Provide a manually-operated isolation switch that is electrically and mechanically interlocked with the contactor so it can only be operated when the contactor is open.
    - a. Provide a switch with the following ratings:
      - (1) Maximum Voltage: 5.5 kV
      - (2) BIL Rating: 60 kV
      - (3) Continuous Current: 600 amperes
  7. Provide a mechanical interlock to prevent opening the medium voltage door when the isolating switch is in the closed position and to prevent closing of the isolating switch when the medium voltage door of the starter is open.
  8. Provide a digital operator keypad with LCD display located on the front door to allow setting of all programmable parameters and the following control functions:
    - a. Power ON
    - b. Start push button
    - c. Stop push button
    - d. "Local-Remote" control selection
    - e. Line current, voltage and frequency
    - f. Elapsed time meter
    - g. Diagnostics package with fault indication.
  9. Include the capability to test the power and adjust microprocessor control when the isolating switch is in open position.

10. Provide a microprocessor-based control logic required to drive the power semiconductors and provide motor and starter monitoring functions having the following features:
  - a. Adjustable ramp time (0-120 seconds)
  - b. Adjustable initial current (50-400 % of motor FLA)
  - c. Adjustable max current (200-600% of motor FLA)
  - d. Kick start (adjustable 0.1 - 10 seconds)
  - e. Adjustable deceleration profile
  - f. Over/under current fault protection
  - g. Line phase loss detection
  - h. Adjustable line current imbalance detection (10-40%)
  - i. Adjustable over/under line voltage protection (10-30%)
  - j. Up to speed indication
  - k. Line phase sequence sensitivity or insensitivity
  - l. Selectable solid state overload class (10, 20, 30)
  - m. Adjustable motor full load amperes
  - n. Real-time clock
  - o. Selectable passcode protection of set starter parameters
  - p. Over/under line frequency protection
  - q. Instantaneous overcurrent detection
  - r. Shorted SCR detection
  - s. Machine ground fault protection
  - t. Time between starts limiter
  - u. Power factor monitor
  - v. Event recorder with time and date stamp (99 most recent events)
  
11. Provide an addressable communication card capable of transmitting the following data over a two-wire network to the Plant SCADA system as specified in Section 26 09 13:
  - a. Status (ON, OFF, TRIPPED)
  - b. Input and output current in each phase
  - c. Input and output kW
  - d. Cause of trip
  
12. Provide dry contacts rated at 10 amperes at 120 volts ac and that indicate the following functions:
  - a. Running
  - b. Up To Speed
  - c. SCR failure
  - d. Motor Overload Trip
  - e. General fault alarm
  
13. Provide line reactors where required, installed within the starter enclosure.

C. Wiring:

1. Provide internal wiring runs for interconnecting units with stranded switchboard wire having 600-volt rated, flame-resistant, type SIS insulation. Provide No. 14 AWG wire for control interconnections and No. 10 AWG wire for current transformer connections. Provide power connections as required for the service.
2. Provide wire markers at each end of all wires.
3. Where wiring connections are made to equipment mounted on hinged doors, provide connections with extra flexible wires suitably cabled together and cleated.
4. Provide wiring of all control connections to individual terminal blocks at each motor starter and contactor. Locate terminal blocks for front access.
5. Provide sufficient terminals for all devices external to the motor control center.
6. Construct all current-carrying connections to the main buses of copper with suitable capacity and conform to the requirements of the main bus insofar as bracing, insulation, temperature limits and the like are concerned.
7. Connect current transformers in such a way that the transformers may be removed and changed without damaging the connection.
8. Provide flexible cable insulated for 5 kV service for control power transformer leads.
9. Wire the communication cable for the microprocessor-based metering system to a single terminal block located in the incoming line structure.

D. Instrument Transformers:

1. Current Transformers
  - a. Provide dry type current transformers, suitable for indoor service and rated as shown.
  - b. Provide sufficient thermal and mechanical capacity to withstand the maximum momentary current rating of the equipment.
  - c. Provide solderless, clamp-type, shorting terminal blocks for secondary connections.
  - d. Properly identify the polarity of all current transformers with standard marking symbols.

- e. Provide window-type current transformers for ground-sensing where shown.
- f. Provide current transformer with accuracy suitable for the instruments and meters specified using the normal burdens of the various devices, and not less than ANSI Standard requirements.

2. Potential Transformers

- a. Provide a dry type, suitable for indoor service, rated single-phase, 60-hertz, 120 volts.
- b. Provide control power transformers that fit into the motor control center unit.
- c. Rate the control power transformers as required for operation and control of the starters, contactors, and auxiliary loads, including motor heating element.
- d. Provide transformers that can withstand a secondary short circuit for at least one second.
- e. Provide transformers meeting the requirements of the ANSI Standard accuracy classifications.
- f. Provide transformers that can withstand an impulse test voltage of 60 kV.
- g. Provide two primary bushings with full insulation.
- h. Provide current-limiting type, primary fuses.
- i. Provide secondary fuses for the protection of potential transformers.

E. Grounding:

- 1. Ground current and control power transformer secondaries with a copper conductor not smaller than No. 10 and connecting to the ground bus.
- 2. Provide connections to the bus that can be easily disconnected and isolated for proof testing.
- 3. Provide each ground wire as a continuous run without intervening splices or terminal blocks.

4. Ground secondary circuits of metering and relaying transformers at one point only.
  5. Effectively ground meter, relay and instrument transformer cases.
- F. Power Transducers: Provide watt transducers in accordance with the following:
1. Solid-state devices.
  2. Output: 4-20 mA into a 750-ohm load.
  3. Provisions for zero and span adjustment with 0.25 percent accuracy.
  4. Input Power: Operate on external 120-volt ac, single-phase, 60-hertz or derive their power supply from input signals.
- G. Push Buttons, Selector Switches and Indicating Lights: Provide push buttons, selector switches and indicating lights including legend plates having the same type, appearance, shape and catalog number throughout each motor control center meeting the requirements of Section 26 30 00.
- H. Control Components: Provide control components including elapsed time meters, control relays, latching relays, time-delay relays, reset timers, repeat-cycle timers, alternators, phase-failure and undervoltage relays and ground-fault protection relays meeting the requirements of Section 26 30 00.
- I. Wiring Schematic: Provide a schematic wiring diagram of each unit and affix it to the inside of the door of that unit.
- J. Identification:
1. Provide identification of the switchgear and its components as specified in Section 26 05 53.
  2. Install nameplates for devices located on doors so they are readable to a person 5'-8" tall standing 3'-0" in front of the equipment.
  3. Locate nameplates so that they are readily associated with items labeled.
  4. Where nameplates are installed on removable relay or device doors, install a nameplate within the relay or device.
  5. Where nameplates are located on other compartments than those served, add additional engraving to identify units served.

## 2.5 SOURCE QUALITY CONTROL

- A. Tests: Provide the following tests and installation procedures in accordance with Section 26 08 00.
  - 1. Shop Tests and Inspection: Completely assemble medium voltage motor control center equipment in the manufacturer's plant for inspection and witness tests. Test the motor control center in accordance with the IEEE and ANSI standards for this class of equipment. Include shop tests to determine general operating condition and circuit continuity, high potential test and other standard tests for that particular class of equipment.
  - 2. Notify the ENGINEER of the proposed date of testing a minimum of ten working days prior to the test.
  - 3. Device Address: Factory set the address of each device.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install medium voltage motor controllers in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 01.
- B. Conformance: Install medium voltage motor controllers as indicated, in accordance with manufacturer's written instructions and in accordance with recognized industry practices; comply with requirements of NEMA standards, NEC, and applicable ANSI Publications.
- C. Coordination: Coordinate with other work, including cabling and wiring, as necessary.
- D. Torque Requirements: Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals in accordance with UL Std 486A.
- E. Fuses: Provide fuses in each unit as required.
- F. Grounding Connections: Make equipment grounding connections for the motor controllers as indicated. Tighten connections in accordance with UL Standard 486A for permanent and effective grounding.
- G. Adjustments: Make all necessary adjustments to the equipment to provide complete and satisfactory operation.

### 3.2 FIELD QUALITY CONTROL

- A. Inspections: Inspect, adjust and check the installation for physical alignment, cable terminations and ventilation.
- B. Tests: Perform the following field tests:
  - 1. Close and open each isolation switch, starter and disconnect switch to test operation.
  - 2. Energize the motor control center and test for hot spots.
  - 3. When site conditions permit, energize and de-energize each equipment item served by each motor control center, testing the complete control sequence of each item.

### 3.3 OPERATION DEMONSTRATION

- A. Manufacturer's Representative: Provide the services of a factory-trained service engineer, specifically trained on the medium voltage motor control center equipment to assist in installation, start-up, testing, calibration, placing into operation and provide training, as specified in Section 01 79 00.
  - 1. Provide a service engineer when the equipment is placed into operation.
  - 2. Provide a service engineer at the jobsite as often as necessary until all problems are corrected and the equipment installation and operation are satisfactory.
  - 3. Following completion of installation and field testing, provide training for 12 employees of the OWNER in the proper operation, troubleshooting and maintenance of the equipment as outlined below. All training will be at the OWNER'S facilities at a time agreeable to the OWNER:
    - a. Operational Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.
    - b. Maintenance Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.
  - 4. Provide a service engineer at the job site as often as necessary to assist in the programming of the SCADA system for accessing the memory map of each device.

### 3.4 CLEANING AND PAINTING

- A. Shop Painting: Paint medium voltage motor controllers in accordance with Section 09 96 00.

- B. Field Painting: Clean and touch up any scratched or marred surface to match original finish.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 26 18 16

### MEDIUM VOLTAGE FUSES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing medium voltage fuses for medium voltage interrupter switches.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 26 05 00 - Basic Electrical Materials and Methods
  - 2. Section 26 14 00 - Medium Voltage Motor Controllers

##### 1.2 SYSTEM DESCRIPTION

- A. Provide medium voltage fuses for use with medium voltage interrupter switches.

##### 1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1 and Section 26 05 00.
- B. Shop Drawings: Provide catalog data and time-current curves for the medium voltage fuses.

##### 1.4 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 (and as follows:)

#### PART 2 PRODUCTS

##### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  - 1. Current Limiting
    - a. ABB Power T&D Company Inc.
    - b. General Electric Company
    - c. Eaton's Cooper Power Systems

B. Current Limiting Type Fuse:

1. Provide current limiting fuses having an interrupting capacity of 50,000 rms symmetrical amperes. Use fuses that operate with no expulsion of gases or vapors. Provide fuse with the voltage class corresponding to the intended service.

PART 3 EXECUTION

3.1 INSTALLATION

- A. General: Install all fuses in accordance with manufacturer's recommendations and approved shop drawings and as specified in Division 01.

END OF SECTION

## SECTION 26 22 00

### GENERAL PURPOSE DRY TYPE TRANSFORMERS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for furnishing and installing ventilated, dry-type transformers.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 09 96 00 – High Performance Coatings
  - 2. Section 26 05 00 – Basic Electrical Materials and Methods
  - 3. Section 26 05 26 – Grounding

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ASTM D 635 - Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
  - 2. 78 FR 23335 - Energy Conservation Program: Energy Conservation Standards for Distribution Transformers
  - 3. NEMA ST 20 - Dry Type Transformers for General Applications
  - 4. NFPA 70 - National Electrical Code (NEC)
  - 5. UL 1561 - Standard for Dry-Type General Purpose & Power Transformers

##### 1.3 SUBMITTALS

- A. General: Furnish all submittals, including the following, as specified in Division 01 and Section 26 05 00.
- B. Product Data and Information: Furnish manufacturer's data including:
  - 1. KVA ratings
  - 2. Service voltages
  - 3. Impedance and X/R ratio
  - 4. Number of phases
  - 5. Taps

6. Insulation class
7. Sound level
8. Dimensions
9. Weights
10. Mounting details

C. Quality Control: Furnish the following as specified in Division 01.

1. Test Reports:

- a. Certified production reports for sound-level and temperature in accordance with NEMA ST 20

2. Manufacturer's Installation Instructions

D. Operations and Maintenance Manuals: Furnish 6 copies of manufacturer's operations and maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. UL Label: Provide UL listing label or mark showing compliance with UL 1561.
- B. Provide all transformers rated 15 kVA or larger in accordance with 78 FR 23335.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 (and as follows:)

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.
  1. Hammond Power Systems
  2. ABB
  3. Eaton/Cutler-Hammer
  4. Square D/Schneider Electric
  5. Siemens

#### 2.2 MATERIALS

- A. General: Provide dry-type transformers suitable for indoor use.

- B. Insulation: Provide transformers above 15 kVA with 220-degree C temperature insulation class. Provide transformers 15 kVA and below with a minimum of 180-degree C temperature insulation class.
- C. Flame Retardant Materials: Provide transformers with flame retardant materials that will not support combustion as defined in ASTM D 635.

2.3 FABRICATION

- A. Transformer Taps: Provide transformers rated over 15 kVA with at least two 2-1/2 percent full capacity taps above and below nominal in the primary winding. Provide transformers rated 15 kVA and below with two 5 percent taps or with four 2-1/2 percent taps below rated voltage on the primary winding.
- B. Windings: Provide primary and secondary windings fabricated from copper conductors.
- C. Voltage and KVA Ratings: Provide three-phase or single-phase transformers with primary and secondary voltages and kVA ratings as specified.
- D. Connections:
  - 1. Three phase: Primary – 3-wire Delta; Secondary – 4-wire, solidly-grounded wye.
  - 2. Single Phase: Primary – 2-wire; Secondary – 3-wire with mid-point solidly-grounded.
- E. Continuous Operations: Provide transformers suitable for continuous operation at the rated kVA with a normal life expectancy as defined in NEMA ST 20 and the performance obtained without exceeding 115 degrees C average temperature rise by resistance or 145 degrees C hot spot temperature rise in 40-degree C maximum ambient and 30-degree C average ambient. Provide transformers that do not exceed 150-degree C maximum operating temperature.
- F. Electrostatic Shields: Provide electrostatic shields between windings.
- G. Construction: Provide transformers with core mounting frames and enclosures of welded and bolted construction with sufficient mechanical rigidity and strength to withstand shipping, erection and short circuit stresses.
- H. Sound Levels: Provide transformers that do not exceed the following sound levels, when measured in accordance with NEMA ST 20:

Transformer kVA	Average Sound Level in dB
0 – 9	40
10 – 30	45

Transformer kVA	Average Sound Level in dB
31 – 50	48
51 – 150	53

- I. Lifting Lugs and Jacking Plates: Provide lifting lugs and jacking plates as required on the transformer.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. General: Install all transformers and provide guards as specified by the latest NEC and ANSI standards, and in accordance with manufacturer's instructions.
- B. Clearances: Provide clearance around the transformer meeting the manufacturer's recommendation.
- C. Supports: Provide suitable supports for all transformers. Mount transformers on one inch of elastomeric pad sound-absorbent material.
- D. Primary Disconnect: Provide primary disconnect circuit breaker or disconnect switch as shown or required.
- E. Grounding: Connect transformers to grounding system in accordance with Section 26 05 26.

#### 3.2 CLEANING AND PAINTING

- A. Shop Painting: Paint transformers meeting the requirements of Section 09 96 00.
- B. Field Painting: Clean and touch up scratched and marred surfaces to match the original finish.

END OF SECTION

## SECTION 26 23 00

### 480 VOLT SWITCHGEAR

#### PART 1 GENERAL

##### 1.1 SUMMARY

A. Section Includes: Requirements for providing, installing and testing 480-volt front accessible switchgear including the following major components:

1. Stationary structure including bus bars
2. Main and tie power air circuit breakers
3. Distribution power air circuit breakers
4. Control, protection, monitoring and metering equipment

B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:

1. Section 01 79 00 - Training
2. Section 09 96 00 – High Performance Coatings
3. Section 26 05 00 - Basic Electrical Materials and Methods
4. Section 26 05 26 - Grounding
5. Section 26 05 53 - Electrical Identification
6. Section 26 08 00 - Electrical Testing Requirements
7. Section 26 05 73 - Short Circuit and Coordination Study
8. Section 26 05 19 - Wires and Cables - 600 Volts and Below
9. Section 26 05 10 - Utility Coordination and Requirements
10. Section 26 33 00 - Battery Systems
11. Section 26 09 13 - Electrical Monitoring System
12. Section 26 29 53 – Control Components and Devices

##### 1.2 REFERENCES

A. Codes and standards referred to in this Section are:

1. ANSI C37.51 - Conformance Testing of Metal-Enclosed Low-Voltage AC Power Circuit Breaker Switchgear Assemblies.
2. IEC 61557-12 - Equipment for testing, measuring or monitoring of protective measures - Part 12: Power metering and monitoring devices (PMD)
3. IEEE C37.13 - Low-Voltage AC Power Circuit Breakers Used in Enclosures
4. IEEE C37.20.1 - Metal-Enclosed Low Voltage Power Circuit Breaker

5. IEEE C37.90 - IEEE Standard for Relays and Relay-Systems Associated with Electric Power Apparatus
6. IEEE C62.41 - IEEE Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits
7. IEEE C62.45 - IEEE Guide on Surge Testing for Equipment Connected to Low Voltage AC Power Circuits
8. MIL-STD-220A- Method of Insertion-loss Measurement 12/1/59; with N1 and N2 (Fed/mil H-q)
9. NEMA SG3 - Low-Voltage Power Circuit Breakers.
10. NEMA SG5 - Power Switchgear Assemblies.
11. NFPA 70 - National Electrical Code (NEC).
12. UL 1283 - Electromagnetic Interference Filters
13. UL 1449 - Transient voltage surge suppressors
14. UL 1558 - Metal-Enclosed Low Voltage Power Circuit Breaker Switchgear  
UL 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors

- B. Material Workmanship Requirements: Provide all materials and workmanship meeting the requirements of NFPA Standards and Codes.
- C. Design and Testing Requirements: Provide all switchgear components designed, manufactured and tested in accordance with the latest NEMA, IEEE and ANSI Standards; and UL listed.
- D. Installation Requirements: Install the switchgear assemblies meeting the requirements of NEC and local Electrical Codes.

### 1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 01.
- B. Product Data and Information: Furnish the following.
  1. Manufacturers catalog data on switchgear assemblies and on each component detailing materials, ratings, type, model and reference number.
  2. Layout drawings customized for the project including physical details, dimensions, clearances, mounting, elevations, sections, and nameplates.

3. Electrical control schematics, wiring diagrams, internal interconnection diagrams and interconnection diagrams, including equipment external to the switchgear.
  4. Terminal lists for all connections.
  5. Provide instruction booklets and time-current curves for each circuit breaker supplied.
  6. Provide microprocessor-based metering system and overload protection systems address, memory map and instruction booklets.
  7. Furnish the following information on transient voltage surge suppressors (TVSS):
    - a. Verification that TVSS devices comply with UL 1449 and UL 1283 SVR.
    - b. Actual let through voltage test data in the form of oscillograph results for both the ANSI/IEEE C62.41 Category C3 (combination wave) and B3 (ringwave) tests in accordance with ANSI/IEEE C62.45.
    - c. Spectrum analysis of each unit based on MIL-STD-220A test procedures between 50 kHz and 200 kHz verifying that the device's noise attenuation exceeds 50 dB at 100 kHz.
    - d. Test reports from a recognized independent testing laboratory verifying the suppressor components can survive published surge current ratings on both a per mode and per phase basis using the IEEE C62.41, 8 x 20 microsecond current wave. Note: Test data on individual modules are not acceptable.
- C. Contractors Drawings: Furnish switchgear installation details including concrete pad details, mounting details, conduit and cable termination details and shipping section split field connection details.

#### 1.4 QUALITY CONTROL

- A. Test Reports: Furnish the manufacturer's certified shop test report and field test report for each 480-volt switchgear.

#### 1.5 OPERATIONS AND MAINTENANCE MANUALS

- A. Provide operation and maintenance manuals, including spare parts lists, as specified in Division 01.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 (and as follows:)
- B. Storage and Protection: Store all equipment in a dry, covered, heated and ventilated location. Provide any additional measures in accordance with manufacturer's instructions.
- C. Provide low voltage breakers with the means of power metering and communications via ethernet.

## 1.7 SPARE PARTS

- A. General: Provide the following spare parts:
  - 1. One transfer truck with fixed and swivel wheels and rubber tires suitable for moving the largest circuit breakers.
  - 2. One portable circuit breaker test kit.
  - 3. Two auxiliary power modules to power breaker trip units when breaker is not in the "connected" position.
  - 4. One complete solid-state sensor unit for each size furnished.
  - 5. Six replacement indicating light color lens for each color furnished.
  - 6. Three current transformers of each type and rating.
  - 7. Two potential transformers of each type and rating.
  - 8. Twelve potential transformer primary fuses.
  - 9. Twelve potential transformer secondary fuses.
  - 10. Two sets of control jumpers.
  - 11. One hand crank per switchgear for circuit breaker withdrawal and insertion.
  - 12. Three 12-ounce spray cans of the final finish for touch-up
- B. Packaging: Pack spare parts in containers bearing labels clearly designating contents and related pieces of equipment. Deliver spare parts in original factory packages. Identify all spare parts with information needed for reordering.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

A. Acceptable Manufacturers: Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted for review.

1. 480-Volt Front Accessible Switchgear
  - a. Eaton/Cutler-Hammer Magnum DS Low Voltage Metal Enclosed Switchgear with Magnum DS drawout power circuit breakers with Digitrip 1150 RMS solid state tripping units.
  - b. Square D/Schneider Electric (Power-Zone III Series 2 Low Voltage Metal Enclosed Switchgear with DSII drawout power circuit breakers with Powerlogic RMS solid state tripping units.) (Power-Zone 4 Low Voltage Metal Enclosed Switchgear with Masterpact drawout power circuit breakers with Micrologic RMS solid state tripping units.)
  - c. Siemens Type WL with RL drawout power circuit breakers with Static Trip III solid state tripping units and power metering option.
2. Microprocessor based Metering Systems
  - a. Eaton/Cutler-Hammer IQ DP-4000
  - b. General Electric Company Multilin
  - c. Square D/Schneider Electric Powerlogic
3. Transient Voltage Surge Suppression (TVSS):
  - a. Eaton/Cutler-Hammer
  - b. Advanced Protection Technologies Inc.

### 2.2 ELECTRICAL CONDITIONS

A. Stationary Structure: The power supply to the switchgear will be from the substation transformers fed from a medium voltage switchgear. Coordinate the circuit breaker trip units with the incoming feeder protection.

B. Switchgear:

1. Provide switchgear with the following features:
  - a. Individually mounted, drawout power air circuit breakers
  - b. Full insulated and isolated bus
  - c. Insulated run back bus

- d. Circuit breakers rated for 100 percent continuous ampere when installed in the switchgear enclosure
  - e. Interrupting rating of 42,000 rms symmetrical amperes at rated voltage
2. Label the switchgear suitable for use as service entrance equipment where appropriate.
  3. Provide all components required for complete functioning units as specified and as shown using factory built standardized units, completely dead front, totally enclosed and freestanding. Each unit comprises a stationary structure and a drawout circuit breaker.
  4. Design, manufacture and test all equipment in accordance with the NFPA 70, NEMA SG3, and SG5; IEEE C37.13, C37.20.1 and C37.51 and UL 1558 Standards.
  5. Provide the required number of units based on the necessary controls and metering as shown and specified.
- C. Distribution System: Connect the switchgear to 480-volt, 3-phase, 60-hertz, 3 wire, solidly grounded neutral power system.

## 2.3 COMPONENTS

- A. Stationary Structure: Construct the stationary structure of the switchgear as follows:
1. Build each unit out of bolted structural steel members, together with formed or fitted sections of smooth sheet steel approximately 90 inches high.
  2. Form completely enclosed compartments for various combinations of circuit breakers and auxiliary equipment.
  3. Provide sufficient structural strength to support all the equipment mounted within, withstand the handling and shipment of the units, maintaining the proper alignment, and be rigid and freestanding.
  4. Provide a formed front door panel for each compartment consisting of concealed type hinges.
  5. Reinforce panels as required to retain alignment and to support instruments, relays, and control equipment mounted thereon.
  6. Provide removable plates to permit access to all compartments individually.
  7. Isolate circuit breaker, buses, and incoming or outgoing cables with separate compartments formed by sheet steel barriers.

8. Provide a circuit breaker cubicle that allows the front face of the circuit breaker to extend to the front of the switchgear enclosure or be enclosed behind the circuit breaker compartment door.
9. Provide suitable ventilation for the individual compartments to keep the temperature of devices and buses within the permissible temperature limits as specified by the Standards.
10. Include insulated buses, fixed portion of primary disconnect devices, insulated connections, instrument transformers, control devices and fuses in the stationary structure. Provide removable boots to give access to bus joint for inspection and maintenance.
11. Provide a positioning mechanism for moving the removable circuit breaker to or from the connected position.
12. Provide guides for proper alignment of all engaging parts during movement of circuit breakers between the connected or disconnected position.
13. Provide stationary structure and circuit breakers that are interchangeable with every other circuit breaker of the same rating.
14. Extend the control and potential buses across all units of the switchgear.
15. Fully isolate the main bus compartment from the circuit breaker compartment and front access cable terminations.
16. Provide main buses rated not less than shown, consisting of rigidly supported insulated copper bars of suitable design and cross-sectional area to satisfactorily carry the rated current without exceeding the temperature rise as specified in the IEEE and NEMA standards.
17. Connect the bus with bolts having Belleville type lock washers.
18. Silver plate the copper bars at current-carrying connections.
19. Insulate all standard bus joints with preformed insulating boots secured by nylon hardware. Insulate nonstandard joints with tape and insulating compound.
20. Equip each switchgear unit with a 1/4-inch by 2-inch bare copper ground bus with a momentary rating at least equal to the highest momentary rating of the unit's circuit breakers. Extend the ground bus the entire length of the structure and comply with all applicable codes and regulations.
21. Ground each stationary unit directly to the ground bus.

22. Provide suitable lug terminals on the ground bus for connections to the station grounding system.
  23. Construct and arrange the stationary structure so that circuit breakers are completely isolated from each other within the same section and that sections are isolated from adjoining sections and front access cable sections.
  24. Provide steel floor channels suitable for embedding into the concrete floor for leveling and anchoring the switchgear. Drill and tap the floor channels as required. Provide bolts, nuts, and washers for anchoring the switchgear to the channel.
  25. Provide electronic interlocks where noted on the Contract Drawings. Where multiply lineups of like equipment are provided, interlock keys are to be keyed unique to each lineup. Where multiple interlock functions are to be provided in a common lineup, the interlock keys for each function are to be uniquely keyed.
- B. Switchgear Enclosure:
1. Provide front accessible switchgear with separate sections for cable compartments and power circuit breakers suitable for installation indoors with
- C. Drawout Circuit Breakers and Tripping Units:
1. Provide 480 volt, 3-pole, 600-volt class, drawout-type, power air circuit breakers with solid-state trip units rated as shown, having 42,000 rms amperes interrupting rating without current limiting fuses. Provide breakers having a 100 percent ampere rating when installed in the switchgear enclosure. Breakers with interrupting ratings of 85,000 rms amperes and below shall have a 30 cycle short time rating equal to the interrupting rating regardless of whether the breaker is equipped with instantaneous trip protection or not to ensure a fully selective system.
  2. Provide circuit breakers with trip free, manual-operating handles, stored-energy type trip mechanism and push-to-trip button; rated for 40 degrees C ambient operation. Provide main and tie circuit breakers with electronic interlocks as shown.
  3. Equip circuit breakers rated for 1200A or higher with means of arc energy reduction using an energy-reducing maintenance switch indicator. The energy reduction method shall be set to operate at less than available arcing current. Proof of effectiveness will be shown through a visual indication on the breakers showing the arc flash mitigation is engaged.

4. Equip the circuit breaker with mechanical interlocks to prevent moving the circuit breaker to and from the connected position without the circuit breaker open.
5. Provide circuit breakers that cannot be closed at any point between the operating and test positions or when the interlock is engaged.
6. Provide means to padlock the circuit breaker in the disconnect position.
7. Provide (electrically operated distribution, main, and tie circuit breakers).
8. Provide electrically operated circuit breakers suitable for 125 volts dc operation. Provide all auxiliary relays, electrical interlocks and cell position switches to accomplish the operation shown or specified.
9. Provide control connections between the stationary structure and removable circuit breaker that have floating terminals mounted in the stationary structure and engaging mating contacts on the breaker that are engaged when the breaker is in either the connected or test position.
10. Provide all circuit breakers with true rms sensing and microprocessor-based logic circuitry having the following protection features for tripping the circuit breaker.
  - a. Trip Indicators
  - b. Long time setting and time delay
  - c. Short time setting, time delay and  $I^2t$  response.
  - d. Instantaneous setting (distribution circuit breakers only).
  - e. Ground fault setting, time delay and  $I^2t$  response.
  - f. Short time and ground fault zone interlocking.
11. Provide all circuit breakers with digital, networked metering capabilities. Include measurement of the following parameters, at standard precision as defined by IEC 61557-12:T:
  - a. Current (RMS), Amps
  - b. Ground Fault Current (RMS), Amps
  - c. Phase-to-Phase Voltages (RMS), Volts
  - d. Active Power, kW
  - e. Reactive Power, kVAR
  - f. Apparent Power, kVA
  - g. Power Factor
  - h. Energy (kWh)
  - i. Reactive Energy (kVARh)
  - j. Apparent Energy (kVAh)

- D. Switchgear Connections and Terminals:
  - 1. Construct all current-carrying connections of copper having suitable capacity, bracing, insulation, temperature rating as the main bus.
  - 2. Connect current transformers in such a way that the transformers may be removed and changed without damaging the connection.
- E. Instrument Transformers:
  - 1. Current Transformers
    - a. Provide dry type current transformers, suitable for indoor service and rated as shown.
    - b. Provide sufficient thermal and mechanical capacity to withstand the maximum momentary current rating of the circuit breaker.
    - c. Provide solderless, clamp type shorting terminal blocks for secondary connections.
    - d. Properly identify the polarity of all current transformers with standard marking symbols.
    - e. Provide current transformers having an accuracy suitable for the instruments and meters specified using the normal burdens of the various devices, and not less than ANSI Standard requirements.
  - 2. Potential Transformers
    - a. Provide dry type potential transformers, suitable for indoor service. single-phase, 60 hertz, 120 volts.
    - b. Provide potential transformers that fit into and coordinate with the complete switchgear units, and with the instruments, relays, meters, and devices specified.
    - c. Rate the potential transformers not less than 100-volt-amperes at 55 degrees C ambient or 150-volt-amperes at 30 degrees C ambient thermal rating.
    - d. Provide potential transformers that can withstand a secondary short circuit for at least one second.
    - e. Provide the transformers meeting the requirements of the ANSI Standard accuracy classifications.
    - f. Provide current-limiting type primary fuses.

- g. Provide secondary fuses sized for the protection of potential transformers.

3. Grounding

- a. Ground current and potential transformer secondaries with copper conductors not smaller than No. 10 AWG and connecting to the ground bus.
- b. Ground potential transformer neutrals, where shown or required with a 600-volt green insulated copper conductor not smaller than No. 10 AWG.
- c. Provide connections to the bus that can be easily disconnected and isolated for field testing individually.
- d. Install each ground wire as a continuous run without intervening splices or terminal blocks.
- e. Ground secondary circuits of metering and relaying transformers at one point only.
- f. Effectively ground meter, relay and instrument transformer cases.

F. Lightning Arresters and Surge Capacitors:

- 1. Provide lightning arresters and surge capacitors for each incoming service.

G. Control Devices:

- 1. Provide provisions for manual closing of each circuit breaker.

H. Power Transducers:

- 1. Provide voltage, current, watt, var, frequency and power factor transducer as shown or required in accordance with the following:
  - a. Solid state devices.
  - b. Output: 4-20 ma into a 750 ohm load.
  - c. Provisions for zero and span adjustment with 0.25 percent accuracy.
  - d. Operate on external 120 volts ac, single phase, 60-hertz or derive their power supply from input signals.

- e. Calibrate power factor transducer between 50 percent lag and 50 percent lead.
  - f. Use watt and var transducers designed for 3-phase, 3 wire system.
- I. Microprocessor-Based Metering and Protection System: Provide a microprocessor-based metering and protection system having the following features:
- 1. UL recognized component meeting IEEE C37.90.
  - 2. Housed in an enclosure suitable for door mounting.
  - 3. Derive control power from metered line.
  - 4. Auto ranging metering of the following values:
    - a. AC amperes in each phase, 0.5 percent accuracy
    - b. AC voltage, phase-to-phase, phase-to-neutral, 0.5 percent accuracy
    - c. Watts, 1 percent accuracy
    - d. Vars, 1 percent accuracy
    - e. Power factor, 2 percent accuracy
    - f. Frequency, 0.5 percent accuracy
    - g. Watt demand, 1 percent accuracy with programmable 5-, 10-, 15-, 30-minute intervals
    - h. Watt-hours, 1 percent accuracy
    - i. Percent total harmonic distortion through the 31st harmonic
  - 5. Protection system with the following functions:
    - a. Voltage phase loss, less than 50% nominal line voltage
    - b. Current phase loss, less than 1/16 of the largest phase
    - c. Voltage phase unbalance, 5 to 40% in 5% increments
    - d. Phase voltage reversal
    - e. Overvoltage, 105 to 140% in 5% increments

- f. Undervoltage, 95 to 60% in 5% increments
  - g. Time delay for overvoltage, undervoltage, and phase unbalance, zero to twenty seconds in one second intervals.
6. Separate Form C (NO/NC) trip and alarm outputs contacts rated 10 amperes at 115-volt ac or 30-volt dc resistive.
  7. Addressable communications card capable of transmitting all data over a two-wire network to the Plant SCADA system as specified in Section 26 09 13.
- J. Transient Voltage Surge Suppression (TVSS):
1. Provide transient voltage surge suppression (TVSS) equipment that complies with UL 1449 and UL 1283.
  2. Provide units with a maximum continuous operating voltage that exceeds 115 percent of the nominal system operating voltage.
  3. Provide TVSS equipment suitable for wye-configured systems.
  4. Provide TVSS equipment having directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G).
  5. Provide TVSS equipment that distributes the surge current to all MOV components to ensure equal stressing and maximum performance and provides equal impedance paths to each matched MOV.
  6. Provide high-performance EMI/RFI noise rejection filters that attenuate the electric line noise at least 55 dB at 100 kHz using the MIL-STD-220A insertion loss test method.
  7. Wire internal components with connections utilizing low impedance conductors and compression fittings.
  8. Provide a monitoring panel for each system that incorporates the following features:
    - a. Green/red solid state indicator light to indicate which phase(s) have been damaged.
    - b. A flashing trouble light to indicate fault detection
    - c. Transient event counter
    - d. Audible alarm
    - e. Form C dry contacts for remote indication of the unit status.

9. Provide each TVSS for service entrance or branch location application with a minimum total surge current capable of withstanding 250kA or 160kA per phase respectively or as shown.

K. Wiring:

1. Completely assemble, wire and test each switchgear section at the factory, including buses, phase, neutral and ground connections, insulators, cleats, terminals, and terminal blocks.
2. Insulate all current-carrying parts.
3. Route all secondary wiring in the front of secondary compartments in wiring troughs and terminate at approved, molded-type terminal blocks with numbered marking strips, conveniently located with respect to the control conduits.
4. Provide terminal blocks with covers mounted so that the wires can be grouped and laced together.
5. Mark and identify all wiring in accordance with the manufacturer's wiring diagrams.
6. Label control wiring with an identification tag that indicates the terminal number of the opposite end connection.
7. Include wire labels and terminal numbers on schematic control and wiring diagrams.
8. Provide spade connectors for wires No. 12 and smaller and solderless lugs for larger sizes.
9. Provide terminals for all connections and an additional 15 percent spare terminals for all control and instrument wiring.
10. Provide No. 10 AWG stranded copper or larger with NEC Type SIS insulation for all current transformer secondary wiring.
11. Provide No. 14 AWG stranded copper or larger with NEC Type SIS insulation for all other control wiring.
12. Provide a fused switch or circuit breaker for the control power supply in each breaker compartment.

L. Identification:

1. Provide identification of the switchgear and its components as specified in Section 26 05 53.
2. Install nameplates for devices located on doors so they are readable to a person 5'-8" tall standing 3'-0" in front of the equipment.
3. Locate nameplates so that they are readily associated with the items labeled.
4. Where nameplates are installed on removable relays or removable device doors, install a nameplate within the relay or device.
5. Where nameplates are located on other compartments than those served, add additional engraving to identify units served.

2.4 ACCESSORIES

- A. Circuit Breaker Lifting Device: Provide a traveling type circuit breaker lifting device rail mounted on the top of each switchgear assembly. Provide all accessories required for lifting and lowering circuit breakers.
- B. Rubber Work Mats: Provide rubber work mats meeting the requirements of Section 26 29 53.

2.5 COMMUNICATIONS

- A. Provide communications accessories as required to interface all metering and protection devices, including circuit breakers to the plant controls system specified in Division 40, including:
  1. Power Supplies
  2. Gateways
  3. Interconnecting wiring and terminations.
  4. Barriers separating power wiring from communications wiring
- B. Provide a single fiber optic connection from the switchgear to the plant SCADA system.

2.6 OPERATION SEQUENCE

1. Provide (IEEE/ANSI Device 86) LOR that locks out main if tie is closed
2. Provide cell-switches that functionally indicate when a breaker is in either the operating or test position. Incorporate cell switch contacts into the breaker

control circuit to allow testing a breaker in the test position without affecting or tripping any other breaker.

## 2.7 SOURCE QUALITY CONTROL

### A. Tests:

1. Conduct shop tests after the switchgear has been assembled to determine general operating condition and circuit continuity, high voltage withstand and other safety standards.
2. Witness Tests: Carry out inspection and witness test of the completed switchgear assembly to assess its state of workmanship and standard of performance.
3. Notify the ENGINEER of the proposed date of testing a minimum of ten working days prior to the test.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install the switchgears in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.
- B. Conformance: Install the switchgears as shown, in conformance with manufacturers written instruction and recognized industry practices. Comply with requirements of NEMA standards, and applicable ANSI publications.
- C. Coordination: Coordinate with other work including cabling and wiring work as necessary to interface installation of switchgears with other work.
- D. Torque Requirements: Tighten electrical connectors and terminals including screws and bolts, in accordance with equipment manufacturer's published torque tightening values of equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals in accordance with UL Standard 486A.
- E. Fuses: Provide fuses in switchgear assemblies as required.
- F. Circuit Breaker Parameters: Set the circuit breaker protection parameters in accordance with the protective coordination study specified in Section 26 05 73.
- G. Grounding Connections: Make equipment grounding connections for the switchgear as shown. Tighten connections in accordance with UL standard 486A for permanent and effective grounding.

- H. Adjustments: Make all necessary adjustments to the equipment to provide complete and satisfactory operation of the system.
- I. Main and Feeder Cable Connections: Train and support cables to limit movement under fault conditions.
- J. Conduit Terminations: Conduits for power conductors are to be physically terminated in the structure where the associated power cables are intended to be terminated. Cabling between structures is only allowed where required for metering, control and monitoring.

### 3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Representative: Provide a factory-trained experienced, competent, and authorized representative of the switchgear manufacturer to visit the site of the Work and inspect, check, adjust if necessary, approve the equipment installation and provide training as specified in Section 01 79 00. Provide all instruments and equipment necessary to conduct required tests, adjustments and training. Have the manufacturer's representative utilize prepared comprehensive check sheets covering inspections, checks and tests required for the assembly of the switchgear. Submit copies of these documents executed and signed by the manufacturer's representative. Have the representative present when each equipment item is placed in operation. Provide representative service as often as necessary until all problems are corrected and each equipment item is installed and operating satisfactorily.
- B. Certified Report: Furnish a written report certifying that the equipment:
  - 1. Has been properly installed
  - 2. Is in accurate alignment
  - 3. Is free from any undue stress imposed by connections or anchor bolts, and
  - 4. Has been operated under full load conditions and that it operated satisfactorily
- C. SCADA Programming: Provide manufacturers representative at the job site as often as necessary to assist in the programming of the SCADA system for accessing the memory map of each device.
- D. Tests and Inspections: Perform the following tests and inspections. Record all tests and submit a written report for approval. Retest as necessary.
  - 1. Check all breakers, relays, meters, power and control fuses and auxiliaries for proper size, rating, and location. Clean control panels and cubicles. Remove all shipping materials.
  - 2. Inspect equipment and each breaker and report installation or shipping damage, loose materials, shipping blocks or contamination.

3. Torque test bus connections where field joints are made.
  4. Test key interlock systems to demonstrate proper function.
  5. Check that all control and panel circuits are numbered and tagged and panel door legends are engraved and installed as per drawings.
  6. Check equipment to determine that it is level, secured to foundations and that doors operate properly.
  7. Test insulation of all control and relay circuits to ground with a suitable megohmmeter. Take suitable precautions where electronic devices, instruments and instrument transformers are involved.
  8. After installation, but before any external connections are made to the switchgear, subject the switchgear to a 10-minute high potential test applied on the stationary structure and breakers. Use a test voltage of 75 percent of the standard factory production tests.
  9. Test all bus, cable, wire and other equipment operating at the service voltage that is energized by closing the incoming main line breakers. This test may be witnessed by the ENGINEER.
  10. Test protective relays to verify settings and determine proper operation.
- E. Training: Following completion of installation and field testing provide training for 12 employees of the OWNER in the proper operation, troubleshooting and maintenance of the equipment as outlined below. All training will be at the OWNER'S facilities at a time agreeable to the OWNER:
1. Operational Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.
  2. Maintenance Training: A minimum of two 4-hour sessions combining both classroom and hands-on instruction, excluding travel time.

### 3.3 GROUNDING

- A. System Inspections: Inspect ground system for compliance with the latest approved drawings.
- B. Connection Inspections: Inspect all ground connections for evidence of looseness and/or corrosion.

### 3.4 CLEANING AND PAINTING

- A. Shop Painting: Paint the switchgear as specified in Section 09 96 00.

- B. Field Painting: Touch up scratched and marred surfaces to match with original finishes.
- C. Work Mats: Thoroughly clean the floor in front of the switchgear and install the rubber work mats.

### 3.5 IDENTIFICATION

- A. General: Provide identification meeting the requirements of Section 26 05 53.
- B. Component Identification: Identify all system components, cables and wires by labels indicating unit numbers, circuit numbers and date of installation.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 28 31 00

### SIGNALING AND ALARM

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for providing an extension of the existing plant fire alarm system complete with alarm initiating devices, alarm notification appliances, control panel(s), auxiliary control devices, annunciators, power supplies and all required wiring. Provide all labor, equipment, materials and the performing of all operations relating to the installation.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 26 05 00 - Basic Electrical Materials and Methods
  - 2. Section 26 05 19 - Wires and Cables - 600 Volts and Below
  - 3. Section 26 05 33 - Electrical Raceway Systems
  - 4. Section 26 05 53 - Electrical Identification

##### 1.2 REFERENCES:

- A. Codes and standards referred to in this Section are:
  - 1. NFPA 70-National Electrical Code (NEC)
  - 2. NFPA 72-National Fire Alarm Code
  - 3. NFPA 101-Life Safety Code

##### 1.3 DEFINITIONS

- A. E.M.I.: Electro magnetic radio interference
- B. R.F.I.: Radio frequency interference

##### 1.4 SYSTEM DESCRIPTION

- A. Location: Provide fire alarm and smoke detection system for each of the following areas:
  - 1. Garage 4
  - 2. Transformer Room
  - 3. Generator Room
  - 4. Low Voltage Switchgear Room
  - 5. Medium Voltage Switchgear Room
  - 6. Unfinished Office Space

- B. System Type: Provide an addressable, noncoded, continuous sounding, electrically supervised fire alarm and smoke detection system with provisions for remote transmission of all alarm and trouble signals.
- C. General Operation: Use addressable device points equipped with analog sensing for addressable operation and analog detection and individual audio and visual signal circuit supervision in the system. Include all control panels, annunciators, manual pull stations, smoke detectors, heat detectors, bells, strobe lights, all wiring, outlet boxes, and all other necessary material for a complete operating system.
- D. Standby Mode Operation: Display a "SYSTEM IS NORMAL" message on the front panel and the current time and date. Flash the appropriate LED (Alarm, Supervisory, or Trouble) when an abnormal condition is detected. Pulse the panel audible signal for alarm conditions and sound steadily for trouble and supervisory conditions.
- E. Alarm Sequence Operation: Provide the following system alarm operation resulting from the alarm activation of any manual station, automatic detection device, or sprinkler flow switch:
  - 1. Sound audible and audio/visual alarm indicating appliances until silenced by the alarm silence switch at the control panel.
  - 2. Release all doors normally held open by door control devices.
  - 3. Provide a supervised signal to notify the fire department or an approved central station.
  - 4. Display the alarm on an 80 character LCD display with 40 characters used to represent the point label, and 40 characters used to represent the device type identification.
  - 5. Flash the system alarm red LED on the control panel.
  - 6. Sound the remote annunciator and an alarm tone until acknowledged at the control panel or the remote annunciator.
  - 7. Flash subsequent alarms received from other zones on the control panel and remote annunciator.
  - 8. Show the new alarm information on the LCD display.
- F. Smoke Detection Operation: Initiate an alarm verification operation upon the activation of any system smoke detector as follows:
  - 1. Reset the activated detector and wait for a second alarm activation.

2. If, within one (1) minute after resetting, a second alarm is reported from the same or any other smoke detector, process the alarm as described previously.
  3. If no second alarm occurs within one minute resume normal operation.
  4. Design the alarm verification system to operate only on smoke detector alarms.
  5. Process other activated initiating devices immediately.
- G. Acknowledgment of System Activity: Design the system to have an alarm list key that allows the operator to display all alarms, troubles, and supervisory service conditions with the time of occurrence.
- H. Alarm Silencing: Design the system alarm silencing as follows:
1. Pressing the "Alarm Silence" button causes all alarm signals to cease operation.
  2. Signals can not be silenced during alarm silence inhibit mode.
- I. System Reset: Design the system reset operation as follows:
1. The "System Reset" button returns the system to its normal state after an alarm condition has been remedied. Provide a LCD display to step the user through the reset process with simple English language messages.
  2. Should an alarm condition continue to exist and the system remains in the abnormal state, do not reset the system control relays.
  3. Display the message, "SYSTEM RESET INHIBITED" when the alarm silence inhibit function is active.
- J. Circuit Supervision: Provide independently supervised initiation circuits so that a fault in any one zone does not affect any other zone.
1. Provide independently supervised and independently fused indicating appliance circuits for alarm devices.
- K. Alarm Initiating Devices: Furnish alarm initiating devices in zones that automatically cause the following operations with activation of any device:
1. Activate audio and visual alarms continuously.
  2. Indicate the alarm zone at the Control Panel and Annunciator Panel.

3. Addressable devices are to be continuously interrogated by the fire alarm control panel CPU to determine whether normal, alarm or trouble conditions exist for each device.
- L. Power Supply: Power the system from the building's 120-volt a-c power system. Provide the control panel, the annunciators, and all system communication devices with a minimum of 36-hours of battery standby with 10-minutes of alarm operation at the end of this period. Supervise and annunciate all normal operating, supervisory, and battery power and fault conditions.
- M. Control Panel: Provide all circuits requiring 24-volt d-c system operating power with individual fusing at the control panel. Provide a minimum of five amps auxiliary fused power at the control panel.

#### 1.5 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1 and Section 26 05 00.
- B. Product Data Information: Provide manufacturer's original catalog data and descriptive information for all components of the equipment to be supplied. Include a complete list of current drain requirements during normal supervisory, trouble and alarm conditions and battery standby calculations showing total standby power required to meet the specified system requirements.
- C. CONTRACTOR's Shop Drawings: Furnish a riser diagram and wiring diagram of the complete fire alarm system.
- D. Operations and Maintenance Manuals: Submit, prior to field testing of the system, operation and maintenance manuals including a list of spare parts for the fire alarm and smoke detection system as specified in Division 1.
- E. Testing Instructions: Submit five complete, comprehensive, step-by-step, testing instructions giving recommended and required testing frequency of all equipment, methods for testing each individual piece of equipment, and a complete trouble-shooting manual explaining what might be wrong if a certain malfunction occurs and explaining how to test primary internal parts of each piece of equipment.
- F. Quality Control: Submit six copies of the certified final checkout report as attested to by the manufacturer's representative.
- G. Record Drawings: Upon completion of the system installation and testing, submit five complete sets of reproducible Record Drawings, showing installed wiring and color coding and wire tag notations for exact locations of all installed equipment, specific interconnections between all equipment and internal wiring of the equipment.

## 1.6 QUALITY ASSURANCE

- A. Codes: Furnish a system conforming to the following codes and standards:
  - 1. NFPA 70 - National Electrical Code (NEC)
  - 2. NFPA 101 - Life Safety Code
  - 3. State code having jurisdiction
  - 4. Underwriters Laboratories Inc. (UL)
  - 5. NFPA 72 - National Fire Alarm and Signaling Code
  - 6. National Electrical Manufacturer's Association (NEMA)
  - 7. Local codes and ordinances
- B. UL Label: Provide UL Listed equipment.
- C. Compatibility of Components:
  - 1. Furnish control panels, detectors and all other components that are the product of the same manufacturer.
  - 2. Furnish control panels, detectors and all other components that are listed for operation with the existing system.
- D. Manufacturers Experience:
  - 1. Furnish equipment manufactured by a firm with a minimum of 10 years experience manufacturing fire alarm systems.
  - 2. Furnish products similar to those the manufacturer has used satisfactorily in installations for not less than five years.

## 1.7 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 01 and as follows:
  - 1. Store and handle all components in accordance with the manufacturer's instructions.
  - 2. Receive equipment at site; verify applicable components and quantity delivered.
  - 3. Handle equipment to prevent internal components' damage and breakage, as well as denting and scoring of enclosure finish.
- B. Acceptance: Do not install damaged equipment.
- C. Storage and Protection: Store equipment in a clean, dry space and protect from dirt, fumes, water, construction debris and physical damage. After installation, protect equipment from damage and from environmental conditions.

## 1.8 SPARE PARTS

### A. Provide the following spare parts:

1. Two smoke detectors of each type
2. Two heat detectors of each type
3. One manual pull station
4. One audible/visible device of each type
5. One visible device of each type
6. Two complete replacements for each indicator lamp.
7. Two complete replacements for each fuse.

### B. Pack spare parts in containers bearing labels clearly designating contents and related pieces of equipment. Deliver spare parts in original factory packages. Identify all spare parts with information needed for reordering.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

#### A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.

1. The fire alarm system specified is manufactured by Tyco Simplex Grinnell and other manufacturers of specialty devices. Catalog and model numbers are intended to establish the type and quality of equipment and system design as well as exact operating features required. The manufacturer's Specification sheets of each item so listed is considered to be part of the specification and binding therein.
2. Other acceptable manufacturers:
  - a. Cerberus Pyrotronics/Siemens
  - b. Fenwal Protection Systems
  - c. Notifier by Honeywell

### 2.2 COMPONENTS

#### A. Control Panel: Furnish a Simplex Model 4008 Fire Alarm Control Panel with key operated locked door and shatter-resistant viewing window. Design each control panel with the following features:

1. Indicating Light Type: Use light emitting diodes (LED) throughout.
2. Switches: Provide operator interface switches for alarm acknowledge/silence (with resound), trouble acknowledge/silence (with

resound), system reset, manual evacuation, power disconnect, auxiliary one bypass (master fan disconnect), and auxiliary two bypass.

3. Indications: Furnish LED indicators for ac power-on (green), power trouble (yellow), remote annunciator trouble (yellow), alarm for each zone (red), trouble for each zone (yellow), and signal circuit trouble for each circuit (yellow).
4. Programmable Features: Provide a panel having the following programmable operating features that are dipswitch selectable in nonvolatile memory:
  - a. Desired signal circuit type of operation, alarm silence inhibit (to prevent silencing of signals before the selected minimum time has expired), signal circuit cut out, and manual evacuation.
  - b. Waterflow/sprinkler supervisory operation on two designated and distinct zones of the system.
  - c. Remote monitoring output capability for all alarms.
  - d. Separate alarm verification for smoke detectors, heat detectors, and manual stations.
  - e. Functional system test capability that will enable any activated initiating device to report its individual resident zone at the control panel and audibly over the signal circuit.
5. Transient Protection: Provide metal oxide varistors (MOV's) on the system power supply for transient suppression protection to the control panel.
6. Remote Outputs: Provide each zone and trouble condition with a Form C contact output for remote monitoring.
7. Control Relays: Provide control relays as required for the shutdown of ventilation system fans.
8. Standby Power: Furnish sealed rechargeable lead calcium batteries capable of providing 60 hours of complete fire alarm operation upon loss of primary power for standby power.
  - a. Provide an automatic, current limiting, combination high rate/float maintenance rate battery charger capable of returning fully discharged batteries to 70-percent of charge within 12-hours. Provide a battery voltmeter and charging current ammeter module.

## 2.3 ACCESSORIES

- A. Annunciator: Provide Simplex 4602 Series LED annunciators to indicate alarm, trouble or status of any system operation or condition. Design each annunciator with the following features:
1. Enclosure: Mount each annunciator in a NEMA 12 enclosure.
  2. Communications: Design each annunciator to communicate with a control panel over one twisted shielded pair of wires.
  3. Power Supply: Provide 24-volt d-c operating power for each panel, fused at the panel.
  4. Provide each annunciator with a common alarm and trouble circuit consisting of:
    - a. Control push button switches for alarm silence, trouble silence, system reset and manual evacuation duplicating the control panel switches.
    - b. Key "enable" switch to activate or deactivate the control switches.
    - c. System trouble LED.
    - d. Power on LED.
- B. Initiating Devices: Provide the following signal initiating devices:
1. Addressable Manual Pull Stations: Manual Pull Stations, Simplex Model 4099-9003. Double action manual pull stations with raised white lettering and a smooth high gloss red finish. Key the stations alike with the fire alarm control panel. When a station is operated, lock the handle in a protruding manner to facilitate quick visual identification of the activated station. Provide with individual addressable communications module for constant monitoring of status and communication changes to the connected fire alarm control panel.
  2. Addressable Detectors
    - a. Smoke Detectors, Simplex Model 4098-9714 w/4098-9789 compatible base. Photoelectric smoke detectors designed to restrict entry of dust and air turbulence with drift compensation software filtering that compensates for environmental factors and component aging while establishing an accurate reference for evaluating new activity. Provide with digital communication of analog sensing which analyzes and stores an average value at the fire alarm control panel for comparison to the sensors present value for determining alarm or abnormal

conditions. Shield the electronics of the unit to protect against false alarms from electro-magnetic interference and radio-frequency. Furnish units with a red LED that pulses to indicate power on and glows continuously to indicate alarm. Provide detectors having a magnetic functional test feature and capable of being supplied with a remote alarm LED indicator. Provide units having a separate mounting base with terminal strip and adapter plate where required for specific mountings.

- b. Heat Detectors, Simplex Model 4098-9733 w/4098-9789 compatible base. Self storing heat sensors with individual programmable rate compensated, fixed temperature sensing and rate-of-rise temperature sensing addressed via integral addressable electronics that constantly monitors the status of the sensor. Adjust fixed temperature setting to 135 degrees F and rate-of-rise setting to 15 degrees F per minute. Furnish units with a red LED that pulses to indicate power on and glows continuously to indicate alarm. Provide detectors capable of being supplied with a remote alarm LED indicator. Provide units having a separate mounting base with terminal strip and adapter plate where required for specific mountings.
3. Remote LED Alarm Indicator, Simplex Model 2098-9808: Provide a remote alarm indicator with red LED suitable for mounting on a single gang box for remote monitoring of detectors where status cannot be readily observed on the detector.
- C. Miscellaneous Components and Devices: Provide the following miscellaneous components and devices:
  1. Isolator Base, Simplex Model 4098-9793. Isolator base for use with an addressable sensor for isolating a short circuit occurring on the output of the base to downstream devices.
  2. Supervised Relay, Simplex Model 2098-9737. DPDT supervised relay for use with non-addressable initiating devices used with addressable systems.
- D. Audible/Visible Notification Appliances: Provide addressable Audible/Visible Appliance, Simplex Model 4906-9227(4906-9231 Weatherproof) Design the unit's enclosure to contain a horn and high intensity, multi-candela Xenon strobe flashing light with a clear translucent lens. Imprint with the word "FIRE" in white on a red enclosure. Provide with individual electronic notification circuitry for programming adjustable features, addressable notification and magnet test diagnostics.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install all fire alarm and smoke detection system in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.
- B. Supervision: Supervise the installation by a UL Inc. certified service technician from the manufacturer of the fire alarm equipment covering the following:
  - 1. Pre-installation visit to the job site to review equipment submittals and verify the system wiring method.
  - 2. Periodic visits to the job site to verify installation and wiring of the system.
  - 3. Verify final connections, final checkout and certification of the system.
  - 4. Date and document all job site visits in writing and submit reports. Note any discrepancies on this Document.
- C. Adjustments: For signaling devices and notification appliances with adjustable settings, communicate with each via the fire alarm control panel and set to the specified preferred settings or those otherwise recommended for the installation.
- D. Power: Provide 120-volt, 1-phase, 2-wire 60-hertz primary power to each Fire Alarm Control Panel.
- E. Conduits: Install the entire system in conduit with raceways, boxes, fittings and the like, sized to accommodate the manufacturer's equipment as specified in Section 26 05 33.
- F. Color Code: Color code all system wiring in accordance with local codes and as recommended by the manufacturer. Provide wiring as specified in Section 26 05 19.
- G. Pull Station Installation Height: Install manual pull stations 42 inches above the finished floor.
- H. Audible/Visible Device Installation Height: Install audible/visible devices 80-inches above the finished floor or 6 inches below ceiling whichever is lower.
- I. Adjustments: If detectors are found to interfere with other equipment or locations interfere with proper operation of the detectors, adjust their locations as required.

### 3.2 FIELD QUALITY CONTROL

- A. Tests: Perform testing of the system in accordance with the procedures outlined in NFPA Standard 72A and as follows:
  - 1. Operate every fire alarm device to demonstrate proper operation and correct annunciation at the Fire Alarm Control Panel and Remote Annunciator.
  - 2. Perform one half of all tests on battery standby power. Where applying heat would destroy any detector, devices may be manually operated. Open at least two locations per zone in each initiating circuit and each signaling circuit to check for the presence of correct supervisory circuitry.
- B. Confirmation: After satisfactory completion of all testing, provide certification attesting to the satisfactory completion of the fire alarm equipment installation.

### 3.3 OPERATION DEMONSTRATION

- A. Perform an operational demonstration of the system.
- B. Give a minimum of 8 hours of operational instructions and training to the OWNER and/or his representative on the system.

### 3.4 CLEANING AND PAINTING

- A. Shop Painting: Shop paint meeting the requirements of Section 09 96 00.
- B. Field Painting: Paint "RED" all conduit, electrical boxes, covers and wireways associated with the fire alarm systems meeting with the approval of the authority having jurisdiction.
- C. Touch Ups and Finish Repairs: Upon completion of the installation, inspect the entire system for scratched or marred surfaces. Repair, clean and touch up to match the original finish.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 31 23 16

### EXCAVATION - EARTH AND ROCK

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for performing open-cut excavations to the widths and depths necessary for constructing structures, pipelines, and conduits including excavation of any material necessary for any purpose pertinent to the construction of the Work.
- B. Related Work Specified in Other Sections Includes, but is Not Limited to, the Following:
  - 1. Section 01 50 00 - Construction Facilities and Temporary Controls
  - 2. Section 31 23 23 - Backfilling
  - 3. Section 31 25 00 - Slope Protection and Erosion Controls
  - 4. Section 31 41 00 - Shoring, Sheeting and Bracing

##### 1.2 DEFINITIONS

- A. Earth: "Earth" includes all materials which, in the opinion of the ENGINEER, do not require blasting, barring, or wedging for their removal from their original beds. Specifically excluded are all ledge and bedrock as well as pieces of masonry larger than one cubic yard in volume.
- B. Rock: "Rock" includes all materials which, in the opinion of the ENGINEER, require ramming, barring, or wedging for removal from their original beds and which have compressive strengths in their natural undisturbed state in excess of 300 psi. Masonry larger than one cubic yard in volume is classed as rock excavation.

##### 1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.

##### 1.4 SITE CONDITIONS

- A. Geotechnical Investigation: Geotechnical investigations and reports prepared are intended only for use by the OWNER and ENGINEER in preparing the Contract Documents.
  - 1. The geotechnical investigation reports may be examined for whatever value it may be worth. However, this information is not guaranteed in accuracy or completeness.

2. The geotechnical investigation reports are included in the Contract Documents in Appendix A.
- B. Actual Conditions: Make any geotechnical investigations deemed necessary to determine actual site conditions.
  - C. Underground Utilities: Locate and identify all existing underground utilities prior to the commencement of Work.
  - D. Quality and Quantity: Make any other investigations and determinations necessary to determine the quality and quantities of earth and rock and the methods to be used to excavate these materials.

## PART 2 PRODUCTS

Not Used

## PART 3 EXECUTION

### 3.1 PREPARATION:

- A. Contact J.U.L.I.E. and the OWNER not less than three (3) working days before performing Work.
  1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum locations.
- C. Notify utility company to remove and relocate utilities.
- D. Protect utilities indicated to remain from damage.
- E. Protect plant life, fences, lawns, rock outcroppings and other features remaining as a portion of final landscaping.
- F. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

### 3.2 EXCAVATION SAFETY

- A. Make all excavations in a safe manner. Provide appropriate measures to retain excavation side slopes and prevent rock falls to ensure that persons working in or near the excavation are protected.

- B. Safety is the sole responsibility of the CONTRACTOR.

### 3.3 CODES, ORDINANCES, AND STATUTES

- A. Familiarize with, and comply with, all applicable codes, ordinances, statutes, and bear sole responsibility for the penalties imposed for noncompliance.
- B. Construction site erosion control must comply with the applicable erosion control ordinance and construction site erosion control plan and permit.

### 3.4 GENERAL

- A. Implement erosion and sediment control as detailed in Section 01 50 00 and Section 31 25 00.
- B. Banks: Shore or slope banks to the angle of repose to prevent slides or cave-ins in accordance with Section 31 41 00.
- C. Prevent water from entering the trench to the extent required to properly grade the bottom of the trench and allow for proper compaction of the backfill. Ensure that dewatering of surface water that enters the excavation is provided for proper completion of the work and protection of their equipment and materials.
- D. All excavated soil shall be spread, piled, or removed from site.
- E. Do not interfere with 45 degree bearing splay of foundations. Where interference is unavoidable, provide a foundation stabilization plan for approval by ENGINEER.
- F. Walls and faces of excavations shall be protected against slides and cave-ins by sloping of ground, or by a shoring system, trench box, sheeting, sheet piling, cribbing, or equivalent means of protection.
- G. Take care not to disturb the bottom of the excavation.
- H. Do not damage existing underground mechanical and electrical utilities and systems encountered during excavation activities.
- I. Where possible interferences are indicated or expected to exist, hand-excavate to expose and locate them during excavating operations.
- J. Piles of excavated material shall not be allowed to accumulate, cause interference with performance of the work or be placed to prevent proper drainage of surface water.
- K. Include breaking up, removal, and disposal of existing roadways, and removal and cleaning out of entire excavated area, pits, trenches, pavement, parking lots, and similar excavation for proper completion of the work.

- L. Remove existing concrete, bituminous paving, concrete walks, and curbs within areas of construction.
- M. Remove material from excavations. This includes fragments of brick, cinders, concrete, gravel, rock fragments, lumped subsoil, boulders and rock, and miscellaneous loose fill.
- N. Concrete, excess material, and debris shall be legally disposed of.
- O. Correct over excavated areas.

### 3.5 STRUCTURE EXCAVATION

- A. Excavation Size: Provide excavations only of sufficient size to permit the Work to be economically and properly constructed in the manner and of the size specified.
- B. Excavation Shape: Shape and dimension the bottom of the excavation in earth or rock to the shape and dimensions of the underside of the structure or drainage blanket wherever the nature of the excavated material permits.
- C. Excavation Limits: Responsibility of the limits of construction are the sole responsibility of the CONTRACTOR. Careless excavation by the CONTRACTOR outside of limits of construction and subsequent work is not cause for additional compensation by the OWNER.
- D. Compaction: Before placing foundation slabs, footings, or backfill, proof roll the bottom of the excavations to detect soft spots.
  - 1. For accessible areas, proof roll with a ten-wheel tandem axle dump truck loaded to at least 15 tons or similarly loaded construction equipment.
  - 2. For small areas, proof roll with a smooth-faced steel roller filled with water or sand, or compact with a mechanical tamper.
  - 3. Make one complete coverage, with overlap, of the area.
  - 4. Over excavate soft zones and replace with compacted select fill in accordance with Section 31 23 23.

### 3.6 PIPE TRENCH EXCAVATION

- A. Identify required lines, levels, contours, and datum locations. Confirm exact pipe alignment and grades. Alignment and grade shall generally conform to the alignment and grade provided in the Drawings, however, avoid all existing and proposed facilities, buildings, structures, equipment, and other buried pipelines and utilities. In general, where a pressurized main crosses a gravity flow pipe, the gravity pipe alignment and grade shall have the priority.

- B. Responsibility of the pipe trench limits of construction are the sole responsibility of the CONTRACTOR. Careless excavation by the CONTRACTOR outside of limits of construction and subsequent work is not cause for additional compensation by the OWNER.
- C. In general, pipe shall be installed in vertical and horizontal directions and parallel to building lines and other existing or proposed pipelines unless shown otherwise. Avoid unnecessary bends, fittings, deflections, or other means which prevent straight and uniform flow of pipe media.
- D. Properly brace and protect trees, shrubs, poles and other structures which are to be preserved. Unless shown or specified otherwise, preserve all trees and large shrubs. Hold damage to the root structure to a minimum. Small shrubs may be preserved or replaced with equivalent specimens.
- E. Adequate Space: Keep the width of trenches to a minimum, however, provide adequate space for workers to place, joint and backfill the pipe properly.
  - 1. Do not allow the clear width of the trench at the level of the top of the pipe to exceed the sum of the outside diameter of the pipe barrel plus 20 inches for pipe 4 through 18 inches in diameter nor the outside diameter of the pipe barrel plus 24 inches for pipe 24 inches in diameter or larger, unless otherwise approved by ENGINEER.
  - 2. In sheeted trenches or when trench boxes are used, measure the clear width of the trench at the level of the top of the pipe to the inside of the sheeting.
  - 3. Should the maximum trench widths specified above be exceeded without written approval, provide concrete cradle or encasement for the pipe as directed. No separate payment will be made for such concrete cradle or encasement.
- F. Depth: Excavate to the lines and grades as shown on the Drawings. Excavate trenches to a minimum depth of 4 inches below the bottom of the pipe or the bottom of encasement for electrical ducts, unless otherwise shown, specified, or directed, so that pipe bedding material can be placed in the bottom of the trench and shaped to provide a continuous, firm bearing for duct encasement, pipe barrels, and bells.
  - 1. If, without direction from the ENGINEER, the trench has been excavated below the required depth for pipe bedding material placement, fill the excess depth with pipe bedding material as specified herein to the proper sub-grade.
- G. Unstable Materials: If unstable material is exposed at the level of the bottom of the trench excavation, excavate the material in accordance with the subsection headed "Authorized Additional Excavation".

1. When, in the judgment of the ENGINEER, the unstable material extends to an excessive depth, the ENGINEER may advise, in writing, the need for stabilization of the trench bottom with additional pipe bedding material, crushed stone, or gravel mat or the need to provide firm support for the pipe or electrical duct by other suitable methods.
  2. Payment for such trench stabilization will be made under the appropriate Contract Items.
- H. Length of Excavation: Keep the open excavated trench preceding the pipe or electrical duct laying operation and the unfilled trench, with pipe or duct in place, to a minimum length which causes the least disturbance. Provide ladders for a means of exit from the trench as required by applicable safety and health regulations.
- I. Water: Allow no water to rise in the trench excavation until sufficient backfill has been placed to prevent pipe or duct flotation. Pipe shall not be laid in water.
- J. Backfill all pipe trenches at the completion of work each day.

### 3.7 ROCK EXCAVATION

- A. Rock Excavation: Excavate rock within the boundary lines and grades as shown, specified, or required.
1. Excavate and remove rocks by mechanical methods. Cut away at bottom of excavation to form level bearing.
  2. Rock removed from the excavation becomes the property of the CONTRACTOR. Handle, transport, and dispose of excavated rock at an off-site disposal location. Obtain the off-site disposal location.
  3. Remove all shattered rock and loose pieces.
  4. Rocks / stones larger than 8 inches in any direction shall not be used for backfill material.
- B. Structure Depths: For cast-in-place structures, excavate the rock only to the bottom of the structure, foundation slab, or drainage blanket.
- C. Trench Depth: For trench excavation in which pipelines or electrical ducts are to be placed, excavate the rock to a minimum depth of 6 inches below the bottom of the pipe or duct encasement and refill the excavated space with pipe bedding material. Include placing, compacting and shaping pipe bedding material in the appropriate rock excavation Bid items.
- D. Manhole Depths: For manhole excavation, excavate the rock to a minimum depth of 8 inches below the bottom of the manhole base for pipelines 24 inches in diameter and larger and 6 inches below the bottom manhole base for pipelines less than 24

inches in diameter. Refill the excavated space with pipe bedding material. Include placing, compacting and shaping pipe bedding material for manhole bases in the appropriate rock excavation Bid items.

- E. Over-Excavated Space: Refill the excavated space in rock below structures, pipelines, conduits, and manholes, which exceeds the specified depths with Class D concrete, pipe bedding, flowable fill, select fill, or other material as directed. Include refilling of over-excavated space in rock as part of the rock excavation Bid items.
- F. Payment: Rock excavation, including ramming, removing from trench, handling, stockpiling, and hauling off-site will be paid for under the appropriate rock excavation Bid items. Placing, compacting and shaping of the additional pipe bedding material or fill material, as required will be considered incidental to the rock excavation cost.
- G. Blasting: Blasting will not be permitted.

### 3.8 FINISHED EXCAVATION

- A. Finish: Provide a reasonably smooth finished surface for all excavations, which is uniformly compacted and free from irregular surface changes.
- B. Finish Methods: Provide a degree of finish which is ordinarily obtainable from blade-grade operations, except as otherwise specified in Section 31 23 23.

### 3.9 PROTECTION

- A. Traffic and Erosion: Protect newly graded areas from traffic and from erosion.
- B. Provide adequate fencing / barriers for fall protection around all open excavations.
- C. Where excavations are to be left open overnight in a non-controlled site such as the regraded slope or the trench drain alignment, cover the entire excavation with steel road plate to provide full fall protection.
- D. Repair: Repair any settlement or washing away that may occur from any cause, prior to acceptance. Re-establish grades to the required elevations and slopes.
- E. Other Requirements: Conduct all Work in accordance with the environmental protection requirements specified in Section 01 50 00.

### 3.10 AUTHORIZED ADDITIONAL EXCAVATION

- A. Additional Excavation: Carry the excavation to such additional depth and width as authorized in writing from the ENGINEER, for the following reasons:
  - 1. In case the materials encountered at the elevations shown are not suitable.

2. In case it is found desirable or necessary to go to an additional depth, or to an additional depth and width.
- B. Refill Materials: Refill such excavated space with either authorized Class D concrete, pipe bedding, flowable fill, or select fill material as authorized by the ENGINEER.
- C. Compaction: Where necessary, compact fill materials to avoid future settlement to densities specified in Section 31 23 23 or to the satisfaction of the ENGINEER.
- D. Payment: Additional earth excavations so authorized and concrete, pipe bedding, flowable fill, or select fill materials authorized for filling such additional excavation and compaction of select fill materials will be paid for under the appropriate Contract Items or where no such items exist, as a change in the Work.

### 3.11 UNAUTHORIZED EXCAVATION

- A. Stability: Refill any excavation carried beyond or below the lines and grades shown, except as specified in the subsection headed "Authorized Additional Excavation", with such material and in such manner as may be approved to provide for the stability of the various structures.
- B. Refill Materials: Refill spaces beneath all manholes, structures, pipelines, or conduits excavated without authority with Class D concrete, pipe bedding, flowable fill, or select fill material, as approved.
- C. Payment: Refill for unauthorized excavation will not be measured and no payment will be made.

### 3.12 SEGREGATION STORAGE AND DISPOSAL OF MATERIAL

- A. Stockpiling Suitable Materials: Stockpile topsoil suitable for final grading and landscaping and excavated material suitable for backfilling or embankments separately on the site in approved locations.
- B. Stockpile Locations: Store excavated and other material a sufficient distance away from the edge of any excavation to prevent its falling or sliding back into the excavation and to prevent collapse of the wall of the excavation. Provide not less than 2 feet clear space between the top of any stockpile and other material and the edge of any excavation.
- C. Excess Materials: Transport and dispose of surplus excavated material and excavated material unsuitable for backfilling or embankments at an off-site disposal location. Obtain the off-site disposal location.

### 3.13 REMOVAL OF WATER

- A. Water Removal: During excavation and until completion and acceptance of the Work at final inspection, provide ample means and equipment with which to remove

promptly and dispose properly water entering any excavation or other parts of the Work in accordance with the requirements of Section 31 23 23.

- B. Dry Excavations: Keep the excavation dry.
- C. Water Contact: Allow no water to rise over or contact masonry and concrete until the concrete and mortar have attained a set and, in any event, not sooner than 12 hours after placing the masonry or concrete.
- D. Discharge of Water: Dispose of water pumped or drained from the Work in a safe and suitable manner without damage to adjacent property or streets or to other work under construction.
- E. Protection: Provide adequate protection for water discharged onto streets. Protect the street surface at the point of discharge.
- F. Sanitary Sewers: Discharge no water into sanitary sewers.
- G. Storm Sewers: Discharge no water containing settleable solids into storm sewers.
- H. Repair: Promptly repair all damage caused by dewatering the Work.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 31 23 22

### CONSTRUCTION SITE DEWATERING

#### PART 1 GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Labor, materials, equipment and services necessary to control, handle, and dispose of ground and surface water encountered on site and affecting project construction.
2. Repair or replacement of property damaged due to failure to properly execute requirements of this Section.
3. Treatment of ground or surface water prior to disposal.

###### B. Related Work Specified in Other Sections includes, but is not limited to, the following:

1. Section 31 25 00 – Slope Protection and Erosion Control
2. Section 31 23 16 - Excavation - Earth and Rock

##### 1.2 REGULATORY REQUIREMENTS

###### A. CONTRACTOR shall comply with applicable rules and regulations for dewatering operations in accordance with:

1. State of Illinois Environmental Protection Agency - Storm Water Pollution Prevention and General Permit discharge requirements.
2. CONTRACTOR shall comply with other local, state, or federal agencies having jurisdiction related to Work of this Section.

###### B. Comply with North Cook County Soil and Water Conservation District requirements, City of Evanston Erosion and Sediment on Construction Sites Control Ordinances (Chapter 23), and Illinois Urban Manual Planning Principles and Practice Standards to control, handle, and dispose of ground and surface water.

###### C. CONTRACTOR shall obtain permits applicable to work of this Section as required by regulatory agencies.

### 1.3 PERFORMANCE REQUIREMENTS

- A. Provide continuous control of water during course of construction.
- B. Provide adequate backup systems to accomplish control of water.
- C. Provide method of control, handling, and disposal of ground and surface water by whatever means necessary and in conformance with this Section, to obtain satisfactory working conditions and maintain progress of Work.
- D. Perform drainage, pumping, and disposal without damage to adjacent property or structures, without interference with operation of other contractors or rights of public or private owners, or pedestrian and vehicular traffic.
- E. CONTRACTOR shall modify water control system at its own expense if, after installation and while in operation, it causes or threatens to cause damage to adjacent property or to existing buildings, structures, or utilities.

### 1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Submit for informational purposes only, working drawings and description of proposed ground and surface water control facilities including but not limited to:
  - 1. Methods, equipment, and power supply.
  - 2. Pollution control facilities and discharge locations to be utilized.
  - 3. Method of monitoring groundwater levels and drawdown.
  - 4. Construction details of dewatering wells.
  - 5. Schedule of installation and operation.
  - 6. Copies of permits obtained.
- C. Submittal shall be made thirty days prior to installation of water control system.
- D. Resubmittals shall be made during course of construction if system is modified during installation or operation.

### 1.5 EXISTING CONDITIONS

- A. Geotechnical-related information for the Water Plant Electrical Reliability Project used to identify the water table at the site is provided as Appendix A to these specifications.

## 1.6 WARRANTY

- A. Loss or damage arising from removal or disturbance of groundwater, including but not limited to claims for subsidence and loss of structure support that may occur in prosecution of Work of this Section, shall be sole responsibility of CONTRACTOR.
- B. If CONTRACTOR fails to correct damage resulting from its operations, OWNER may, after giving CONTRACTOR 30-day written notice, proceed to repair, rebuild, or otherwise restore such damaged property, and cost thereof will be deducted from any compensation which may be or become due CONTRACTOR under this Contract.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Selected by CONTRACTOR to accomplish Work of this Section.

### 2.2 EQUIPMENT

- A. Utilize equipment specifically applicable to dewatering work.
- B. Operate and maintain equipment in an efficient manner to produce acceptable results.

## PART 3 EXECUTION

### 3.1 SUBDRAINAGE

- A. Intercept and divert surface drainage away from work sites by use of dikes, curb walls, ditches, sumps, or other means.
- B. Design surface drainage systems so that they do not cause erosion on or off site.
- C. Control surface runoff to prevent entry of water into excavations.
- D. Remove surface drainage systems when no longer needed.

### 3.2 WATER CONTROL IN EXCAVATIONS

- A. Use water control methods which are appropriate to ground conditions, construction operations, and requirements of these documents.
- B. Methods shall involve removal of water within excavations and may involve removal of water outside excavations or construction of facilities to control water movement into excavation.

- C. Water control measures shall minimize adverse effects of elevated or reduced water pressure on Work, surrounding ground, and adjacent facilities and structures.
- D. Design and operate water control measures to prevent removal of in-situ materials, or loosening or softening of in-situ materials within excavations.
- E. Control groundwater and surface water so that construction of foundations, tunnels, shafts, trenches, and other structures will be performed without adverse effects of water, and to prevent hydrostatic uplift pressures until construction has been completed.
- F. Control water during periods when concrete is being placed, pipe or conduit is being laid, and at such other times as is necessary for efficient and safe execution of Work.
- G. Where groundwater is removed from ground, install piezometers and monitor groundwater levels as necessary to evaluate effect of dewatering on structures.
- H. Preparation and procedures shall be in place to take immediate steps to control large amounts of water inflow into an excavation.
  - 1. A large amount of inflow into an excavation requiring immediate control shall be defined as that which adversely affects performance of the Work or has potential of causing loss or damage to adjacent property or structures.
- I. Structures including, but not limited to, buildings, bridges, streets, and utilities that become unstable or vulnerable to settlement due to removal or disturbance of groundwater shall be supported immediately.
- J. Structure support shall include, but not be limited to, bracing, shoring, underpinning, or compaction grouting.

### 3.3 DEWATERING WELLS

- A. CONTRACTOR shall obtain a permit for dewatering wells that singly or in aggregate produce in excess of 100,000 gallons per day from:
  - 1. State of Wisconsin Department of Natural Resources (DNR), Bureau of Drinking Water and Groundwater.
- B. Permits shall be obtained prior to installation of wells. Provide two copies of permits to RESIDENT PROJECT REPRESENTATIVE.
  - 1. Wells shall be constructed, operated and abandoned in accordance with:
    - a. State of Illinois Environmental Protection Agency and any other Authority having Jurisdiction.

- C. Dewatering wells shall be constructed and operated to prevent removal of fines.

#### 3.4 DISPOSAL OF WATER

- A. Water removed from construction site shall be discharged through pipe or hoses.
- B. Conveying of water in open ditches or trenches will not be allowed.
- C. Water shall be discharged in a manner that will not cause soil erosion at discharge point, or cause siltation or flooding in any stream or storm sewer, or on any adjacent property.
- D. Permits to use storm or sanitary sewers for water disposal shall be obtained from authority having jurisdiction of facilities. Costs of meeting requirements for and use of these facilities shall be borne by CONTRACTOR.
- E. CONTRACTOR shall not cause flooding by overloading or blocking flow in drainage facilities and shall leave facilities unrestricted and clean upon completion of use.
- F. CONTRACTOR shall repair or replace any damage to facilities as a result of its operations as directed by RESIDENT PROJECT REPRESENTATIVE or authority having jurisdiction at CONTRACTOR's sole expense.

#### 3.5 TREATMENT OF WATER

- A. CONTRACTOR shall obtain a permit for direct or indirect discharge to waterways from:
  - 1. State of Illinois Environmental Protection Agency and any other Authority having Jurisdiction.
  - 2. Provide two hard copies of permit to RESIDENT PROJECT REPRESENTATIVE prior to installation of treatment facility.
- B. Provide drawings and specifications for treatment and discharge of water and disposal of sludge from settling basins or treatment plant, for approval to the Authorities having Jurisdiction, prior to the commencement of any Work.
- C. Treatment of water to remove contaminants shall be by use of settling basins, mechanical wastewater treatment plants, or other approved means.
- D. Design treatment systems for maximum discharge anticipated. Treatment systems shall be capable of expansion if greater capacity becomes necessary during course of Work.

- E. Obtain approval of submittals prior to installation of treatment and discharge systems.
- F. Comply with State of Illinois Environmental Protection Agency and any other Authority having Jurisdiction's requirements for treatment of discharges which are dependent upon quantity of daily discharge and sediment content of discharge.
  - 1. Oil and grease content are additional criteria.
  - 2. Effluent limits are based upon daily average.
  - 3. Certified operator may be required to operate treatment facilities.
  - 4. Sampling frequency is dependent upon contaminant levels and discharge rates.
  - 5. Restrictions may vary and it shall be CONTRACTOR's responsibility to satisfy requirements.

END OF SECTION

## SECTION 31 23 23

### BACKFILLING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Backfilling all excavation to the original surface of the ground or to such other grades as may be shown or required. Obtain approval before backfilling against masonry structures. Remove from all backfill, any compressible, putrescible, or destructible rubbish and refuse and all lumber and braces from the excavated space before backfilling is started. Remove sheeting.
- B. Equipment Limitations: Do not permit construction equipment used to backfill to travel against and overcast-in-place concrete structures until the specified concrete strength has been obtained, as verified by concrete test cylinders. In special cases where conditions warrant, the above restriction may be modified providing the concrete has gained sufficient strength, as determined from test cylinders, to satisfy design requirements for the removal of forms and the application of load.
- C. Related Work Specified in Other Sections Includes, but is Not Limited to, the Following:
  - 1. Section 31 23 16 - Excavation - Earth and Rock
  - 2. Section 31 25 00 - Slope Protection and Erosion Control
  - 3. Section 31 41 00 - Shoring, Sheeting, and Bracing

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ASTM D 1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>))
  - 2. ASTM D6936 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
  - 3. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

1.3 SUBMITTALS

- A. Provide all submittals, including the following in accordance with Division 1.
  - 1. Certified laboratory reports of all proposed backfill material.

PART 2 PRODUCTS

2.1 BACKFILL MATERIAL - GENERAL

- A. General: Backfill with sound materials, free from waste, organic matter, rubbish, boggy, or other unsuitable materials.
- B. General Materials Requirements: Conform materials used for backfilling to the requirements specified. Follow common fill requirements whenever specialized fill is not specified. Determine and obtain the approval of the appropriate test method where more than one compaction test method is specified.
- C. Frozen Materials: Do not use frozen material for backfilling.

2.2 SELECT FILL

- A. Materials for Select Fill: Use gravel, crushed stone, limestone screenings or other granular or similar material as approved which can be readily and thoroughly compacted to 95 percent of the maximum dry density obtainable by ASTM D 1557 or use IDOT standard gradation CA 6 aggregate.
  - 1. Grade select fill between the following limits:

U.S. Standard Sieve	Percent Passing by Weight
2 inch	100
1-1/2 inch	90-100
1 inch	75-95
1/2 inch	45-70
#4	25-50
#10	15-40
#200	5-15

- 2. Very fine sand, uniformly graded sands and gravels, or other materials that tend to flow under pressure when wet are unacceptable as select fill.

2.3 PIPE BEDDING

- A. Bedding material may be crushed stone chips made from crushing sound limestone or dolomite, crushed or uncrushed gravel, crushed steel furnace slag, or air-cooled blast furnace slag. The material shall be hard, tough, and durable.
  - 1. Material shall conform substantially to the gradations listed below or IDOT standard gradation CA7.

Grading Requirements for 3/4-inch Crushed Stone Chips  
(ASTM C 33 – AASHTO No. 67)

U.S. Standard Sieve	Percent Passing by Weight
1 inch	100
3/4 inch	90-100
3/8 inch	20-55
#4	0-10
#8	0-5

2.4 COMMON FILL

- A. Materials for Common Fill: Material from on-site excavation may be used as common fill if it can be readily compacted to 90 percent of the maximum dry density obtainable by ASTM D 1557 and does not contain unsuitable material. Select fill may be used as common fill at no change in the Contract Price.
- B. Granular Materials On-Site: Granular on-site material, which is fairly well graded between the following limits may be used as granular common fill:

U.S. Standard Sieve	Percent Passing by Weight
3 inch	100
#10	50-100
#60	20-90
#200	0-20

- C. Cohesive Materials On-Site: Cohesive site material may be used as common fill.
  - 1. The gradation requirements do not apply to cohesive common fill.
  - 2. Use material having a liquid limit less than or equal to 40 and a plasticity index less than or equal to 20.

- D. Material Approval: All material used as common fill is subject to approval. If there is insufficient on-site material, import whatever additional off-site material is required which conforms to the specifications and at no additional cost.

## 2.5 GEOTEXTILE FABRIC

- A. Provide non-woven, permeable, synthetic fiber material designed to prevent fine soil particles from migrating through the material. Provide geotextile filter fabric in accordance with Section 645 of the State Specifications.
- B. Protect geotextile during storage from becoming wet, coming in contact with soil, cement, or other foreign materials, and from exposure to sunlight.

## PART 3 EXECUTION

### 3.1 ELECTRICAL DUCT AND PRECAST MANHOLE BEDDING

- A. Bedding Compaction: Bed all electrical ducts and precast manholes in well graded, compacted select fill. Extend electrical duct bedding a minimum of 12 inches below the bottom of the duct encasement for the full trench width. Compact bedding thickness no less than 8 inches for precast concrete manhole bases.
- B. Concrete Work Mats: Cast cast-in-place manhole bases and other foundations for structures against a Class D concrete work mat in clean and dry excavations, unless otherwise shown, specified, or required.
- C. Bedding Placement: Place pipe bedding used for bedding beneath electrical ducts and precast manhole bases, in uniform layers not greater than 9 inches in loose thickness.

### 3.2 PIPE BEDDING

- A. Provide pipe bedding material under all pipe for the full width of the trench. Minimum depth of bedding material below the pipe barrel shall be 6 inches. Hand-grade bedding to proper grade ahead of pipe laying operation. Bedding shall provide a firm unyielding support along the entire pipe length.
- B. The pipe zone shall be considered to include the full width of the excavated trench from the bottom of the trench to a point 12 inches above the top outside surface of the barrel of the pipe.
- C. Particular attention must be given to the area of the pipe zone from the flow line to the spring line of the pipe to insure that firm support is obtained to prevent any lateral movement of the pipe during the final placement of cover material in the pipe zone.

D. Pipe Zone:

1. Place pipe bedding material as specified herein to proper grade and elevation and for the full width of the trench. Before the pipe is laid, compact the bedding material to provide a firm, unyielding support for the pipe. Excavate as required to accommodate the pipe bell.
2. Care shall be taken to ensure that the pipe is uniformly supported on the barrel throughout its entire length.
3. After the pipe is laid to line and grade, place, and carefully compact pipe bedding material for the full width of the trench to the spring line of the pipe. Place the material around the pipe in 6-inch layers and thoroughly hand tamp with approved tamping sticks supplemented by "walking in" and slicing with a shovel to assure that all voids are filled.
4. Place and carefully compact the area above the pipe spring line with pipe bedding material to a point 12 inches above the top outside surface of the pipe barrel. Compaction above pipe shall be done only when sufficient cover over the pipe has been achieved to prevent damage to the pipe.

E. Large Stone Placement: Do not place large stone fragments in the pipe bedding or backfill to 1 foot over the top of pipes, nor nearer than 2 feet at any point from any pipe, conduit, or concrete wall.

F. Unallowed Materials: Pipe bedding containing very fine sand, uniformly graded sands and gravels, or other materials that tend to flow under pressure when wet is unacceptable.

### 3.3 TRENCH BACKFILL

A. General: Backfill trenches from 12 inches over the top of the pipe, from the top of electrical duct bedding or as shown to the bottom of pavement base course, subgrade for lawns or lawn replacement, to the top of the existing ground surface or to such other grades as may be shown or required.

B. Backfill trenches to contours and elevations with unfrozen fill materials.

C. Backfill simultaneously on each side of free-standing structures and pipe.

D. Materials: Provide select fill, pipe bedding, flowable fill, suitable job-excavated material, or other material, as specified and as approved for trench backfill. Common fill shall be used as backfill material above the pipe cover material.

E. Depth of Placement - General: Except under pavements, walkways, railroad tracks, and street or highway appurtenances, or as otherwise specified, place trench backfill in uniform layers not greater than 9 inches in loose thickness and

thoroughly compact in place using suitable mechanical or pneumatic equipment. Compact backfill to not less than 90 percent of the maximum dry density as determined by ASTM D 1557.

- F. Depth of Placement - Traffic Areas and Under Utilities: Where pavements, walkways, and street or highway appurtenances are to be placed over trenches (except in tunnels) and under utilities or utility services crossing the trench, provide trench backfill using select fill, unless flowable fill is required per the Drawings or specifications.
- G. Depth of Placement - Undeveloped Areas: In nondeveloped areas and where select fill material or hand-placed backfill are not specified or required, place common fill, suitable job-excavated material or other approved backfill in lifts not exceeding 9 inches in loose thickness. When the trench is full, consolidate the backfill by jetting, spading, tamping, or puddling to ensure complete filling of the excavation. Mound the top of the trench approximately 12 inches to allow for consolidation of backfill.
- H. Dropping of Material on Work: Do trench backfilling work in such a way as to prevent dropping material directly on top of any conduit or pipe through any great vertical distance. Do not allow backfilling material from a bucket to fall directly on a structure or pipe and, in all cases, lower the bucket so that the shock of falling earth will not cause damage.
- I. Distribution of Large Materials: Break lumps up and distribute any stones, pieces of crushed rock or lumps which cannot be readily broken up, throughout the mass so that all interstices are solidly filled with fine material.

#### 3.4 STRUCTURE BACKFILL

- A. Use of Select Fill: Use select fill underneath all structures, and adjacent to structures where pipes, connections, electrical ducts, and structural foundations are to be located within this fill. Use select fill beneath all pavements and walkways extend to the bottom of pavement base course or ballast.
  - 1. Place backfill in uniform layers not greater than 8 inches in loose thickness and thoroughly compact in place with suitable approved mechanical or pneumatic equipment.
  - 2. Compact backfill to not less than 95 percent of the maximum dry density as determined by ASTM D 1557.
  - 3. For backfill under the water storage reservoirs, compact backfill to not less than 98 percent of the maximum dry density as determined by ASTM D 1557.

- B. Use of Pipe Bedding: Use pipe bedding as described in 3.2 except where pipe is to be located within Select Fill adjacent to a structure as described in Article 3.4, Paragraph A.
- C. Use of Common Fill: Use common granular fill adjacent to structures in all areas not specified above, unless otherwise shown or specified. Select fill may be used in place of common granular fill at no additional cost.
  - 1. Extend such backfill from the bottom of the excavation or top of bedding to the bottom of subgrade for lawns or lawn replacement, the top of previously existing ground surface or to such other grades as may be shown or required.
  - 2. Place backfill in uniform layers not greater than 8 inches in loose thickness and thoroughly compact in place with suitable equipment, as specified above.
  - 3. Compact backfill to not less than 90 percent of the maximum dry density as determined by ASTM D 1557.
- D. Use of Clay: In unpaved areas adjacent to structures for the top 1 foot of fill directly under lawn subgrades use clay backfill placed in 6-inch lifts. Compact clay backfill to not less than 90 percent of the maximum dry density as determined by ASTM D 1557.
  - 1. Use clay having a liquid limit less than or equal to 40 and a plasticity index less than or equal to 20.

### 3.5 EARTH EMBANKMENTS

- A. Use of Cohesive Materials: Make all earth embankments of approved cohesive common fill material.
  - 1. Place fill in uniform layers not greater than 10 inches in loose thickness. Compact in place with suitable approved mechanical equipment.
  - 2. Compact earth embankments to not less than 90 percent of the maximum dry density as determined by ASTM D 1557.
  - 3. Do not use cohesionless, granular material as earth embankment backfill, unless otherwise shown or required.

### 3.6 COMPACTION EQUIPMENT

- A. Equipment and Methods: Carry out all compaction with suitable approved equipment and methods.

1. Compact clay and other cohesive material with sheep's-foot rollers or similar equipment where practicable. Use handheld pneumatic tampers elsewhere for compaction of cohesive fill material.
2. Compact low cohesive soils with pneumatic-tire rollers or large vibratory equipment where practicable. Use small vibratory equipment elsewhere for compaction of cohesionless fill material.
3. Do not use heavy compaction equipment over pipelines or other structures, unless the depth of fill is sufficient to adequately distribute the load.

### 3.7 FINISH GRADING

- A. Final Contours: Perform finish grading in accordance with the completed contour elevations and grades shown and blend into conformation with remaining natural ground surfaces.
  1. Leave all finished grading surfaces smooth and firm to drain.
  2. Bring finish grades to elevations within plus or minus 0.10 foot of elevations or contours shown.
- B. Surface Drainage: Perform grading outside of building or structure lines in a manner to prevent accumulation of water within the area. Where necessary or where shown, extend finish grading to ensure that water will be carried to drainage ditches, and the site area left smooth and free from depressions holding water.

### 3.8 RESPONSIBILITY FOR AFTER SETTLEMENT

- A. After Settlement Responsibility: Take responsibility for correcting any depression which may develop in backfilled areas from settlement within one year after the work is fully completed. Provide as needed, backfill material, pavement base replacement, permanent pavement, sidewalk, curb and driveway repair or replacement, and lawn replacement, and perform the necessary reconditioning and restoration work to bring such depressed areas to proper grade as approved.

### 3.9 INSPECTION AND TESTING OF BACKFILLING

- A. Sampling and Testing: Sampling and testing of all in-place backfill and concrete will be provided in accordance with Division 01 – General Requirements: Section 01 45 00 – Quality Control.
- B. Testing completed shall be per the following standards:
  1. Tests and analysis of fill material will be performed in accordance with ASTM D2922 and ASTM D3017.

2. Compaction testing will be performed in accordance with ASTM 698, ASTM D2992, and ASTM D3017.
- C. If initial testing reveals non-compliance with Contract requirements, remove existing work, replace and retest at no cost to OWNER. All additional testing will be made at the CONTRACTOR'S expense.
  - D. Correction of Work: Correct any areas of unsatisfactory compaction by removal and replacement, or by scarifying, aerating, or sprinkling as needed and recompaction in place prior to placement of a new lift.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 31 25 00

### SLOPE PROTECTION AND EROSION CONTROL

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: The requirements for providing slope protection and erosion control practices for all areas within the contract limits and other area indicated, including work designated in permits and other agreements, as specified in Division 1.
- B. Related Work Specified in Other Sections Includes, but is Not Limited to, the Following:
  - 1. Section 02 41 00 - Demolition
  - 2. Section 31 23 16 - Excavation - Earth and Rock
  - 3. Section 31 23 23 - Backfilling
  - 4. Section 32 90 00 - Landscaping Work

##### 1.2 REFERENCES

- A. Illinois Department of Transportation (IDOT)
  - 1. Erosion and Sediment Control Field Guide for Construction: [SU\\_2IM\\_ESCFieldGuideWorking\\_08232010.pdf \(illinois.gov\)](http://www.idot.gov/ESCS/ESCS_Field_Guide_Working_08232010.pdf)
- B. Metropolitan Water Reclamation District of Greater Chicago (MWRD)
  - 1. Watershed Management Ordinance: [MWRD - Watershed Management Ordinance](http://www.mwrdd.com/Watershed_Management_Ordinance)
- C. U.S. Environmental Protection Agency (USEPA):
  - 1. Developing Your Stormwater Pollution Prevention Plan: A Guide for Construction Sites. [http://www.epa.gov/npdes/pubs/sw\\_swppp\\_guide.pdf](http://www.epa.gov/npdes/pubs/sw_swppp_guide.pdf)

##### 1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
- B. Erosion and Sediment Control Plan: Submit an Erosion and Sediment Control Plan conforming to the requirements of Cook County and of the Division of Water Pollution Control of the Illinois Environmental Protection Agency.

- C. Submit copies of all required permits to the ENGINEER before performing any work.

## PART 2 PRODUCTS

Not Used

## PART 3 EXECUTION

### 3.1 EROSION AND SEDIMENT CONTROL PLAN

- A. General: Prepare an Erosion and Sediment Control Plan to include erosion control practices as specified in the most current edition of the Standards and Specifications for Soil Erosion and Sediment Control, prepared by the Illinois Environmental Protection Agency, Division of Water Pollution Control, Permit Section.
- B. Contents: Prepare the Erosion and Sediment Control Plan to include but not limited to the following information:
  - 1. Total square area disturbed by excavation.
  - 2. Quantity of erosion control practices to be provided. For instance, feet of vegetative control, feet of interceptor ditches, feet of berms, cubic feet of silt traps, etc.
  - 3. Approximate square feet of area controlled by the erosion control practices as specified in the Erosion and Sediment Control Plan, and the type of erosion control practices, whether permanent or temporary.
  - 4. Topographical or plan maps of construction area with areas marked to indicate erosion control practices used.
  - 5. Drainage area, including construction site.
  - 6. Area of construction site in acres that fall in the following slope categories:
    - a. 0-2 percent slope
    - b. 3-4 percent slope
    - c. 4-6 percent slope
    - d. 6 percent and storm slope
  - 7. A summary of the disposition of the collected sediment from the slope areas listed in Item 6.
- C. Availability: Keep the Erosion and Sediment Control Plan at the construction site at all times available for inspection for the entire construction period.

- D. Ordinances: Comply with all erosion and siltation control ordinances in effect and required by governing bodies having jurisdiction over the construction site and provide appropriate control measures as required.

### 3.2 EROSION AND SEDIMENT CONTROL

- A. Provide necessary precautions and facilities to protect all indicated areas within the Contract Limits from discharges resulting from construction operations, excessive erosion runoff of the construction site, silting and any other contamination resulting from construction work. Provide erosion control practices conforming to the specified requirements and to include but not limited to the following provisions:
  - 1. Place all erosion and siltation control measures prior to or as the first step in grading.
  - 2. Mulch and seed all storm and sanitary sewer trenches not in streets within 15 days after backfill. Do not allow more than 500 feet of trenches to be open at any one time.
  - 3. Place all excavated material on the uphill side of trenches where possible. Do not place materials in stream beds. Seed any stockpiled material which remains in place longer than thirty days with temporary vegetation and mulch.
  - 4. Mulch and seed all temporary earth berms, diversions, erosion barriers and temporary stockpiles with temporary vegetative cover within 10 days after grading.
  - 5. Do not stockpile or otherwise place dredged, excavated, or other material, at any time, in or near a stream bed which may increase the turbidity of the water. If turbidity producing materials are present, hold surface drainage from cuts and fills within the construction limits and from borrow and waste disposal areas in suitable sedimentation ponds or grade surface drainage to control erosion within acceptable limits. Provide and maintain temporary erosion and sediment control measures such as berms, dikes, drains, or sedimentation basins, if required to meet the above standards, until permanent drainage and erosion control facilities are completed and operative. Hold to a minimum the area of bare soil exposed at any one time by construction operations.
  - 6. Drain wet dredged material for a minimum of 7 days. Store the material for drainage to a maximum height of 4 feet.
  - 7. Provide temporary erosion and sediment control measures to include but not be limited to the following:
    - a. Installation (and ultimate removal) of silt screens.

- b. Straw bales and silt traps around construction areas for all required structures.
- c. Diked area with earth berm and silt trap for draining dredged material.
- d. Straw bales with silt traps along top of slope of fill area plus seeding and mulching of entire fill area not otherwise protected.

END OF SECTION

## SECTION 31 41 00

### SHORING, SHEETING AND BRACING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Work required for protection of an excavation or structure through shoring, sheeting, and bracing.
- B. Related Work Specified in Other Sections Includes, but is Not Limited to, the Following:
  - 1. Section 31 23 16 - Excavation - Earth and Rock
  - 2. Section 31 23 23 - Backfilling

##### 1.2 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
- B. CONTRACTOR's Submittals: Submit a CERTIFICATE (ONLY), signed and sealed by a Licensed Professional Engineer experienced in Structural Engineering and registered in the State of Illinois, that certifies that the Licensed Professional Engineer has evaluated and approved the CONTRACTOR's excavation plan and has prepared complete design calculations including a global stability check and working drawings for the shoring, sheeting and bracing, not specifically shown on the Contract Drawings, which will be used for excavation support. Provide a separate CERTIFICATE for each excavation before starting the excavation. Where commercially manufactured trench boxes are to be used, provide a CERTIFICATE from the CONTRACTOR's Licensed Professional Engineer stating the conditions under which the trench boxes will be used.

##### 1.3 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. All Federal, State, and local laws and regulations applying to the design and construction of shoring, sheeting, and bracing.
  - 2. National Bureau of Standards Building Science Series 127 "Recommended Technical Provisions for Construction Practice in Shoring and Sloping Trenches and Excavations."

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS AND MATERIALS

- A. Use manufacturers and materials for shoring, sheeting, and bracing as recommended by the CONTRACTOR's Licensed Professional Engineer who designed the shoring, sheeting, and bracing. Where wood lagging is to be left in place use oak or treated fir or treated pine. Use only environmentally safe treatment for wood lagging.

## PART 3 EXECUTION

### 3.1 SHORING, SHEETING AND BRACING INSTALLATION

- A. General: Provide safe working conditions, prevent shifting of material, prevent damage to structures or other work, and avoid delay to the work, all in accordance with applicable laws and regulations. Properly shore, sheet, and brace all excavations that are not cut back to the proper slope, as determined by the CONTRACTOR's Licensed Professional Engineer.
  - 1. Take sole responsibility for the design and adequacy of shoring, sheeting, and bracing not shown on the Contract Drawings.
  - 2. Take sole responsibility for the methods of installation of the shoring, sheeting, and bracing.
- B. Arrange shoring, sheeting, and bracing so as not to place any strain on portions of completed work until the general construction has proceeded far enough to provide ample strength.
- C. If the CONTRACTOR or its Licensed Professional Engineer is of the opinion that at any time the CONTRACTOR's excavation plan, shoring, sheeting, or bracing is inadequate or unsuited for the purpose, take immediate and appropriate action. Provide a new CERTIFICATE if the CONTRACTOR's excavation plans, shoring, sheeting, or bracing require modifications.
- D. Monitoring:
  - 1. Monitor horizontal and vertical deflections of sheeting, shoring, and bracing.
- E. Accurately locate all underground utilities and take the required measures necessary to protect them from damage. All underground utilities shall be kept in service at all times as specified in Division 1.
- F. Remove shoring, sheeting, and bracing as the excavation is refilled in a manner to avoid the caving in of the bank or disturbance to adjacent areas or structures or pipe bedding.

1. Carefully fill voids left by the withdrawal of the shore, sheeting and bracing. No separate payment will be made for the filling of such voids.
  2. If pipe bedding is disturbed, re-compact it to meet specified density requirements.
- G. Permission for Removal: Obtain permission from the CONTRACTOR's Licensed Professional Engineer before the removal of any shoring, sheeting, or bracing. Retain the responsibility for injury to structures or to other property or persons for failure to leave such shoring, sheeting, and bracing in place even though permission for removal has been obtained.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 31 50 00

### EXCAVATION SUPPORT AND PROTECTION

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section includes temporary excavation support and protection systems.

##### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

##### 1.3 ACTION SUBMITTALS

- A. Delegated-Design Submittal: For excavation support and protection systems, including analysis data signed and sealed by the qualified, licensed Illinois structural engineer responsible for their preparation.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:
  - 1. Structural Engineer: Experience with providing delegated-design engineering services of the type indicated, including documentation that engineer is licensed in the state in which Project is located.
- B. Contractor Calculations: For excavation support and protection system. Include analysis data signed and sealed by the qualified, licensed Illinois structural engineer responsible for their preparation.
- C. Existing Conditions: Using photographs or video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by inadequate performance of excavation support and protection systems. Submit before Work begins.

##### 1.5 CLOSEOUT SUBMITTALS

- A. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

## 1.6 FIELD CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility-serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
  - 1. Notify Owner no fewer than two days in advance of proposed interruption of utility.
  - 2. Do not proceed with interruption of utility without Owner's written permission.
- B. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks, and record existing elevations.

## PART 2 PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified, licensed Illinois structural engineer, as defined in Section 014000 "Quality Requirements," to design excavation support and protection systems to resist all lateral loading and surcharge, including but not limited to, retained soil, groundwater pressure, adjacent building loads, adjacent traffic loads, construction traffic loads, material stockpile loads, and seismic loads, based on the following:
  - 1. Compliance with OSHA Standards and interpretations, 29 CFR 1926, Subpart P.
  - 2. Compliance with AASHTO Standard Specification for Highway Bridges or AASHTO LRFD Bridge Design Specification, Customary U.S. Units.
  - 3. Compliance with requirements of authorities having jurisdiction.
  - 4. Compliance with utility company requirements.
  - 5. Compliance with railroad requirements.

### 2.2 MATERIALS

- A. Provide materials that are either new or in serviceable condition.
- B. Structural Steel: ASTM A36, ASTM A690, or ASTM A992.
- C. Steel Sheet Piling: ASTM A328, ASTM A572, or ASTM A690; with continuous interlocks.
- D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application.

- E. Shotcrete: Comply with Section 033713 "Shotcrete" for shotcrete materials and mixes, reinforcement, and shotcrete application.
- F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.
- G. Reinforcing Bars: ASTM A615, Grade 60, deformed.
- H. Tiebacks: Steel bars, ASTM A722.

### PART 3 EXECUTION

#### 3.1 INSTALLATION - GENERAL

- A. Locate excavation support and protection systems clear of permanent construction, so that construction and finishing of other work is not impeded.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.

#### 3.2 SOLDIER PILES AND LAGGING

- A. Install steel soldier piles before starting excavation.
  - 1. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement.
  - 2. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging.
  - 3. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- B. Install wood lagging within flanges of soldier piles as excavation proceeds.
  - 1. Trim excavation as required to install lagging.
  - 2. Fill voids behind lagging with soil, and compact.
- C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

### 3.3 SHEET PILING

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock vertical edges to form a continuous barrier.
- B. Accurately place the piling using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer.
  - 1. Limit vertical offset of adjacent sheet piling to 60 inches.
  - 2. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- C. Cut tops of sheet piling to uniform elevation at top of excavation.

### 3.4 TIEBACKS

- A. Drill, install, grout, and tension tiebacks.
- B. Test load-carrying capacity of each tieback, and replace and retest deficient tiebacks.
  - 1. Have test loading observed by a qualified, licensed Illinois structural engineer responsible for design of excavation support and protection system.
- C. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

### 3.5 BRACING

- A. Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
  - 1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.
  - 2. Install internal bracing if required to prevent spreading or distortion of braced frames.
  - 3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

### 3.6 MAINTENANCE

- A. Monitor and maintain excavation support and protection system.
- B. Prevent surface water from entering excavations by grading, dikes, or other means.

- C. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

### 3.7 FIELD QUALITY CONTROL

- A. Survey-Work Benchmarks: Resurvey benchmarks daily during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open.
  - 1. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions.
  - 2. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.
- B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.
- C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

### 3.8 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures.
  - 1. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.
  - 2. Remove excavation support and protection systems to a minimum depth of 48 (1200) inches (mm) below overlying construction, and abandon remainder.
  - 3. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earth Moving."
  - 4. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.

END OF SECTION

(NO TEXT FOR THIS PAGE)

## SECTION 31 66 00

### HELICAL PILE/ANCHOR DEEP FOUNDATIONS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes the furnishing of all labor, tools, equipment, materials and supervision to install Helical Piles according to the specifications contained herein and shown on the construction drawings. The Helical Pile Contractor shall install a helical pile which will provide a minimum load capacity as indicated on the construction documents/plans.

##### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

##### 1.3 DEFINITIONS

Some of the terms used in this specification may be unfamiliar to the reader, or may be used with a specific meaning not commonly known outside the helical pile industry. In determining the meaning of any term used herein, a definition contained in the following list shall take precedence.

- A. Bearing Stratum – The undisturbed soil layer at any pile excavation location which provides a significant portion of the axial resistance of an installed helical pile bearing on one or more of the pile helices.
- B. Contractor - The person/firm responsible for performing the helical pile work.
- C. Crowd – Axial compressive force applied to the head (top) of the helical pile shaft during installation as required to ensure the pile progresses into the ground with each revolution a distance approximately equal to the helix pitch.
- D. Extension – A pile section without helical plates. Extension(s) are installed after the lead section. Each extension is connected with integral couplings which provide a rigid load transferring connection. Their purpose is to extend the lead section with helical plates to a load bearing stratum.
- E. Helix Driver – A high torque hydraulic motor used to advance (screw) a helical pile into the soil to a load bearing stratum. Depending on the capacity of the helix driver, it may be either hand held or machine operated.
- F. Helical Pile – A steel pile consisting of one or more helical plates which is torqued into the

soil until the lead section is embedded into a load bearing stratum. Their purpose is to transfer structural loads (tension and/or compression) to a load bearing stratum.

- G. Helix Plate – A round plate formed into a ramped spiral. When rotated into the soil, the helical shape provides thrust along its longitudinal axis thus aiding in pile installation. After installation, the plate transfers axial load into the soil through bearing.
- H. Installation Torque – The resistance generated by a helical pile when installed into the soil. The installation resistance is a function of the strength properties of the soil the helical piles are being installed in as well as the shaft geometry of the pile shaft and helical plates.
- I. Lead Section - The first helical pile section installed into the soil consisting of one or more helix plates welded to the pile shaft.
- J. Torque Rating – The maximum torque energy that can be applied to a helical pile during installation into the soil.

#### 1.4 REFERENCES

- A. American Society of Testing and Materials (ASTM)
  - 1. ASTM-A29 Steel Bars, Carbon and Alloy, Hot Wrought and Cold Finished
  - 2. ASTM-A36 Structural Carbon Steel
  - 3. ASTM-A53 Welded and Seamless Steel Pipe
  - 4. ASTM-A500, Grade C, Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
  - 5. ASTM-A307 Carbon Steel bolts and Studs
  - 6. ASTM-563 Carbon and Alloy Steel Nuts
- B. American Welding Society (AWS)
  - 1. AWS D1.1 Structural Welding Code – Steel
- C. Society of Automotive Engineers (SAE)
  - 1. SAE J429 Mechanical and Material Requirements for Externally Threaded Fasteners
- D. International Code Council - Evaluation Services (ICC-ES)
  - 1. Acceptance Criteria for Corrosion Protection of Steel Foundation Systems Using Polymer (EAA) Coatings (AC228)
  - 2. Acceptance Criteria for Helical Pile Systems and Devices (AC358)
  - 3. Evaluation Service Report (ESR)

- E. International Organization for Standardization (ISO)
  - 1. ISO 9001:2008 – Quality Management System
- 1.5 ACTION SUBMITTALS
  - A. Delegated-Design Submittal: Design of the helical piles/anchors shall be performed by a Structural Engineer licensed in the State of Illinois in accordance with existing building code requirements.
- 1.6 INFORMATIONAL SUBMITTALS
  - A. Qualification Data: For the following:
    - 1. Structural Engineer: Experience with providing delegated-design engineering services of the type indicated, including documentation that engineer is licensed in the state of Illinois.
    - 2. The Contractor performing the Work of this Section shall have been regularly engaged in pile work for a period of not less than 5 years and shall be properly equipped to execute the Work. If directed, furnish a list of projects of a similar type and magnitude executed by the Contractor.
    - 3. In lieu of the Contractor achieving 5 years of Helical Pile experience, a certificate of competency can be provided by manufacturer. The certificate should state that the Contractor has been trained and is authorized to install the underpinning pile system or the manufacturer shall provide a letter expressing the ability and intent to provide on-site supervision of the pile installation.
    - 4. The helical pile shall be recognized by the International Code Council (ICC) and the manufacturer shall hold a current ICC-ES issued ESR report showing compliance with AC308 and the current International Building Code (IBC).
    - 5. The manufacturer shall have been issued an International Organization for Standardization – (ISO) 9001:2008 – Quality Management System Certificate and be compliant.
  - B. Site specific shop drawings sealed by a registered Structural Engineer in the State of Illinois. Shop drawings to include:
    - 1. Helical pile/anchor identification number and location
    - 2. Helical pile/anchor design load
    - 3. Type and size of helical pile/anchor shaft
    - 4. Helical configuration (number and diameter of helical plates)
    - 5. Minimum effective torque required
    - 6. Connection details
    - 7. For battered helical piles, battered angle and orientation

- C. Copies of certified calibration reports for all hydraulic gages. The calibrations shall have been performed within one (1) year of the proposed starting date of the pile installation.
- D. Provide steel manufacturer's mill test reports, covering physical and chemical tests, for all steel piles.
- E. Provide strength and properties sections of pile sections and calculations by a Structural Engineer licensed in the State of Illinois demonstrating the pile will meet or exceed the strength requirements of the design loads as shown on the construction documents.
  - 1. If applicable, the calculation(s) shall include the load eccentricity on the pile. The eccentricity shall be measured from the vertical face of the footing to the center of the pile shaft.
  - 2. If the helical pile is deemed laterally unbraced per section 1808.2.5 of the International Building Code (IBC), the allowable load capacity calculation(s) of the pile shall take into consideration the unbraced length of the pile per section 1808.2.9.2 of the International Building Code (IBC).

#### 1.7 CLOSEOUT SUBMITTALS

- A. Installation Records: Within 7 days after pile installation, submit 2 copies of the installation record for each pile installed.
  - 1. The installation record shall clearly indicate the pile identification number or mark, pile diameter, helix configuration, installation depth, installation torque, ultimate and allowable capacity of pile.
  - 2. Where helical piles are being installed on existing structures provide final lifting force/design load applied to pile, the amount of elevation recovery of each pile.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Transport, store, and handle piles in a manner to prevent damage to the piles. Piles shall be stored above the ground surface by pallets, blocking or other means.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. All helical piles shall be designed to support the design load(s) as shown on the plans.
- B. Except where noted on the plans, all helical pile components shall be selected to provide a minimum factor of safety against ultimate mechanical failure of two (2).
- C. The helical pile design shall take into account pile spacing, soil stratification and strain compatibility issues as are present for the project. See drawings for reference for the project geotechnical report. A copy of the project geotechnical report shall be provided to and reviewed by the Pile Contractor prior to bid submittal.

- D. Where helical piles are subjected to lateral or base shear loads as indicated on the plans, the bending moment and stress from said loads shall be determined using a lateral load analysis program such as LPILE or equal commercially available software. The required soil parameters ( $c$ ,  $\phi$ ,  $\gamma$  and  $k_s$ ) for use with LPILE or equal shall be provided in the geotechnical report(s).
- E. Additional soil investigations if required for Helical Pile design shall be contracted directly by the General Contractor.
- F. The allowable lateral deflection of the helical pile shall be limited to one (1") inch unless noted otherwise on the plans.
- G. The helical pile bracket shall distribute the design load(s), as indicated on the plans, to the concrete foundation such that the concrete bearing stress does not exceed those in the ACI Building Code and the stress in the steel plate/welds do not exceed AISI allowable stresses for steel members.
- H. Helical piles shall be designed by a licensed Structural Engineer in the State of Illinois in accordance with the current International Building Code (IBC) adopted by the local jurisdiction.
- I. Helical piles shall be designed to meet a corrosion service life of 50 years unless noted otherwise on project plans.

## 2.2 MATERIALS

- A. Manufacturer:
  - 1. Ram Jack Systems
  - 2. Chance Helical Piles
  - 3. Helical Anchors, Inc.
  - 4. Approved Equal
- B. The helical piles/anchors shall have a central shaft that is cold formed welded and seamless carbon steel structural round tubing with a minimum yield strength of 65 ksi and meeting the dimensional and workmanship requirements of ASTM A500.
- C. Helix Plates:
  - 1. Shall conform to ASTM A-36 and have minimum yield strength ( $F_y$ ) of 50 ksi.
  - 2. Shall have a minimum thickness of 3/8".
- D. All other flat plate steel shall conform to ASTM A-36 unless noted otherwise on the plans.
- E. All coupling connection thru bolts shall be 3/4" diameter and conform to SAE J429 Grade 8 or equivalent. (minimum yield strength ( $F_y$ ) = 130 ksi and minimum tensile strength ( $F_u$ ) = 150 ksi) .

- F. All piling sections and brackets shall be coated with a polymer alloy thermoplastic powder coating, Plascoat PPA 571ES or equal, in compliance with ICC-ES acceptance criteria AC228 for corrosion resistance.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Before entering the construction site to begin work, the Helical Pile Contractor shall provide proof of insurance coverage as stated in the general specification and/or the contract.
- B. The Helical Pile Contractor shall request markings of underground utilities by an underground utility location service. All efforts shall be made to protect any underground utilities encountered during the excavation and pile installation. Any separations or damage caused to the underground utilities shall be repaired/performed by a licensed professional.
- C. Mark all pile installation locations as shown on the plans or approved shop drawings. The Engineer of Record shall be notified if the piles are relocated more than 12” from the locations shown on the plans or approved shop drawings. Relocation of the piles will not be allowed unless approved by the Engineer of Record.
- D. A torque indicator shall be used during helical pile/anchor installation. The torque indicator can be an integral part of the installation system or externally mounted in-line.
- E. Owner shall engage a third party inspector to oversee all aspects of installation of the helical piles/anchors. The items to be inspected include, but not limited to the following:
  - 1. Verify the type of helical pile/anchor being installed is as specified on the shop drawings.
  - 2. Verify final embedment depth of helical pile/anchor.
  - 3. Verify final installation torque readings as specified on the shop drawings.

### 3.2 INSTALLATION

- A. The helical pile/anchor installation technique shall be such that it is consistent with the geotechnical, logistical, environmental and load carrying conditions of the project.
- B. The lead section shall be positioned at the location as shown on the construction drawings. Battered helical piles/anchors can be positioned perpendicular to the ground to assist in initial advancement into the soil before the required battered angle shall be established.
- C. The helical pile/anchor sections shall be engaged and advanced into the soil in a smooth, continuous manner at a rate of rotation of 5 to 25 RPM’s. Extension sections shall be provided to obtain the required minimum overall length and installation torque

as shown on the construction drawings. Connect sections together using coupling bot(s) and nut torqued to snug tight per AISC.

- D. Sufficient down pressure shall be applied to uniformly advance the helical pile/anchor sections approximately 3-inches per revolution. The rate of down pressure (crowd) shall be adjusted for different soil conditions and depths.
- E. The minimum installation torque and minimum overall length criteria as shown on the construction drawings shall be satisfied prior to terminating the helical pile/anchor installation.
- F. If the torsional strength rating of the pile shaft and/or installation equipment has been reached prior to achieving the minimum overall length required, the Contractor shall have the following options:
  - 1. Terminate the installation depth obtained subject to the review and acceptance of the Engineer of Record, or:
  - 2. Remove the existing helical pile/anchor and install a new one with fewer and/or smaller diameter helix plates. The new helix plate configuration shall be subject to review and acceptance of the Engineer of Record. If re-installing in the same location, the top-most helix of the new helical pile/anchor shall be terminated at least three feet (3'-0) beyond the terminating depth of the original helical pile/anchor.
- G. If the minimum installation torque as shown on the working drawings is not achieved at the minimum overall length and there is no maximum length constraint, the Contractor shall have the following options:
  - 1. Install the helical pile/anchor deeper using additional extension sections, or:
  - 2. Remove the existing helical pile/anchor and install a new one with additional and/or larger diameter helix plates. The new helix plate configuration shall be subject to review and acceptance of the Engineer of Record. If re-installing in the same location, the top-most helix of the new helical pile/anchor shall be terminated at least three feet (3'-0) beyond the terminating depth of the original helical pile/anchor.
  - 3. De-rate the load capacity of the helix pile/anchor and install additional helical piles/anchors. The de-rated capacity and additional helical piles/anchors location shall be subject to the review and acceptance of the Engineer of Record.
- H. If the helical pile/anchor is refused or deflected by a subsurface obstruction, the installation shall be terminated and the pile/anchor removed. The obstruction shall be removed, if feasible, and the helical pile/anchor re-installed. If the obstruction can't be removed, the helical pile/anchor shall be installed at an adjacent location, subject to the review and acceptance of the Engineer of Record.
- I. The Contractor shall conduct his construction operations in a manner to insure the safety of persons and property in the vicinity of the work. The Contractor's personnel

shall comply with safety procedures in accordance with OSHA standards and any established project safety plan.

- J. The portion of the construction site occupied by the Helical Pile Contractor, his equipment and his material stockpiles shall be kept reasonably clean and orderly.

### 3.3 FIELD QUALITY CONTROL

- A. The Helical Pile Contractor shall furnish and install all helical piles per the plans and approved pile design documentation. In the event of conflict between the plans and approved pile design documentation, the contractor shall not begin construction on any affected items until such conflict has been resolved.
- B. Centerline of helical piles/anchors shall not be more than three inches (3”) from indicated plan location unless approved by the Engineer of Record.
- C. Helical pile/anchor plumbness shall be within 2 degrees of the design alignment.

### 3.4 CLEAN UP

- A. A. Within seven (7) days of completion of the work. The Helical Pile Contractor shall remove any and all material, equipment, tools, building materials, concrete forms, debris or other items belonging to the Contractor or used under the Contractor’s direction.

END OF SECTION

## SECTION 33 05 14

### TRENCH DRAIN

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Requirements for furnishing and installing trench drains shown, specified or required for a complete system. In addition, furnish and install the following:

1. Trench Drain

- B. Related Work Specified in Other Sections Includes:

1. Section 33 05 50 – Laying and Jointing Buried Pipe
2. Section 33 30 00 – Sanitary and Storm Sewerage Piping

##### 1.2 REFERENCES

- A. None.

##### 1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.

- B. Product Data and Information: Provide component sizes, outlet type, rough-in requirements, service sizes, and finishes.

- C. Shop Drawings: Indicate dimensions, weights and placement of openings and holes.

- D. Operation and Maintenance Manuals: Submit operation and maintenance manuals for the trench drain and clean out, as specified in Division 1.

1. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 1.
- B. Acceptance: Accept specialties on-site in original factory packaging. Inspect for damage.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Acceptable manufacturers are listed below. Other manufacturers of equivalent products may be submitted.

- 1. Trench Drains:

- a. Dura-Trench
- b. Swift drain
- c. Josam Co.
- d. Wade Division/Tyler Pipe
- e. J.R. Smith Mfg. Co.
- f. Zurn
- g. Watts

#### 2.2 MATERIALS

- A. Trench Drains (TD):

- 1. Trench Body: Smooth Precast Fiber Reinforced Polymer.
- 2. Frame: T304 Stainless Steel.
- 3. Anchor Studs: 3" x 3/8" Diameter
- 4. Grate: Stainless Steel, include locking toggle.
- 5. Installation Brackets: Rigid Metal Anchors.
- 6. Installation Bars: #4 Rebar
- 7. Outlet: Side
- 8. Top Loading Classification: Heavy Duty, H-20 Rated.
- 9. Junction Box with 8" Diameter Side Outlet.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. Coordination: Coordinate grading around the trench to slope to the trench.
- B. Install trench drain outlet as shown on the Contract Drawings.
- C. Prepare Concrete cradle with slab thickness of 4" and per manufacturer recommendations.

### 3.2 INSTALLATION

- A. Install trench drains as shown on Contract Drawings. Set grates of drains flush with surrounding pavement.
- B. Connect to outlet stormsewer as shown on the Contract Drawings.

END OF SECTION

(NO TEXT ON THIS PAGE)

## SECTION 33 05 50

### LAYING AND JOINTING BURIED PIPELINES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Installation of all underground pipelines. Provide pipeline materials, coatings and linings as specified and pipe of the types, sizes and classes shown or specified.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 01 45 50 - Leakage Tests
  - 2. Section 31 23 16 - Excavation - Earth and Rock
  - 3. Section 31 23 23 - Backfilling
  - 4. Section 33 30 00 - Sanitary and Storm Sewerage Piping

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges
  - 2. ASTM D 2321 - Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
  - 3. ASTM E 165 - Practice for Liquid Penetrant Examination
  - 4. ASTM E 709 - Practice for Magnetic Particle Examination
  - 5. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
  - 6. AWWA C115/A21.15 - Flanged Ductile-Iron Pipe with Threaded Flanges

##### 1.3 DELIVERY, STORAGE AND HANDLING

- A. General: Deliver, store and handle all products and materials as specified in Division 1 and as follows:

- B. Transportation and Delivery: Take every precaution to prevent damage or wear to the pipe during transportation and delivery to the site.
  - 1. Cover pipe bell and spigot ends to keep the inside of the pipe clean of exhaust fumes, films, and other residue during transportation and delivery in accordance with the manufacturer's recommendations.
- C. Loading and Unloading: Take extreme care in loading and unloading the pipe and fittings.
  - 1. Work slowly with skids or suitable power equipment, and keep pipe under perfect control at all times.
  - 2. Under no condition is the pipe to be dropped, bumped, dragged, pushed, or moved in any way that will cause damage to the pipe or coating.
  - 3. Protect the pipe from drying effects and possible contamination.
- D. Sling: Handle the pipe and fittings using of belt slings, padded cradles, or other devices, designed and constructed to prevent damage to the pipe, coating or lining. When handling the pipe with a crane or other lifting equipment, use a suitable sling around the pipe.
  - 1. Under no condition pass the sling through the pipe.
  - 2. Use a nylon canvas type sling or other material designed to prevent damage to the pipe and coating.
  - 3. The use of steel cables, chains, hooks, or other like equipment that might injure the pipe, coating or lining will not be permitted.
- E. Damaged Piping: If in the process of transportation, handling, or laying, any pipe or fitting is damaged, replace or repair such pipe or pipes.
- F. Blocking and Stakes: Provide suitable blocking and stakes installed to prevent pipe from rolling.
  - 1. Obtain approval for the type of blocking and stakes, and the method of installation.
- G. Storage:
  - 1. Storage for Pipe: Store stockpiled pipe on pallets, skids, sand or rock free berms, sand bags, old tires or other suitable means so that the pipe and coating is not damaged.
    - a. Do not roll, push, or slide the pipe into place.

- b. Protect pipe that will be stored during periods of adverse environmental conditions from the effects of drying.
  - c. Arrange pipe that is placed in storage as not to cause inconvenience to traffic.
2. Storage for Gaskets: Store gaskets for pipe joints in a cool place and protect gaskets from light, sunlight, heat, oil, or grease until installed.
- a. Do not use any gaskets showing signs of checking, weathering or other deterioration.
  - b. Do not use gasket material stored in excess of six months without approval.

#### 1.4 FIELD CONDITIONS

- A. Encase utilities that cross over new pipe in flowable fill as shown in the standard details. Reconstruct utilities damaged by pipeline construction.
- 1. Furnish and install all materials and do all work necessary for the reconstruction or repairs of sanitary sewers and services.
  - 2. Provide pipe for reconstruction of sanitary sewers and services meeting the appropriate specification requirements.
  - 3. Provide pipe of the same size as the existing sewer or when the same size is not available, use the next larger size of pipe. Obtain approval of joints made between new pipe and existing pipe.

### PART 2 PRODUCTS

Not used

### PART 3 EXECUTION

#### 3.1 PREPARATION

- A. Dry Trench Bottoms: Lay pipe only in dry trenches having a stable bottom.
- 1. Where groundwater is encountered, make every effort to obtain a dry trench bottom.
  - 2. If a dry trench bottom has not been obtained due to improper or insufficient use of all known methods of trench dewatering, then the order to excavate

below grade and place sufficient bedding material, crushed stone, or Class D concrete over the trench bottom may be given.

3. If all efforts fail to obtain a stable dry trench bottom and it is determined that the trench bottom is unsuitable for pipe foundation, obtain an order, in writing, for the kind of stabilization to be constructed.
4. Prevent water from entering the trench to the extent required to properly grade and allow for proper compaction of pipe bedding and backfill. Provide dewatering of surface water that enters the excavation for proper completion of the Work.
5. Perform trench excavation and backfill in accordance with Sections 31 23 16 and 31 23 23.

### 3.2 INSTALLATION

A. General: Install all piping in accordance with the manufacturer's recommendations, approved shop drawings and as specified. Refer to the specification specific to the pipe material being installed.

1. Arrange miscellaneous pipelines, which are shown in diagram form on the Drawings, clear of other pipelines and equipment.
2. Provide factory prepared pipe ends unless a field cut is required for connections.
3. Cutting Pipe and Dressing Cut Ends:
  - a. Cut pipe with a portable guillotine saw, abrasive wheel, saw, or milling cutter. The use of flame cutting or hydraulic squeeze type cutters will not be acceptable. Field-cut holes for saddles with mechanical cutters; oxyacetylene cutting will not be acceptable.
  - b. Cut pipe smooth, straight, and at right angles to the pipe axis in a neat manner, without damage to the pipe lining.
  - c. After cutting, dress the ends of the pipe with a file or a power grinder to remove all roughness and sharp edges. Dress the ends of pipe in accordance with the type of joint to be made and as recommended by the manufacturer. Suitably bevel cut ends of push-on joint pipe as recommended by the manufacturer.

B. Code Requirements: Provide pipeline installations complying with AWWA C600 for ductile iron pipe, and as modified or supplemented by the Specifications.

C. Pipe Laying - General:

1. Thoroughly clean the interior of pipe and fittings of foreign matter prior to installation. Cut away any lumps or projections on the face of the spigot end or the shoulder.
2. For pipelines intended for gravity flow, begin pipeline laying at the low end of a run and proceed upgrade.
3. Generally, lay pipe with bells pointing ahead.
4. Do not lay pipe until the trench has been excavated as specified, shown, or as directed to provide a firm bed for supporting the pipe. Do not lay pipe upon a material in which frost exists nor at any time when the ENGINEER deems that there is a possibility of the formation of ice or the penetration of frost at the bottom of the excavation.
5. Carefully lay pipelines accurately to line and grade. Do not drop or dump pipe or accessories into trench. Lay pipelines in trench excavations on pipe bedding material or other foundations as shown, specified or ordered in writing. Rest no part of the pipe upon or against rock.
6. Lay pipelines not supported on piles, concrete cradle, or other structural support in pipe bedding material. Carefully grade and compact pipe bedding. Install the barrel of the pipe so that it is in contact on the sides and the bottom of the pipe with the shaped, compacted pipe bedding so as to provide full bearing on and uniform support by the pipe bedding throughout the entire length of pipe. Make adjustments by scraping away or filling in pipe bedding material under the body of the pipe. Hand tamping under the end of the pipe to bring it to grade or wedging or blocking up the pipe barrel is not permitted.
7. Properly secure the pipe against movement and make the pipe joints in the excavation as required. Bring the faces of the spigot ends and the bells of pipes into contact and firmly and completely shove the pipe home. Do not bring succeeding pipe into position until the preceding length is covered with backfill and secured in place.
8. Bell Holes:
  - a. Cut out bell holes for each joint as required to permit the joint to be properly made and allow the barrel of the pipe to have full bearing throughout its length.
  - b. Thoroughly tamp bell holes full of pipe bedding material following the making of each joint.

9. Take care to secure water tightness and to prevent damage to or disturbing of the joints during backfilling and after the pipes have been laid and the joints have been made.
  10. Take every precaution to prevent the floating of the pipe due to water accumulation in the trench, or the collapse of the pipeline from any cause. Should floating or collapse occur, inspect for damage. Replace any damaged pipe at no expense to the OWNER.
  11. Keep the interior of pipelines clean and free of dirt and other deleterious material during construction. Maintain a clean pipe interior clear of sand, dirt, mortar splatter, and any other deleterious material prior to testing the completed pipeline.
- D. Other Foundations: Install pipelines laid on other types of foundations as specified for such other foundations or as ordered in writing.
- E. Ductile Iron Pipe Mechanical Joints:
1. Assembly:
    - a. In making up mechanical joints, center the spigot in the bell.
    - b. Thoroughly brush the surfaces with which the rubber gasket comes in contact with a wire brush just prior to assembly of the joint.
    - c. Brush lubricant over the gasket just prior to installation.
    - d. Place the gasket and gland in position, bolts inserted, and the nuts tightened fingertight.
    - e. Tighten the nuts with a torque wrench so that the gland is brought up toward the pipe evenly.
    - f. Prime bolts by dipping with a bituminous coating, except the threads. Coat threads immediately prior to installation of nuts.
  2. Torques: Apply bolt torques complying with AWWA C600 (latest edition).
  3. Remaking of Joints: If effective sealing is not obtained at the maximum torque listed above, disassemble and reassemble the joint after thorough cleaning.
  4. Restrained Mechanical Joint: Where specified or shown on the Drawings, restrain mechanical joint with EBAA Meagalug, Romac Industries, or approved equal.

- F. Temporary Bulkheads: Provide temporary bulkheads at the ends of sections where adjoining pipelines have not been completed, and in connections built into pipelines where adjoining pipelines or structures have not been completed and are not ready to be connected.
1. Remove bulkheads encountered in connecting sewers or structures included in this Contract, or in pipelines or structures previously built, when they are no longer needed or when ordered.
- G. Sleeve Type Couplings: For sleeve type couplings, equally tighten diametrically opposite bolts on the connection so that the gaskets will be brought up evenly all around the pipe.
1. Torque Wrenches: Do the final tightening with torque wrenches set for the torque recommended by the coupling manufacturer.
- H. Concrete Cradle
1. General: When a concrete cradle is shown, specified, or ordered in writing, lay the pipe to grade by supporting each section on concrete blocks located near each end.
    - a. Shape the tops of the blocks to fit the outside diameter of the pipe.
    - b. Set the blocks approximately 3/8 inch low.
    - c. Place the pipe on the blocks on a layer of stiff mortar of sufficient thickness to bring the pipes to exact grade.
    - d. Timber blocking is not acceptable.
  2. Cradle: Place Class D concrete cradle, on one side only, until it has risen above the invert on the other side, after which deposit the remainder of the concrete on both sides to the pipe spring line.
    - a. Prevent movement of the pipe during concrete placement.
- I. Concrete Encasement: When concrete encasement is to be provided, as shown, specified, or ordered in writing, lay and block the pipeline and place concrete as specified for concrete cradle.
1. Continue the placing of concrete to provide complete encasement to the dimensions shown, specified, or ordered.

- J. Valve Box Setting: Install valve boxes vertical and concentric with the valve stem.
  - 1. Satisfactorily reset any valve box which is moved from its original position, preventing the operation of the extension valve stem.
  - 2. Replace any extension valve stem which has been damaged so that it can be operated.
  
- K. Erection:
  - 1. Anchorage: Place anchorage of pipelines and appurtenances as shown on the Drawings or as ordered.
    - a. Accomplish anchorage by placing concrete to the dimensions shown between undisturbed earth and the fitting to be anchored.
    - b. Provide restrained joints as specified in Section 33 05 55 as the primary method for thrust restraint. Install pipe with restrained joints for the distance (both upstream and downstream of pipeline appurtenances) as shown.
    - c. Thrust blocks are not allowed for use on this project.
  - 2. Valve Setting: Erect valves carefully in their proper positions, free from all distortion and strain, with flanged, mechanical or push-on joints, and pack and leave in satisfactory operating condition.
  - 3. Short Tunnel Construction: Joint pipes to be placed in short tunnels prior to being placed into position.
    - a. Place the pipe into position in a manner which keeps joints tight.

### 3.3 FIELD QUALITY CONTROL

- A. Testing: Test pipelines in accordance with Section 01 45 50.
  - 1. Test valves in place, as far as practicable, and correct any defects in valves or connections.
  
- B. Inspection: Clean, inspect, and examine each piece of pipe and each fitting and special defects before it is installed.
  - 1. Cut away any lumps or projections on the face of the spigot end or the shoulder.
  - 2. Do not use any cracked, broken, or defective pieces of the work.

3. If any defective piece should be discovered after having been installed, remove and replace this piece with a sound piece in a satisfactory manner at no increase in Contract Amount.

### 3.4 CLEANING

- A. General: Thoroughly clean all pipe before it is laid and keep it clean until it is accepted in the completed work.
- B. Removal of Materials: Exercise special care to avoid leaving bits of wood, dirt, and other foreign particles in the pipe. If any particles are discovered before the final acceptance of the work, remove and clean the pipe.

### 3.5 SCHEDULE

- A. Definitions: Abbreviations used in the schedule are:
  1. Pipe Materials:
    - a. DI Ductile Iron
  2. Joints:
    - a. MJ Mechanical Joint
  3. Coatings and Linings:
    - a. BC Bituminous - Cold Application
    - b. CL Cement-Mortar Lined
    - c. PEW Polyethylene Wrapped
- B. Schedule: Provide products as listed in the following schedule:

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BURIED PIPING SCHEDULE

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Facility/Service	Size (Inches)	Pipe Material	Protective Coatings		Joints	Test Pressure (psig)	Pipe Class or Thickness (inches)	Notes and Remarks
			Int.	Ext.				
<u>PRESSURE ADJ STATION</u> Storm Sewer	8	DI	CL	BC, PEW	MJ	5	PC 150	1

Notes:

1. Refer to Section 33 30 00.

END OF SECTION

## SECTION 33 30 00

### SANITARY AND STORM SEWERAGE PIPING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Furnishing and installing reinforced concrete sewer pipe, fittings and specials.
- B. Related Work Specified in Other Sections Includes, But is Not Limited to, the Following:
  - 1. Section 01 45 50 - Leakage Tests
  - 2. Section 33 05 50 - Laying and Jointing Buried Pipelines

##### 1.2 REFERENCES

- A. Codes and standards referred to in this Section are:
  - 1. ASME B16.1 - Grey Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
  - 2. ASTM F593 - Standard Specifications for Stainless Steel Bolts, Hex Cap Screws, and Studs
  - 3. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings
  - 4. AWWA C115/A21.15 - Flanged Ductile-Iron Pipe With Ductile-Iron or Grey-Iron Threaded Flanges
  - 5. AWWA C150/A21.50 - Thickness Design of Ductile-Iron Pipe
  - 6. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast
  - 7. AWWA C153/A21.53 - Ductile-Iron Compact Fittings
  - 8. Standard Specifications for Water and Sewer Construction in Illinois, latest edition

##### 1.3 SUBMITTALS

- A. General: Provide all submittals, including the following, as specified in Division 1.
  - 1.

- B. Shop Drawings: Submit complete shop drawings for all diameters and classes of reinforced concrete pipe, fittings and specials showing dimensions, strength and materials specifications and standards, joint details, reinforcement position and plastic sheet lining details for approval prior to manufacture.
  - 1. Pipe joints, fittings, and appurtenances. Where special designs or fittings are required, provide a drawing to show the Work in large detail and completely describe and dimension items.
  - 2. Fully dimensioned drawings of piping layout including pipes, fittings, adapters, appurtenances, valves, supports and anchors. Label pipe size, materials, type, and class on drawings and include limits of restrained joints. Show cross sections with the elevations of appurtenances, pipes, fittings, and valves.
  - 3. Catalog data for pipe, joints, fittings, coatings, lining, gaskets, and other appurtenances.
  
- C. Design Standards: Provide ductile iron pipe meeting the requirements of AWWA C150/A21.50 and C151/A21.51.
  - 1. Materials Compliance: Submit notarized affidavits of all materials compliance with AWWA C150/A21.50.
  - 2. Product Compliance: Submit notarized affidavit of pipe compliance with AWWA C151/A21.51 and these specifications.
  
- D. Quality Control: Submit certified results of all shop tests for approval.

#### 1.4 QUALITY ASSURANCE

- A. Provide the following:
  - 1. An affidavit from the pipe supplier attesting that plant and equipment capacity is sufficient to perform the required pipe production, testing, fabrication, lining, and coating within the specified Contract Time in accordance with the CONTRACTOR's approved Progress Schedule.
  - 2. Premanufacture notification for ductile iron pipe, fittings, and appurtenances.
  - 3. Deliver, store and handle products and materials as specified in Division 01 and Section 33 05 50.

## PART 2 PRODUCT

### 2.1 MANUFACTURERS

- A. Acceptable manufacturers are listed below. Manufacturers of equivalent products may be submitted unless specified otherwise.
1. Ductile iron pipe and fittings: Equivalent products may not be submitted.
    - a. AMERICAN
    - b. McWane, Inc.
    - c. United States Pipe and Foundry Company
  2. Ductile Iron Retainer Glands
    - a. EBAA Iron, Inc. MEGALUG Series 1100
    - b. Or Approve Equal
  3. Restrained Mechanical Joints
    - a. AMERICAN
    - b. McWane, Inc.
    - c. United States Pipe and Foundry Company
  4. Gaskets
    - a. AMERICAN
    - b. Garlock Packing Company
    - c. John Crane, Inc.
    - d. McWane, Inc.
    - e. Specification Rubber Products, Inc.
    - f. United States Pipe and Foundry Company
    - g. U.S. Rubber Company
  5. Coatings and Linings
    - a. Carboline
    - b. Fulton Enterprises, Inc.
    - c. Madison Chemical Industries
    - d. Tnemec
    - e. Vulcan Coatings

### 2.2 MATERIALS

- A. Fittings: Provide fittings meeting the requirements of AWWA C153/A21.53, or AWWA C110/A21.10 where required, unless shown or specified otherwise. Provide fittings having a pressure rating meeting or exceeding that shown. Match fitting coating and lining to the pipe coating and lining.

1. Flanged: Provide flanged fittings as shown. Flanges installed in a buried condition are not acceptable for use on this project. Where long radius flanged fittings and other flanged fittings not covered in AWWA C110/A21.10 are shown or specified, provide items meeting the requirements of AWWA C110/A21.10 and having laying lengths conforming to ASME B16.1 for 125-pound American Standard fittings.
- B. Gasket Joints: Provided mechanical joints and push-on joints meeting the requirements of AWWA C110/A21.10, AWWA C111/A21.11, and AWWA C153/A21.53 as applicable.
1. Compact Mechanical Joint and Rubber Gasket Joint: Provide restrained joints at fittings as specified in this Section. Unless shown otherwise, provide items meeting the requirements of AWWA C153/A21.53.
  2. Fasteners: Provide anti-rotational T-bolts and nuts on mechanical joints, except where special bolts are supplied with the approved restraint device, that are high-strength, corrosion resistant, Type 304L stainless steel, annealed, minimum 60,000 psi tensile strength, in accordance with the manufacturers recommendations meeting the requirements of AWWA C111 and ASTM F593. Nuts are to be Xylan or FluoroKote #1 (corrosion resistant) coated.
  3. Fasteners: Provide anti-rotational T-bolts and nuts on mechanical joints, except where special bolts are supplied with the approved restraint device, that are high-strength, corrosion resistant, Type 304L stainless steel, annealed, minimum 60,000 psi tensile strength, in accordance with the manufacturers recommendations meeting the requirements of AWWA C111 and ASTM F593. Nuts are to be Xylan or FluoroKote #1 (corrosion resistant) coated.
- C. Connecting Pieces and Special Fittings
1. General: Provide connecting pieces, such as bell and bell, and bell and spigot meeting the requirements of AWWA C110/A21.10, or AWWA C153/A21.53.
  2. Design: Provide special fittings, where required, of an approved design that have the same diameters and thicknesses as standard fittings, unless otherwise required, but their laying lengths and other functional dimensions are determined by their positions in the pipeline and by the particular piping materials to which they connect.
- D. Linings and Coatings
1. Cement Lining: Provide ductile iron pipe and fittings having a cement-mortar lining not less than standard thickness meeting the requirements of

AWWA C104/A21.4, unless shown or specified otherwise. Finish interior of the pipe so that the Hazen-Williams friction factor will not be less than 140.

- a. Repair: Repair cement mortar lining damaged during handling, hauling, storage or installation.
2. Labels: Label the supplier's name or trademark, size, pressure class, manufacture date, bend angle turned and locations of short and long sides, and control number cross referenced to the laying schedule conspicuously in white on the outside of each pipe, fitting, and special casting after the shop coat has hardened. Provide cast marks and other marks in accordance with applicable standards.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

- A. Install all ductile iron sewer pipe, fittings and specials in accordance with the manufacturer's recommendations and approved shop drawings and as specified in Division 1.

#### 3.2 LEAKAGE TESTS

- A. Test the ductile iron sewers for leakage after completion in accordance with Section 01 45 50.

#### 3.3 SCHEDULES

- A. Refer to the schedule contained in Section 33 05 50 for information on the piping that is to be constructed using the pipe materials and methods specified herein.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 40 67 17

CONTROL PANELS

SCADA SWITCHGEAR NETWORK PANEL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. General Electrical Provisions indicated in Division 26 General Electrical Provisions, apply to this Section.
- C. Related work specified elsewhere includes, but is not limited to:
  - 1. Section 40 80 30 In-Factory Testing Scada Switchgear Network Panel
  - 2. Section 40 80 40 Field Testing
  - 3. Section 26 05 60 Electrical Requirements for Shop Assembled Equipment
  - 4. Section 26 29 53 Control Components and Devices

1.2 SUMMARY

- A. This Section includes the equipment and installation practices for SCADA Switchgear Network Panel and associated Control Equipment.

1.3 DEFINITIONS

- A. Ethernet: Local area network based on IEEE 802.3 standards.
- B. Firmware: Software (programs or data) that has been written onto read-only memory (ROM). Firmware is a combination of software and hardware. Storage media with ROMs that have data or programs recorded on them are firmware.
- C. HTML: Hypertext markup language.
- D. I/O: Input/output.
- E. KB: Short for kilobyte. When used to describe data storage, "KB" represents 1024 bytes.
- F. LAN: Local area network; sometimes plural as "LANs."
- G. LCD: Liquid crystal display.

- H. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or remote-control, signaling and power-limited circuits.
- I. Modbus: An open protocol for exchange of process data.
- J. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.
- K. PC: Personal computer; sometimes plural as "PCs."
- L. rms: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.
- M. RS-232: A TIA standard for asynchronous serial data communications between terminal devices.
- N. RS-485: A TIA standard for multipoint communications using two twisted-pairs.
- O. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.
- P. THD: Total harmonic distortion.
- Q. UPS: Uninterruptible power supply; used both in singular and plural context.
- R. WAN: Wide area network.
- S. HMI: Human Machine Interface
- T. TFT: Thin-Film Transistor
- U. Nit: A unit of measurement of luminance, or intensity of visible light, where one nit is equal to one candela per square meter. Nits are used to describe the brightness of computer displays such as LCD and CRT monitors
- V. PLC: Programmable Logic Controller
- W. SPDT: Single Pole Double Throw
- X. VT: Voltage Transformer
- Y. RTD: Resistance Temperature Detector
- Z. TVSS: Transient Voltage Surge Suppressor

- AA. MOV: Metal Oxide Varistor
- BB. SAD: Silicon Avalanche Diode
- CC. AI: Analog Input
- DD. AO: Analog Output
- EE. DI: Digital Input
- FF. DO: Digital Output

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For power monitoring and control equipment. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Outline Drawings: Indicate arrangement of components and clearance and access requirements.
  - 2. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
  - 3. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 4. Wiring Diagrams: Power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.
  - 5. In addition to the above, provide the following information for the Control Panels:
    - a. Panel and subpanel layout (exterior and interior) drawings for all enclosures. Include dimensioned plan requirements and elevation views of components. Show access, and work space.
    - b. A listing of devices mounted within the enclosures. Include the quantity, description, manufacturer and complete model number for each device.

- c. Panel wiring diagrams. Add panel power distribution, and ancillary devices such as relays, alarms, fuses, lights, fans and heaters. Show circuit components individually. Do not submit typical diagrams for multiple circuits.
    - d. Color schedule with color samples and paint chips for all enclosures.
    - e. Provide calculations for sizing the heating and/or cooling (fans, heaters, air conditioners) devices at the control panel.
  - 6. In addition to the above, provide the following for PLCs:
    - a. Narrative description of the operation of the system.
    - b. The hardcopy of the program that is to be written onto the PLC. The program shall be in the IEC 61131-3 compliant format (Ladder Logic, Function Block, Sequential Function Chart, Instruction List, or Statement Language).
- C. Software and Firmware Operational Documentation:
- 1. Self-study guide describing the process for setting equipment's network address; setting Owner's options; procedures to ensure data access from any PC on the network, using a standard Web browser; and recommended firewall setup.
  - 2. Software operating and upgrade manuals.
  - 3. Software Backup: On a magnetic media or compact disc, complete with Owner-selected options.
  - 4. Device address list and the set point of each device and operator option, as set in applications software.
  - 5. Graphic file and printout of graphic screens and related icons, with legend.
- D. Software licenses and upgrades required by and installed for operating and programming digital and analog devices.
- E. Qualification Data: For installer and manufacturer.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For power monitoring and control units, to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Operating and applications software documentation.
2. Software licenses.
3. Software service agreement.
4. PC installation and operating documentation, manuals, and software for the PC and all installed peripherals. Software shall include system restore, emergency boot diskettes, and drivers for all installed hardware. Provide separately for each PC.
5. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.

H. Other Informational Submittals:

1. System installation and setup guides, with data forms to plan and record options and setup decisions.
2. Submit the hardcopy of the final and fully tested program that is written onto the PLC. The program shall be in the IEC 61131-3 compliant format (Ladder Logic, Function Block, Sequential Function Chart, Instruction List, or Statement Language). Include a narrative description of the program.
3. Submit record drawings for Control Panels.
4. For Control Panels: Keep a neatly marked set of record wiring drawings showing the installed location and routing of all wiring, including spares. These drawing shall also show all terminal connections. Keep drawings current with the work as it progresses. These drawings are subject to inspection by the Engineer at any time. Coordinate this requirement with point-to-point wiring documentation. Drawings must show as a minimum:
  - a. All wiring between I/O modules and interface terminal strips, including terminal and wire numbers for all wiring.
  - b. All communication cable wiring and interconnection.
  - c. All interconnections between various components.
  - d. All power connections to system components and other devices.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

- B. Manufacturer Qualifications: A firm experienced in manufacturing power monitoring and control equipment similar to that indicated for this Project and with a record of successful in-service performance.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

#### 1.6 COORDINATION

- A. Coordinate features of distribution equipment and power monitoring and control components to form an integrated interconnection of compatible components.
  - 1. Match components and interconnections for optimum performance of specified functions.
- B. Coordinate Work of this Section with those in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

#### 1.7 SOFTWARE SERVICE AGREEMENT

- A. Patches, fixes, technical support, updates and upgrades shall be provided at no additional cost to the owner for a period of two years after the date of Substantial Completion.
  - 1. Provide 30-day notice to Owner to allow scheduling and access to system.
  - 2. Owner shall be automatically notified via email when patches, fixes, updates and upgrade become available.

#### 1.8 CONTROL PANEL DESIGN CRITERIA

- A. Provide installation of the control panels. Installation shall be in accordance with applicable federal, local and state codes. Supervise the installation and be responsible for the performance of the completed system.
- B. Instruments and control hardware associated with the control panels shall be properly installed, wired, and tested to be suitable for operation. Work necessary to properly install, adjust, and place the panels and enclosures in operation shall be provided by the Contractor.
- C. Work shall comply and be in accordance with approved trade practices and equipment manufacturer's recommendations.
- D. Terminal strips shall be provided within the panel enclosures. Inputs and outputs from the process control system shall be wired to and terminated at the panel.

- E. The panels shall include all termination strips, interface hardware, wiring, cabling, etc. necessary to provide a complete operational interface between the panels and the process control system.
- F. Panels shall include all components as shown and specified. Necessary accessories such as power supplies, mounting hardware, terminal blocks, control circuit breakers, fuses, and other items which may be required to complete the system shall be provided.
- G. Analog signals which are received from the field at the panels shall be 4-20 mA dc signal, unless otherwise noted. The signal conversion necessary for compatibility with panel mounted instruments and the interface to the process control system shall be provided.
- H. Control components such as relays, timers and other equipment necessary to provide the interfacing and interlocking required between the motor starter or variable speed drive, and associated protective circuits, or other type of control circuit function applicable to a particular final control element, shall be furnished premounted and wired in the applicable panel.
- I. Panel construction shall be compatible with the environment of the installed location and shall protect the enclosed instruments and equipment from ambient temperature extremes, moisture, dirt, gaseous contaminants and normal wear and tear.
- J. The elementary circuit diagrams shown on the Drawings illustrate some electrical schematics for major equipment associated with the panels. These schematics are to be considered typical of the equipment expected to be furnished. Provide engineering necessary to interface to the panels, prepare wiring schematics for equipment, provide all interconnections and put the panels in a complete operational status. Provide additional detailed engineering necessary to properly interface with equipment actually furnished. Any changes resulting from deviations from the typical schematics shall be furnished with no increase in scope or cost.
- K. Panel design shall allow for removal and maintenance of equipment after installation.
- L. Front of panel mounted nameplates shall be furnished to properly identify all panels and the equipment mounted on the panel front. A final list of nameplates to be used and a location drawing shall be submitted to the Engineer for review. Nameplates shall be laminated plastic having black letters on white background and shall include device identification number as well as descriptive name. Nameplates shall be permanently secured by stainless steel screws.
- M. Back-of-panel mounted plastic markers, with black letters on a white background shall be used in the panel interior to identify each device mounted on the panel exterior or interior. The markers shall be located adjacent to, but not on, the given

device and visibility shall not be obstructed by wire bundles or other equipment. Markers shall include device identification number as well as descriptive name.

- N. Provide for the protection, insurance and proper storage of equipment. Defects in the equipment shall be repaired or replaced, as required, at no additional cost. Any defects that are found shall be immediately brought to the attention of the Engineer.
- O. Equipment shall be installed in strict accordance with the manufacturer's recommendations. Use the manufacturer's installation manuals for guidance and for details not shown on the Drawings.
- P. All control panels shall be designed and built so that they are fully compliant with Underwriters Laboratories Subject 508A (UL508A) regarding Industrial Control Panels. All control panels shall bear the UL seal. The UL508A standard shall be applied to modifications made to existing control panels. Control panel builder shall be UL Certified.

## PART 2 PRODUCTS

### 2.1 CONTROL PANELS

#### A. FABRICATION

1. The enclosures shall meet the requirements of the NEMA Type specified in the Contract Documents.
2. Panels shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA, ANSI, NFPA and UL.
3. The enclosures shall have sufficient structural reinforcements to insure a plane surface, to limit vibration and to provide rigidity during shipment, installation and operation without distortion or damage to the panel or injury to any instruments mounted thereon. Seams are to be continuously welded.
4. Panels shall be fully enclosed units with front access (all devices and equipment within the panel shall be front accessible, rear access shall not be provided unless otherwise noted), and designed to fit in the space available.
5. After completion of construction and installation of all panel mounted devices, and raceway there shall be no holes at the enclosure. Any holes shall be sealed with Hole Seals, Hoffman Hol-Tite Oil Tight Hole Seal or approved equal. Provide stainless steel hole seals (meeting UL/NEMA Type 4, 4X, 12, and 13) for NEMA Type 4X enclosures and steel hole seals (meeting UL/NEMA Type 4, 12 AND 13) for all other enclosures. Oil resistant gasket shall be provided with the hole seals.

6. Free-standing enclosures shall be bonderized, primed and finished with two coats of ANSI enamel finish on exterior surfaces. Wall mounted steel enclosures shall be bonderized, primed and finished with two coats of ANSI polyester powder finish on interior and exterior surfaces. The panel interior shall be white. The exterior color shall be selected by the Engineer at the time drawings are submitted for review.
7. Each panel shall have print pockets mounted inside the door which shall hold detailed wiring and interconnection diagrams for the panels. If a PLC is provided inside the panel, a hardcopy of the PLC program shall also be provided. One copy of the relevant record drawings shall be provided and placed in these pockets.
8. A locking door handle shall be provided for each panel. Locks shall be keyed alike, unless otherwise noted. Provide 3 copies of the keys per enclosure, unless otherwise noted.
9. If a NEMA Type 4 or 4X enclosure is specified, the door clamps and hinge pins shall be stainless steel.
10. Touch up paint shall be furnished for each enclosure. Paint shall be taken from the same batch mix as that used for the enclosure. Touch up paint shall be provided in spray cans (16 ounce maximum or in paint cans (32 ounce maximum). A minimum of 128 ounces for each color shall be furnished. The color shall be identified on each container. Enclosures made from non-metallic material do not require painting.
11. Steel stiffeners shall be provided on the back of the panel face as required to prevent deflection due to instruments, operations of equipment, or opening/closing of doors. As a minimum use 0.25 inch high by 1 inch wide by 0.5 inch deep channel stiffeners and tack welded to the panel. Where panel mounted instruments require rear mounting support, provide support brackets per the manufacturer's recommendations.
12. Internal condensation and freezing protection with thermostat control shall be provided for enclosures mounted outdoors or in unheated areas.
13. Circuit breakers and/or motor circuit feeding motors and other loads shall be grouped together in the enclosure.
14. Enclosure doors shall be rubber gasketed with continuous hinge.
15. Where fans are required by the contract documents, the fans shall have the following features:
  - a. Ball bearing construction and split capacitor motors

- b. Split capacitor motors shall be thermally protected
- c. Finger guard, aluminum air filter and grille shall be provided
- d. A sealing gasket shall be provided between the grille and the enclosure
- e. An internal thermostat shall be provided to control the fan
- f. Fans and related accessories shall be Hoffman Enclosures, Inc. or approved equal.
- g. A separate control power transformer and associated control circuit shall be provided for the fans.
- h. The fans shall not allow the temperature inside the enclosure to exceed 40 degrees C, unless a lower temperature is required by the electrical devices inside the enclosure, in which case the lower temperature requirement shall apply (the more stringent requirement shall apply). Provide multiple fans as required.
- i. The system integrator shall provide heat load calculations for the panel to determine the need for heating or cooling of the panel.

## B. ENCLOSURES

- 1. Free-Standing Enclosures:
  - a. Free-standing enclosures shall be fabricated from sheet steel. Single door enclosures shall be fabricated with 12 gauge (minimum) sides, top and back. Double door or multiple door enclosures shall be fabricated with 10 gauge (minimum) back and 12 gauge (minimum) top, sides and front.
  - b. Exterior welds shall be ground and sanded to a smooth finish free of burrs. Surfaces shall be free of ridges, nuts, bolt heads and similar protrusions.
  - c. Removable lifting lugs designed to facilitate rigging and lifting of the enclosure during installation shall be provided on the top of the enclosure. Plugs shall be provided to fill the lifting ring holes after installation is complete.
  - d. A full-length door shall be provided for the front or rear access. The handle mechanism shall be furnished with a three-point latch. A key locking mechanism shall be provided.

- e. Where indicated on the contract documents, steel 12 inch floor stands shall be provided.
- f. A 10 gauge (minimum) steel back panel shall be provided inside the enclosure. All electrical equipment inside the enclosure shall be mounted on the back panel.
- g. The SSNP shall be a Free-Standing Enclosure.
- h. Hoffman A723624FS NEMA 12, 72 x 36 x 24 Steel, or equal.

### C. PANEL WIRING AND TERMINATIONS

- 1. Wiring and terminations shall be designed, manufactured and tested in accordance with the latest standards of the National Electrical Code as well as state and local electrical codes for the area where the panels will be installed.
- 2. Panel Wiring:
  - a. Instrumentation and Communication Signal wiring shall be segregated from control power wiring, grouped functionally and arranged neatly to facilitate tracing of circuits.
  - b. Plastic wiring wraps shall be used to bundle wires, except within wiring ducts. The bundles shall be securely fastened to the steel structure at suitable intervals, not exceeding 12 inches in length.
  - c. Flexible stranded copper wiring shall be used throughout. No solid conductor wire shall be permitted for the instrumentation and control wiring.
  - d. Instrumentation signal wiring shall be uniformly twisted with a minimum of six twist per foot.
  - e. Where shielding is required, shields shall be continuous foil or metalized plastic providing 100% coverage. A drain wire in continuous contact with the shield shall be included.
  - f. All AC and DC signal wiring shall be completely segregated from AC power wiring within the same panel.
  - g. The wiring for AC signals and the wiring for DC signals shall be segregated as much as possible within the panel. They shall be bundled in separate bundles. The running of DC signal wiring and AC signal wiring in a common duct or panduit shall be kept to a minimum.

- h. Panel wiring shall be stranded copper wire with crosslinked polyethylene (XLPE) insulation (90 degrees C wet or dry), type XHHW-2, rated for 600 Volts. No wire smaller than 14 AWG shall be used for power wiring, unless noted on the drawings. Instrument signal wiring shall be no smaller than 18 AWG. Control circuit wiring shall be no smaller than 16 AWG.
- i. Wiring shall not be spliced. Wire shall run in continuous lengths from screw terminal to screw terminal. Wire service loops shall be provided to permit device removal.
- j. Wires shall be identified at both ends with white sleeve-type markers. The wire markings shall correspond to the wire designation shown on the panel wiring drawings.
- k. Unless otherwise noted, wiring shall be color coded as follows:
  - (1) Line and load circuits for AC or DC power – black
  - (2) AC control circuits – red
  - (3) DC control circuits – blue
  - (4) Interlock control circuits on the panel energized from external source (foreign voltage) – YELLOW
  - (5) Equipment grounding conductors – green
  - (6) Current carrying grounded conductor – white
- l. Wiring to hand switches, relays, etc., which interlock with energized circuits independent of the panel's normal circuit breaker protection shall be clearly identified.
- m. In panels where foreign voltages exist, furnish a highly visible warning label inside the panel with the following words: "WARNING: FOREIGN VOLTAGES EXIST IN THIS PANEL. THEY ARE IDENTIFIED BY YELLOW WIRE COLOR."

### 3. Terminal Blocks

- a. Terminal blocks shall be provided for interconnection between field devices and panel wiring. The terminal blocks shall be factory assembled on a mounting rail and the rail bolted to the inside of the panel. Center to center spacing of terminal block strips shall not be less than 6 inches for low density terminal blocks and 8 inches for high density terminal blocks.
- b. Terminal blocks shall be of the screw type with pressure plate (compressor type) requiring no lugs on connecting wires. Terminals shall accept wire size 14 AWG or smaller and shall be suitable for 600 volts service. The terminals shall have continuous marking strip, using

the alphanumeric nomenclature. Separate terminals shall be provided for terminating shield wires.

- c. One side of each terminal strip shall be reserved for field incoming conductors. Common connections and jumpers required for internal wiring shall not be made on the field site of the terminal. No more than two wires shall be terminated at any one terminal.
- d. A minimum of 25% spare mounting rail length shall be installed. Spare terminal blocks shall be mounted of type and quantity equal to the points on one I/O card of each type used in that panel.
- e. Two ground buses shall be provided in each panel, one for shield and panel grounding, and one for signal grounding. Grounding lugs for each connection to the external grounding system shall be provided.
- f. High density terminal blocks and fuses for AC and DC signals shall be Phoenix Contact, Weidmuller, or equal.

#### 4. Wiring Ducts

- a. Wiring ducts shall be provided to manage path of wire and cable inside the enclosure
- b. Snap-back wire retention to trap wires during installation
- c. UL 94v-0 Flammability Rating, UL Component Recognized

- 5. Surge suppressors shall be provided on all DC operated relay coils to reduce high transient voltages generated when the circuit to the operating coil is opened.

#### D. DISCONNECT

- 1. A main disconnect shall be provided to disconnect the control panel from source of power. Disconnect shall consist of a circuit breaker, thru-door kit, operating mechanism and handle. Provide a door mounted external operating handle for operating the circuit breaker located inside the enclosure. Operating handle shall be interlocked with doors. Operating handle shall be in the OFF position before the door can be opened. Provide a means to defeat the interlock that will require a use of a flat head screwdriver.

## 2.2 PROGRAMMABLE AUTOMATION CONTROLLER

### A. GENERAL

1. The Contractor shall furnish and install the control system in accordance with the Performance Criteria Section of this specification and as detailed on the applicable Contract Drawings. Each PAC shall include but not to be limited to: a processor module (CPU), communications interface module, power supply, software for applications programming, operator interface system diagnostics, communications, data acquisition, and module racks. The PAC shall collect data, process control functions, communicate with other PACs, distribute process information along the data highway, and may have their program down loaded from programmer's terminal, and be locally programmed from a portable programmer. The PAC shall have provisions for communicating unsolicited messages (report by exception) to an operator interface to reduce network traffic.
2. The PCS system shall be furnished by a single vendor who has actively been manufacturing PACs of the required specified capabilities and whose products have operated successfully for a period of at least eight years.
3. All PAC equipment shall be UL listed.
4. The PAC system manufacturer shall maintain, as part of a national network, engineering service facilities within 200 miles of the Project, to provide start-up service, emergency service calls, repair work, service contracts, maintenance, and training of Department personnel. Emergency service shall be available within twenty-four hours of notification.
5. Allen-Bradley – ControlLogix 5580 1756 – L82E Programmable Automation Controller (No substitutions)

### B. CONSTRUCTION

1. The plant-wide programmable automation controller (PAC) shall be part of a modular system with expansion and modification capability. The system shall include:
  - a. One (or more) chassis
  - b. PAC(s) with embedded Ethernet port and embedded energy storage module
  - c. Communications network module(s) (optional)

- d. A power supply at the left end of each chassis
  - e. I/O modules
2. All system modules and local and remote chassis shall be designed to operate in:
    - a. An industrial environment with – a) An ambient temperature of 0°C to 60°C (32°F to 140°F) per IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat), and IEC 60068-2-14 (Test Nb, Operating Ther-mal Shock). b) A relative humidity range of 5% to 95%, non-condensing per IEC 60068-2-30 (Test Db, Unpackaged Damp Heat).
    - b. A free airflow environment (convection cooling only, no fans or other air moving devices shall be required).
    - c. Conformal coating of the PAC offered as an option for use in corrosive or haz-ardous applications, with suitability for ambient temperatures of -25°C to 70°C (-13°F to 158°F).
  3. All system modules and local and remote chassis shall be designed and tested to operate in high electrical noise environments.
  4. All chassis shall be designed for horizontal-only, back-panel mounting, and each chassis shall have 4 to 17 slots.
    - a. The chassis backplane shall provide a high-speed communication path between modules and shall distribute power to each of the modules within the chassis.
    - b. The PAC shall be capable of being placed in any slot of its chassis, and multiple PACs shall be capable of being installed in the same chassis.
    - c. Each I/O module shall be self-contained and housed within a chassis.
    - d. Each chassis, with its respective modules, shall contain up to 512 unique points (16 modules x 32 points/module, using a 17-slot chassis).
    - e. All system modules, including the PAC, shall be capable of removal and inser-tion under power (RIUP) from/into the chassis without faulting the controller or damaging the modules. A software configuration to fault the controller shall be available.
  5. The PAC shall monitor and control I/O across its backplane and over network links.

### C. PAC

1. The PAC shall be a self-contained unit and will be capable of providing control program execution, supporting remote and local programming, and controlling all I/O scanning, inter-controller, and peripheral communication and diagnostic functions.
  - a. 32 tasks (up to 1000 scheduled programs per task at any point in time).
  - b. Multiple Controllers with support of up to 300 EtherNet/IP network nodes.
  - c. Network connections per optional network module in the local chassis:
    - a) 128 (or 256) EtherNet/IP and 64 (or 128) TCP b) 40 (or 100, 128) ControlNet
  - d. The PAC shall be capable of sharing produced and consumed tags with other controllers on the same network.
2. The PAC shall support Continuous, Periodic, and Event tasks.
  - a. Interrupt mechanism shall adhere to IEC 61131-3 definition of preemptive mul-titasking.
  - b. Tasks shall have a user-settable watchdog timeout, which is unique to that task.
  - c. Periodic tasks shall run via an interrupt at a user-defined interval in 1- $\mu$ s increments from 1 ms to 2000 s.
  - d. Periodic and Event execution priority shall be user-assignable with a priority number.
  - e. Event tasks shall support a range of triggers, including:
    - (1) Module input data change-of-state
    - (2) Consumed tag trigger
    - (3) Event instruction
    - (4) Axis trigger
    - (5) Motion event trigger
3. The PAC shall provide a means for fault handling.
  - a. The capability shall exist for a project to have a controller fault handler for over-all project fault recovery.
  - b. The capability shall exist for a program to have its own fault routine for program fault recovery.
4. Programming instructions shall include the following:

- a. Relay-Type (for example: Examine On, Examine Off, One Shot)
- b. Counter and Timer
- c. Data Comparison (for example: Equal, Greater than or Equal, Less than, Equal)
- d. Data Manipulation (for example: Copy, Move)
- e. Logical (for example: And, Not, Or)
- f. Integer and Floating Point Math (for example: Add, Subtract, Multiply, Log 10)
- g. Advanced Math and Trigonometric Functions (for example: Sine, Cosine, Tan-gent)
- h. Statistical (for example: Moving Average, Moving Standard Deviation)
- i. File Function (for example: Average, Standard Deviation, Sort)
- j. Matrix and Array (for example: COP, CPS, FIFO)
- k. BCD Conversion
- l. Program Flow Control (for example: Jump/Label, Subroutine)
- m. Word Shift (for example: Sequencer Input, Output, Load)
- n. Bit Shift (for example: Bit Shift Left, Bit Shift Right)
- o. Diagnostic
- p. Communication
- q. Proportional Integral and Derivative (PID)
- r. Block Read and Write
- s. FOR-NEXT Loop
- t. Alarm (for example: Analog Alarm, Digital Alarm)
- u. Debugging (for example: Always False)

5. It shall be possible for users to create instructions to encapsulate code in a similar fashion to subroutines.
  - a. Once defined in a project, created instructions shall behave similarly to the built-in instructions already in the PAC.
  - b. Custom instruction logic can be created using Ladder Diagram, Structured Text, or Function Block Diagram. The PAC shall be capable of executing each pro-gramming language at the same performance.
6. The system must be capable of storing the following data:
  - a. Timer Values
  - b. Counter Values
  - c. Boolean Values (0 or 1)
  - d. Short Integer Numbers (-128 to 127)
  - e. Integer Numbers (-32,768 to 32,767)
  - f. Double Integer Numbers (-2,147,483,648 to 2,147,483,647)
  - g. Floating Point Numbers to 8 significant digits (for 8+ digits, conversion to expo-nential form from  $\pm 1.1754944 \text{ E } -38$  to  $\pm 3.402823 \text{ E } +38$ )
  - h. Long Integer Numbers (-9,223,372,036,854,775,808 to 9,223,372,036,854,775,807)
  - i. Internal Processor Status Information
  - j. User-defined data types
  - k. Arrays (one, two, or three dimensions) a) Able to be indexed b) Only limited in size by the amount of available memory
7. Data shall be distinguishable to the PAC by address and sub-element mnemonic.
  - a. Management of the data into memory subsections shall be an automatic function of the PAC operating system.
  - b. Data can be displayed in ASCII, Binary, Octal, Hexadecimal, or Decimal.
  - c. Function-specific data such as PID, Axis, Axis Group, or Message shall have dedicated displays available that annotate the meaning of specific

control bits and words within them and allow for selective control where appropriate.

8. The PAC shall have an embedded Energy Storage Module (ESM) that provides enough power for the controller to write all program and variable data to internal nonvolatile memory during loss of power.
9. For clock support and backup of memory at power down, the PAC shall have:
  - a. A clock value in the form of a predefined tag, accessible via logic or remotely.
  - b. A capacitor-based ESM.
  - c. A memory card capable of storing current tag data in the state it was when the nonvolatile memory was last saved.
10. The front of the PAC shall have:
  - a. A scrolling status display for general, status, and fault messages, including –
    - (1) I/O connection status.
    - (2) ESM status.
    - (3) Power-up information – hardware and firmware revisions, power-up test status.
    - (4) EtherNet/IP connection information.
    - (5) Backup energy alerts.
  - b. Four color LED indicators –
    - (1) RUN to indicate if the controller is in the Run mode.
    - (2) FORCE to indicate if I/O forces are placed in an On or Off state and if the force is active (enabled).
    - (3) SD to indicate Secure Digital card status.
    - (4) OK to indicate controller status.
  - c. Two EtherNet/IP LED indicators –
    - (1) NET to indicate connection status.
    - (2) LINK to indicate network activity.
  - d. Key-switch positions for three modes of operation –
    - (1) RUN – No control logic edits possible, program always executing.
    - (2) PROGRAM – Programming allowed, program execution disabled.

- (3) REMOTE – Programming terminal can make edits and change processor mode, including Test mode, whereby the logic executes and inputs are monitored.
  - e. A USB 2.0 port communicating at 12 MB/s for temporary local programming purposes.
  - f. A 1-gigabit (Gb) Ethernet port.
11. Behind the door on the front of the PAC shall be:
- a. A Secure Digital (SD) card socket to support removable non-volatile SD cards.
  - b. A reset button with two stages of reset –
    - (1) Stage 1 clears application program and memory, but retains IP address and network settings.
    - (2) Stage 2 clears all settings, including network and time synchronization.
12. The PAC shall support firmware updates.
13. The PAC shall provide diagnostic web pages that track controller, network, and backplane performance.
14. The PAC shall have the ability to provide a master system clock and the IEEE 1588 PTP version 2 CIP Sync object to allow time synchronization, transport, and routing of the system clock to the control system and motion axes in a local chassis or on an EtherNet/IP network.
15. The PAC shall monitor internal module temperature and respond as temperature increases.

#### D. SECURITY

- 1. It shall be possible to determine if the configuration of a PAC has been modified quickly, on the order of one second after the modification has been made.
  - a. It shall be possible to make this determination from another PAC or from personal computer-based software monitoring the PAC.
  - b. It shall be possible to configure the PAC as to what events constitute configuration changes. Examples include:
    - (1) Online edits modified the PAC program
    - (2) Firmware update attempted

- (3) PAC mode changed
    - (4) Removable media inserted or removed
    - (5) Constant tag value changed
  - c. The PAC shall keep a log of its most recent configuration changes and expose the log for use by personal computer-based software.
  - d. The PAC shall allow the following features to be disabled programmatically:
    - (1) Scrolling LCD display messages
    - (2) HTTP server (Embedded webpage)
    - (3) Embedded Ethernet port
- 2. The PAC shall provide firmware security:
  - a. The PAC shall be configurable to accept only firmware updates from authorized users.
  - b. The PAC shall use digitally signed firmware to guard against malicious or fraudulent firmware downloads.
- 3. The PAC and associated project files shall be configurable to allow modification only by authorized users, and all communication paths to the PAC shall be configurable to restrict operations that modify the PAC program or firmware.
- 4. The PAC shall allow individual tags, memory addresses, or variables to be configured by external applications according to each element's user-defined access level.
  - a. These individual tags, memory addresses, or variables shall be configurable to be read/write, read only, or none.
  - b. The PAC shall enforce these access levels at runtime.
- 5. The PAC shall allow individual tags, memory addresses, or variables to be configured as constants to prevent controller logic from changing an element's value.
- 6. Individual routines or custom instructions in the PAC shall be configurable to prevent modification or viewing by unauthorized individuals.
- 7. Custom instructions can be digitally signed so that their contents can be easily audited for unexpected changes.

#### E. MEMORY

- 1. The plant-wide PAC shall have 3 (or 5, 10, 20, 40) MB of user memory.

2. The PAC shall have installed a 2-GB industrial-rated SD memory card to back up volatile memory, including data and program logic, and to store the PAC and local modules' current firmware.
  - a. The card shall support a Windows file system, allowing multiple files to be stored.
  - b. When memory is restored, a user-selectable option to restore in Run mode or Program mode shall be provided.
  - c. The PAC shall be able to be configured for automatic download of nonvolatile memory from the card on power-up or upon memory corruption.
  - d. The PAC shall be able to be manually triggered to save nonvolatile memory to or to load from the card.
  - e. The PAC shall be able to verify that required modules in the chassis are updated to the correct revision level for the project by using the firmware files stored on the SD card.

#### F. I/O MODULES

1. The plant-wide PAC system shall support a total of up to 128,000 local and re-remote inputs/outputs, up to 4,000 of which can be analog inputs/outputs.
  - a. I/O modules and other devices shall be capable of being added to the controller configuration while online and in the Run mode.
  - b. It shall be possible to manually set (force) all input and output points:
    - (1) Discrete inputs and outputs can be forced ON or OFF.
    - (2) Analog inputs and outputs can be forced to a user-defined value.
    - (3) Removal of forced values can be achieved either individually or totally through the design software.
2. The PAC shall support I/O modules with EtherNet/IP architecture.
3. The supplier shall configure each local I/O module to the optimum requested packet interval (RPI) for the application.
4. Reference the I&C System Architecture Drawing, P&IDs, and Diagrams.

#### G. PROGRAMMING ENVIRONMENT

1. Programming shall be local, via remote access, or through a network, using Studio 5000 Logix Designer Application Version 31.00.00 or later.

2. The programming software shall run on Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, Windows 7, and Windows 8, and the programming languages shall be:
  - a. IEC 61131-3 compliant ladder diagram (LD)
  - b. Structured text (ST)
  - c. Function block diagram (FBD)
  - d. Sequential function chart (SFC)

#### H. COMMUNICATION

1. The PAC shall have a USB 2.0 port to support programming, configuration, firmware updates, and on-line edits at full speed (12 MB/s).
2. The PAC shall have a 10/100/1000 MB/s EtherNet/IP port with one IP address.
  - a. The interface support shall include:
    - (1) IEEE 802.3 Physical and Data Link Standard
    - (2) Common Industrial Protocol (CIP), the protocol that provides real-time I/O messaging and information/peer-to-peer messaging
    - (3) Standard TCP/IP and UDP/IP communication
    - (4) 10/100/1000 MB/s auto sensing and auto switching
    - (5) Standard Ethernet media
    - (6) Subnet masking
    - (7) BOOTP and DHCP support
    - (8) Manual configuration using specified software
    - (9) Programmable Automation Controller messaging to peer controllers and workstations
    - (10) I/O data, real-time interlocking and information
    - (11) Full duplex and auto-negotiate communication
    - (12) Built-in Web access to diagnostics
    - (13) I/O control
    - (14) Device level ring (DLR)
    - (15) Precision Time Protocol (CIP Sync, IEEE 1588)
  - b. Ethernet Messaging (Class 3) shall be 2000 messages per second, with:
    - (1) 256 unconnected message buffers.
    - (2) 256 concurrent cached message instructions in the running state.

3. The manufacturer shall have communications options available for:
  - a. EtherNet/IP
  - b. ControlNet
  - c. DeviceNet
  - d. Data Highway Plus
  - e. Remote I/O
  - f. SynchLink
  - g. Modbus TCP

#### I. POWER SUPPLY

1. The PAC shall operate in compliance with electrical service of:
  - a. 85 to 265 VAC (120 to 220 VAC nominal), single phase, 47 to 63 Hz  
2. 18 to 132 VDC (24 VDC nominal) 3. 30 to 60 VDC (48 VDC nominal) 4. 90 to 143 VDC (125 VDC nominal)
2. A single main power supply shall be integral to each chassis and have the capability of supplying 1.2V, 3.3V, 5V, and 24V power directly to the chassis back-plane.
3. The power supply shall monitor the incoming line voltage for proper levels and include an easily viewed indicator to show status of the DC power applied to the backplane.
4. A power disconnect switch to disable power to the PAC shall be easily accessed by the operator.
5. The power supply shall provide electronic protection:
  - a. At the time of power-up, the power supply shall inhibit operation of the controller and I/O modules until the DC voltages are within specifications.
  - b. The power supply shall automatically shut down the PAC system when its output power exceeds 125% of its rated power.
  - c. The power supply shall be fused.
6. The PAC shall be capable of operating with redundant power supplies.

## J. RATINGS

1. The PAC shall be able to withstand conducted susceptibility tests as outlined in:
  - a. Temperature IEC 60068-2-1 IEC 60068-2-2 IEC 60068-2-14, Humidity IEC 60068-2-30, Vibration IEC 60068-2-6, Shock, Operating & Non-operating IEC 60068-2-27, Emissions IEC 61000-6-4 ESD, Immunity IEC 61000-4-2, Radiated RF Immunity IEC 61000-4-3 EFT/B, Immunity IEC 61000-4-4, Surge Transient Immunity IEC 61000-4-5, and Conducted RF Immunity IEC 61000-4-6

## K. EXAMINATION

1. The supplier shall verify that jobsite is ready to receive equipment.
2. The supplier shall verify that the jobsite environment can be maintained during and after installation within the service conditions required by the manufacturer of the programmable automation controller (PAC).

## L. INSTALLATION

1. Installation shall be in compliance with all manufacturer requirements, instructions, and contract drawings, including:
  - a. Space surrounding the PAC to maintain adequate cooling.
  - b. Conditioning of space surrounding the PAC enclosure to maintain the manufacturer's ambient temperature and humidity ranges.
  - c. Accessibility of PAC diagnostic lights, communication ports, and memory modules – the components shall be free from obstructions at all times.

## M. MANUFACTURER AND MODEL NUMBER

1. PLC shall be AB Rockwell ControlLogix 55801756-L82E PAC.

## 2.3 GENERAL PURPOSE CONTROL RELAYS

- A. Control relays shall have the following features: 120VAC operating coil (+10% to -15% of nominal); pick-up time approx. = 13 ms; drop-out time = approx 10 ms; continuous duty cycle; Silver Cadmium Oxide contacts, 5 ampere rated; AC inrush = 3.5 VA; AC sealed = 1.2 VA; with internal pilot lights (for positive indication of power to the coil). Relays shall be enclosed in a dust proof clear plastic cover. Control relays shall have up to 4PDT (4-pole, double throw) output contacts.
- B. Control relays shall be mounted onto plug in sockets.

- C. Control relay shall be Square D, Class 8501, Type R or approved equal, meeting the specifications indicated.

#### 2.4 GENERAL PURPOSE TIMING RELAY

- A. General purpose timers shall have the following features: 120 VAC operating voltage (+10/-15% of nominal); DPDT (double pole, double throw) silver cadmium oxide timed output, 10A RATED, contacts; ±1% repeat accuracy for constant voltage and temperature; ±10% repeat accuracy for any variation of voltage and temperature within specifications; dial-type adjustment knob.
- B. Control relays shall be mounted onto plug in sockets.
- C. General purpose timers shall be Square D Type JCK or approved equal, meeting the specifications indicated.

#### 2.5 INTERFACE RELAYS

- A. Interface relays shall interface Digital Inputs and Outputs from a device such as a PLC to external signals. The interface relays shall have the following features: LED operation indicator, #14-#26 AWG wiring, contact type is double pole, double throw, contact material is Silver Nickel, maximum switching voltage is 250 VAC, minimum switching voltage is 5V, limiting continuous current is 6A, max inrush current is 8A, min switching current is 10 mA, maximum power rating is 1500 VA, minimum switching power is 50 mW, mechanical service life is 3 x 10<sup>7</sup>, nominal input voltage is 120 VAC, pickup time is 7 ms, response time is 10 ms, and DIN rail mountable.
  - 1. Interface relays shall be Phoenix Contact PLC-RSC-120UC/21-21, or approved equal. Unused output contacts shall be spare.
- B. Intrinsically safe interface relays shall act as intrinsically safe barriers. The device shall have the following features: UL Listed intrinsically safe device, #14-#24 AWG wiring, capable of switching 0.5 amperes at 125 VA, minimum switching current is 10 microamperes, mechanical service life is 10 x 10<sup>6</sup>, supply voltage is 20-35 VDC, LED indication (green for power supply, yellow for switching status and red for line errors), and DIN rail mountable.
  - 1. Intrinsically safe interface relays shall be Phoenix Contact PI-Ex-NAM/RNO or approved equal, meeting the specifications indicated. The device shall provide intrinsically safe circuit for use in hazardous locations Class I, Zone 0 (AEx ia) IIB.

#### 2.6 SIGNAL ISOLATOR FOR 4-20 MA SIGNALS

- A. Signal isolators shall isolate input, output and power supply. The signal isolators shall have the following features: DIN rail mount; green power LED to indicate that

supply voltage is present; accepts #14-#24 AWG solid or stranded wiring; requires 18-30VDC power supply, and provides 4-20mA input and 4-20 mA output.

1. Signal isolator shall be Phoenix Contact MCR 3-way isolating amplifier, or approved equal, meeting the specifications indicated.
- B. Intrinsically safe signal isolators shall act as intrinsically safe barriers. The device shall have the following features: DIN Rail mount; green power LED; accepts #14-#24 AWG wiring; requires 20-35 VDC power supply, and provide 4-20mA intrinsically safe input and 4-20 mA output.
1. Intrinsically safe signal isolator shall be Phoenix Contact PI-Ex-RPSS-I/I, or approved equal, meeting the specifications indicated. The device shall provide intrinsically safe circuits for use in hazardous locations Class I, Zone 0 (Ex ia) IIC.

## 2.7 SIGNAL MULTIPLIER FOR 4-20 MA SIGNALS

- A. Signal multipliers shall isolate input, 2 outputs, and power supply. Signal multipliers shall split the input signal into 2 output signals. The signal multipliers shall have the following features: DIN rail mount; green power LED to indicate that supply voltage is present; accepts #14-#24 AWG solid or stranded wiring; requires 18-30VDC power supply; and provides 4-20 mA input and 2 sets of 4-20 mA outputs.
1. Signal multiplier shall be Phoenix Contact MCR Signal Multiplier, or approved equal, meeting the specifications indicated.

## 2.8 6-CHANNEL TEMPERATURE MONITOR

- A. Features:
1. Protects motors, generators, transformers, other equipment
  2. Monitor 6 RTDs
  3. overtemperature or undertemperature protection
  4. Microprocessor based; fully programmable
  5. Large, bright LED displays shows degrees F or C
  6. Stores high and low temperature peaks
  7. Trip points, programs, peaks stored in non-volatile memory
  8. Programmable silence button
  9. Versatile override switch permits manual relay toggling. The programmable override button manually toggles a selected set of relays on and off. This

enables the operator to bypass automatic functions to assume direct control. For example, the operator could turn on fans or shut a machine down at temperatures below the trip point.

10. Rugged enclosure with sealed front panel
  11. Sensor failure protection: if any scanned RTD circuit shorts or opens, the device sounds its alarm and locks out that zone. Other zones continue to scan normally. The Error light stays on until the faulty input is repaired and the self-test run.
  12. Self test: Press the test button to test all panel lights and inputs. The operator can also program the Test button to trip relays connected to external alarms, fans, etc.
- B. Input shall be any of the following (coordinate input to match the device being measured):
1. Platinum, 100 ohms at 0 degrees C
  2. Platinum, 1000 ohms at 0 degrees C
  3. Copper, 10 ohms at 25 degrees C
  4. Nickel, 120 ohms at 0 degrees C
- C. Input: 6 RTDs, 2 or 3 wires
- D. Input scan rate: 8 readings per second.
- E. Input fault detection: Open or shorted circuit sounds alarm and locks out faulty zone. Other zones unaffected.
- F. Input protection:  $\pm 30$  VDC continuous, any input to ground
- G. Output: 5 independent trip points: 4 relays and one audible alarm. Alarm may be programmed to sound when selected relays trip
- H. Relays: Form C, SPDT, 10 amps at 250 VAC resistive load,  $\frac{1}{4}$  HP at 120 VAC.
- I. Trip point hysteresis (deadband): programmable from 2 to 20 degrees C or F
- J. Display: 16 LED indicators
- K. Accuracy:  $\pm 2$  degrees C at 10 to 30 degrees C ambient,  $\pm 3$  degrees C at 0 to 55 degrees C ambient
- L. Zone and relay labels: Replaceable from rear for custom labeling

- M. Supply power: 115 or 230 VAC  $\pm 10\%$ , 50/60 Hz. 15 W, max.
- N. Power loss protection: Trip points, peaks, and program parameters stored in non-volatile memory. Normal operation resumes when power is restored.
- O. Keyboard: 10 membrane type keys with audible feedback.
- P. Programming: Programmable from front panel. Access to program mode requires special key sequence.
- Q. Program fault protection: Watchdog circuit resets microprocessor if it fails to perform program sequence.
- R. Enclosure: ABS case, water and dust resistant front panel
- S. Ambient temperature rating: 0 to 55 degrees C
- T. Mounting: Panel-mounted unless otherwise noted.
- U. Device shall be Minco CT124 8-Channel Temperature Monitor, or approved equal, meeting the specifications indicated.

## 2.9 24 VDC POWER SUPPLY

- A. 24 VDC Power Supply shall have sufficient output current to feed the loads required and shall have the following features:
  1. Linear Regulated
  2. Input Voltage: 105-125 VAC, 50-400 Hz, single phase
  3. Remote Voltage Adjustment/Sensing: Provision for sensing the output voltage across the load, so that drops in the load line are compensated. This feature also permits the use of an externally located potentiometer to adjust output voltage.
  4. Temperature Coefficient: 0.015% per degrees C
  5. Ambient Operating Temperature: -20 to +71 degrees C
  6. Response Time: less than 20 microseconds
  7. Output Regulation:  $\pm 0.005\%$
  8. Ripple: 0.250 mV RMS
  9. Output voltage adjust:  $\pm 0.5V$
  10. Overload Protection: Electronic Current Limiting

11. Overvoltage Protection: An internal preset overvoltage protector shall be provided
  12. UL Recognized
  13. Five year warranty
- B. Power supply shall be Acopian Gold Box – Linear Regulated, or approved equal, meeting the specifications indicated.
- 2.10 THERNET SWITCH
- A. The switch shall be a scalable Layer 2 managed switch with embedded Cisco technology.
  - B. The switch shall be an IEEE 802.1x Security standard switch providing access control and authentication.
  - C. Advanced Networking Features shall be standard:
    1. Integrated Device Level Ring (DLR) connectivity shall be provided as standard to optimize the network architecture and diagnostics.
    2. Native Integrated Network Address Translation (NAT) will provide 1:1 IP address mapping.
    3. Standard Security features shall be provided which include access control lists, ensuring only authorized devices, users and traffic can access the network.
    4. Provide a Secure Digital (SD) card as standard to simplify device replacement.
  - D. Optimized Integration:
    1. The switch shall be provided with Studio 5000® Add-on Profiles (AOPs) as standard to enable premier level integration into the Rockwell Automation Integrated Architecture® system.
    2. Predefined Logix tags shall be standard for monitoring and port control.
    3. Native FactoryTalk® View faceplates shall be provided as standard to enable status monitoring and alarming.
    4. Configuration, and Monitoring shall be simplified through use of standard Add-On Profiles.
    5. Cisco® Internet Operating System (IOS) shall be standard to provide secure integration.

- E. Device Level Ring Technology:
  1. The Device Level Ring (DLR) is a layer 2 protocol that allows multi-port EtherNet/IP devices to form a ring topology.
  2. The Integrated DLR connectivity shall allow the switch to act as a node or a supervisor on the ring.
  3. The Supervisor (designated switch) in the ring shall be able to detect a break in the ring and provide an alternate data route to help recover the network quickly.
  4. The designated supervisor shall consolidate information from the ring, aggregating in a single place managing the machine-level network diagnostics and DLR status.
  5. The switch shall provide DHCP IP address assignment to end devices on the DLR network for simplified device replacement.
  6. DLR protocol shall be provided as standard.
  7. The DLR protocol shall be provided for this installation
- F. The ethernet switch shall have Studio 5000 Automation Engineering and Design Envi-ronment™ integrated natively.
- G. The Allen-Bradley® Stratix 5200™ Ethernet Switch shall be provided (no substitutes).

## 2.11 SERVER

- A. Operating System - Stratus Redundant Linux 2.0 OS with Virtualization & Availability
- B. Supported Guests - Microsoft Windows Server (2019) and Linux variants
- C. Provisions - Microsoft Windows Server (2019), FactoryTalk Historian, FactoryTalk HMI, VMWorkstation, and VMPlayer.
- D. Availability - System redundancy, Seamless recovery from system failure, Automatic second site failover (deployment option)
- E. Installation - DIN rail, wall mount
- F. Performance - Virtualization: up to 4 VMs, Processor: Intel Xeon W-1290TE, 2.4 GHz, 4 hyper threaded cores-hot swappable, Memory: 32 GB DDR4 2400, Storage: 512 GB SSD

- G. I/O - HDMI Ethernet: 4 ports – 10 x 1GbE (for a-links), 6 x 1GbE (for Network), USB: 2 x USB 2.0 (Restricted)
- H. Storage: 2 TB SSD (NvMe)
- I. Operating temp: -40°F to 140°F (-40°C to 60°C) If using provided AC adapter 0°F to 122°F (0°C to 50°C)
- J. Humidity: 10 – 95% (non-condensing)
- K. Shock: 50G @ 11ms
- L. Vibration: 3 Grms (5-500 Hz)
- M. Dimensions - 280 mm (11.02 in) x 190 mm (7.48 in) x 76 mm (2.99 in)
- N. Weight – 9.2kg (20.2 lbs)
- O. Power - 9 to 36 volts DC; 35 watts
- P. The server shall be a Stratus ztC Edge 250i Server (no substitutes).

## 2.12 GRAPHIC DISPLAY WITH TOUCH SENSITIVE SCREEN

- A. Conforming to Standards: IEC 61131-2, IEC 60801-2 Level 3, IEC 60801-3 and IEC 60801-4 level 3, IEC 60068-2-6, IEC 60068-2-27, UL 508
- B. Product Certifications: UL Listed
- C. Temperature Operation: 0 to 55 degrees C
- D. Degree of Protection: Front Panel IP65 conforming to IEC 60529, NEMA Type 4, UL Type 4; Rear Panel IP 20, conforming to IEC 60529
- E. Screen: 15 inch TFT 256 colors with keyboard, and resistive matrix tactile feedback, 1024 x 768 XGA, 18-bit color graphics pixel resolution
- F. Power Supply: 24 Vdc
- G. Signaling: 1 LED for communication monitoring, 1 LED for tactile feedback Activity
- H. Dynamic RAM memory: 80 MB
- I. Application Memory: 512 MB

- J. Dialogue Application: 30-300 application, alarm, help, form, and recipe pages depending on the memory card used; 16 real-time curves.
- K. Manufacturer and Model Number: Device shall be AB Rockwell PanelView Plus Performance (no substitutions).
- L. Accessories:
  - 1. Provide development software used to make screens. Provide installation disks for software. Provide one year of updates and patches at no additional cost.

## PART 3 EXECUTION

### 3.1 APPLICATION

- A. The Medium Voltage Starters, Medium Voltage Transformers, UPS and Battery Chargers are hardwired to the SSNP. Provide coordination with the manufacturers for all discrete I/O from the field equipment.
- B. Reference the Electrical Specifications for the Ethernet Communications with the Medium Voltage Switchgear, Low Voltage Switchgear, Medium Voltage Starters, Distribution Panels and Generator Master Control Panel.
- C. Unless otherwise noted on the drawings, comply with the following:
  - 1. Provide interface relays and signal isolators/multipliers to isolate the PAC from all external devices and equipment (devices/equipment that are remote from the enclosure containing the PAC). Provide labels on these interfacing and isolating devices that will indicate source and destination of the signal. A distinct alphanumeric code shall suffice. A table indicating the full description of the source and destination associated with each alphanumeric code, shall be provided on the inside of the door of the control panel containing the PAC.
  - 2. Interface relays shall be used to split signals (1 input, and up to 4 outputs) between the SSNP PAC and other equipment.
- D. Provide DC Power Supply for all equipment that require DC power.
- E. Provide AC Power Supply for all equipment that require AC power.
- F. Calibrate all electrical devices and instruments.
- G. Provide relay coil suppressors where recommended by the manufacturer of the device or equipment, or where required for proper operation of the device or equipment. Coil suppressors shall be compatible with the control circuit and the device/equipment.

- H. Provide the following label on control panels that have voltage being supplied from multiple sources: "Warning: This Control Panel is fed from multiple sources of power, disconnect all sources of power before working on the panel."

### 3.2 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 ADJUSTMENTS

- A. Adjust settings in accordance with the manufacturer or the engineer's recommendations. Settings shall be adjusted such as to keep protective devices from inadvertently operating. Devices shall be selectively coordinated.
- B. Adjust the potentiometers on the signal isolators/multipliers to produce the desired signal.

### 3.4 ON-SITE ASSISTANCE

- A. When requested within one year of the date of Substantial Completion, provide on-site assistance. On site assistance shall include any adjustments required by the owner. Provide up to 2 requested adjustment visits to the site for this purpose.

### 3.5 CABLING

- A. Comply with NECA 1.
- B. Pulling Cable: Do not exceed manufacturer's written recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
- C. Wiring Method: Install wiring in raceway. Conceal raceway and wiring except in unfinished spaces.
- D. Install communication cables using techniques, practices, and methods that are consistent with specified category rating of components and that ensure specified category performance of completed and linked signal paths, end to end.
- E. Install cables without damaging conductors, shield, or jacket.

### 3.6 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Electrical Requirements for Shop Assembled Equipment."

- B. Provide identification labels on all wires, interface relays, signal isolators/multipliers and terminal blocks. Identification labels shall be consistent throughout the project.
- C. Label each power monitoring and control module with a unique designation.

### 3.7 GROUNDING

- A. Comply with IEEE 1100, "Power and Grounding Sensitive Electronic Equipment."

### 3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform tests and inspections and prepare test reports.

- 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

- B. Tests and Inspections:

- 1. Electrical Tests: Use caution when testing devices containing solid-state components.
- 2. Continuity tests of circuits.
- 3. Operational Tests: Set and operate controls at workstation and at monitored and controlled devices to demonstrate their functions and capabilities. Use a methodical sequence that cues and reproduces actual operating functions as recommended by manufacturer. Submit sequences for approval. Note response to each test command and operation. Note time intervals between initiation of alarm conditions and registration of alarms at central-processing workstation.
  - a. Coordinate testing required by this Section with that required by Sections specifying equipment being monitored and controlled.
  - b. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of calculated battery operating time.
  - c. Verify accuracy of graphic screens and icons.
  - d. Metering Test: Load feeders, measure loads on feeder conductor with an rms reading clamp-on ammeter, and simultaneously read indicated current on the same phase at central-processing workstation. Record and compare values measured at the two locations. Resolve discrepancies greater than 5 percent and record resolution method and results.

- e. Record metered values, control settings, operations, cues, time intervals, and functional observations and submit test reports printed by workstation printer.
- C. Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.
- D. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.
- E. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.
- F. Remove and replace malfunctioning devices and circuits and retest as specified above.

### 3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment.
  - 1. Train Owner's management and maintenance personnel in interpreting and using monitoring displays and in configuring and using software and reports. Include troubleshooting, servicing, adjusting, and maintaining equipment. Provide a minimum of 4 hours training per device specified in this Specification Section.
  - 2. Training Aid: Use approved final versions of software and maintenance manuals as training aids.
- B. Training shall include but not be limited to:
  - 1. Addition of future devices to the system
  - 2. Proper use and setup of reports and alarming.
  - 3. Reformatting and reinstalling software after a “crash”.
  - 4. Adjusting setpoints on the devices.
  - 5. Installation and removal of devices.
  - 6. Phone numbers for technical support and repair technicians.

### 3.10 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied

conditions. Provide up to three visits to Project during other-than-normal occupancy hours for this purpose. Adjustments shall include, but not be limited to, the following:

1. Adjusting setpoints of the devices.
2. Recalibrating devices to suit field conditions and to ensure proper operation.

END OF SECTION

(NO TEXT FOR THIS PAGE)

SECTION 40 80 30  
IN-FACTORY TESTING  
SCADA SWITCHGEAR NETWORK CABINET

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section describes the requirements for in-factory tests to demonstrate that the hardware and software provided for the SCADA Switchgear Network Panel (SSNP) are in conformance with the Specifications.
- B. Related work specified elsewhere includes, but is not limited to:
  - 1. Section 40 67 17 - Control Panels
  - 2. Section 40 80 20 - Field Testing
  - 3. Section 40 96 15 - IO List

1.2 SUBMITTALS

- A. Include the following information in the submittal for this section:
  - 1. A detailed step-by-step test procedure of each test at least six weeks in advance of each scheduled test date. Include sign-off sheets and punch list forms. Procedure documents shall:
    - a. Contain, in the Contractor's format, the test ID number, name, and description.
    - b. List the logical step-by-step procedure with expected response at each step and provide space for recording of actual results.
    - c. Provide space for approval of each test.
    - d. Contain minimal reference to other documents.
    - e. Generally, be structured such that simpler tests are run first.
    - f. Be written in a manner such that they can be used by the City's personnel during site testing.
    - g. Describe any steps necessary to simulate inputs required by the test.

2. Confirm, in writing, times and dates two weeks before a test.

### 1.3 GENERAL

- A. The purpose of the test is to verify, insofar as practical, a fully integrated system, including all components, being used under simulated conditions similar to those for which the system was designed. Test hardware and basic software. Factory testing of field mounted, process instrumentation is not required.
- B. Factory testing will be conducted by, and is the responsibility of, the SSNP Supplier in coordination with the City's designated System Integrator (SI). The City's designated Engineer reserves the right to participate in the test. The City's designated Engineer reserves the right to test any specified function whether or not explicitly stated in the test submittal. The Engineer has the final authority on whether or not a test is successful.
  1. The hardware tested will be the City's hardware. Exceptions to this will be granted only by the written approval of the Engineer. Where exception is granted, use hardware of the same make, model and revision level as the City's.
  2. If the City's hardware or basic software is not used, provide written certification that the hardware or software used will perform exactly as the City's and that the hardware and software components are in every way the same.
  3. Substitute equipment may be necessary for system components that cannot be tested at the factory because they are either existing, or because it would be physically impractical or otherwise impossible to perform a factory test, such as in the case for existing or third-party PLC (eg. Medium Voltage and Low Voltage Switchgear PLC and Ethernet Switch, Generator Master Control Panel Controller to name a few).
  4. Interconnect subpanels such that equipment supplied function as an integrated unit. Provide temporary harnesses and/or jumper wires as required.
- C. Demonstrate the following:
  1. The components can function as stand-alone subsystems and perform the specified requirements (eg. SCADA Switchgear Network Panel (SSNP) under full simulation.
  2. The components can be integrated into the complete PCS and perform the specified requirements (eg. SSNP, Medium Voltage Switchgear, Low Voltage Switchgear, Generator Master Control Panel, Uninterruptable Power Supply, Battery Charger, Transformers, Distribution Panels, and RVSSs in simulation). Reference Field Testing for integrated testing.

- D. Meet the following criteria prior to the start of the test:
  - 1. Complete submittals and resolve disputes.
  - 2. Ensure that the Engineer has reviewed and approved the test procedure.
  - 3. Set a test date that is agreeable to all.
  - 4. All hardware and basic software must be fully operational.
- E. Test all control and monitoring functions and system interactions using the aforementioned simulations.
- F. Test for up to five (5) working days if required to accomplish the task. Testing may be conducted in several separate sessions.
  - 1. Limit testing to eight hours per day.
  - 2. Hold a meeting each morning to review the day's test schedule.
  - 3. Hold a meeting each evening to review the day's test results and to review or revise the next day's test schedule.
  - 4. At the end of the test, meet to review the list of deficiencies. The Engineer will indicate those items that must be corrected prior to shipment.
- G. The test will be conducted at the SCADA Switchgear Network Panel Supplier's facility. The SSNP Supplier shall pay for costs of ground transportation (car rental), meals, and lodging for up to 4 representatives from City designated Engineer associated with the 5 days for factory testing as required to accomplish the task. The SSNP Supplier shall pay costs for round trip air fare for each participant, in addition to the provisions described (if deemed necessary) if SSNP Supplier's facility is more than five hours drive from the City of Evanston Water Facility.

## PART 2 PRODUCTS

NOT USED

## PART 3 EXECUTION

### 3.1 GENERAL

- A. Test the system as follows:
  - 1. Verify hardware/software and manuals against inventory lists.

2. Run hardware diagnostics.
3. Perform system backup and restart.
4. Verify equipment failure operations.
5. Verify operation of peripherals.
6. Show communications functions for SCADA Switchgear Network Panel. For every Medium Voltage Switchgear, Low Voltage Switchgear, Generator Master Control Panel, Uninterruptable Power Supply, Battery Charger, Transformers, Distribution Panels, and RVSS, demonstrate a change of state for all I/O points. Provide and configure basic HMI test displays that will provide a visual indication of I/O point changes of state.
7. Use a 5-point range check (i.e., [+/-] 0, 25, 50, 75, and 100 percent of full scale) for analog inputs and outputs on a display.
8. Operation of all support software.
9. If available from the City's designated Engineer, test new/updated PCS control strategy (eg RVSS, MV and LV Switchgear, Generator Master Control Panel).
10. Demonstrate power fail/restart.
11. Demonstrate communications failure/restart.
12. Demonstrate redundancy where applicable.

B. Equipment Monitoring Systems:

1. Vendors are responsible for providing the memory mapping and data registers for the monitoring devices in their respective equipment.
2. Information shall be provided to the SSNP supplier after the successful completion of the respective Factory Acceptance Tests.
3. All data from the respective vendors shall be received 4 weeks prior to the In Factory Testing of the SSNP.
4. Specifications dedicated to the vendors obligated to provide required information to the SSNP Provider:

Section 26 13 00 – Medium Voltage Switchgear  
 Section 26 23 00 – 480 Volt Switchgear

Section 26 14 00 – Medium Voltage Motor Controllers  
Section 26 33 00 – Battery Systems  
Section 26 32 13 – Packaged Engine Generator Systems  
Section 26 33 53 – Uninterruptible Power Supply Systems

### 3.2 PERFORMANCE TEST

- A. Testing will include all aforementioned equipment, equipment simulations and associated components.
- B. Test each equipment simulation in conjunction with the SSNP and test HMI:
  - 1. I/O point generation and processing.
  - 2. Failure operations.
  - 3. Hardware diagnostics.
  - 4. Verify equipment and manuals against inventory list.
- C. Demonstrate and test the integration of each subsystem into the SSNP. Include the following:
  - 1. Use of fiber optic communications lines and transceivers.
  - 2. A step-by-step walkthrough of how each subsystem is integrated into the control system. Make physical connections, test and place into operation.
- D. The City's designated Engineer will test control software, database points, displays, logs, and reports configured by the SSNP Supplier in coordination with the City's Designated System Integrator.
  - 1. Permit City's designated Engineer an additional two weeks of time for factory testing of applications software.
  - 2. The SSNP Supplier will pay for costs of ground transportation (car rental), meals, and lodging associated with the additional two weeks for factory testing of the applications software.

### 3.3 CORRECTION OR DEFICIENCIES

- A. The following paragraphs are applicable to all tests:
- B. Document discrepancies found during each test and maintain in a record file. Describe the subsequent corrections. Proper operation will be verified by representatives of the City of Evanston Water Facility.

- C. The system will not be shipped until successful completion of testing is certified by the City's designated Engineer. Delay in shipment of the system due to failure to pass testing will not be considered an unavoidable delay and justification for later delivery.

#### 3.4 TESTING AIDS AND EQUIPMENT

- A. Provide use of the following documentation:

1. One copy of submittals applicable to the equipment to be tested.
2. One copy of the Drawings and Specifications together with addenda and change orders.
3. One master copy of the test procedure.
4. A complete inventory of the equipment to be tested including make, model and serial number.

- B. Provide use of the following support facilities:

1. Desk with key lock or lockable room with table for use by the City's designated Engineer..
2. Meeting room.
3. Reproduction facilities for copying test information.

- C. Provide use of the following test equipment:

1. I/O Test Set. Wire to representative input and output components to allow testing.
2. Off-line diagnostic and test programs.
3. Maintenance and test equipment including, but not limited to: board extenders, oscilloscope, electrician's tool set, and special test equipment.

END OF SECTION

## SECTION 40 80 40

### FIELD TESTING

#### SCADA SWITCHGEAR NETWORK PANEL

##### PART 1 GENERAL

##### 1.1 DESCRIPTION

- A. This section describes the requirements for field testing at the Evanston Water Department Facility and the manner in which field testing will take place.
- B. Related work specified elsewhere includes, but is not limited to:
  - 1. Section 40 80 30 – In - Factory Testing Scada Switchgear Network Cabinet
  - 2. Section 40 67 17 – SCADA Switchgear Network Cabinet
  - 3. Section 40 96 15 – IO List

##### 1.2 SUBMITTALS

- A. Include the following information in the submittal for this section.
  - 1. Schedules, procedures, and sign-off forms for tests.
  - 2. Loop checkout schedule arranged by Facility Area and Unit Process. Include checkout procedures and signoff forms.
  - 3. System performance test procedures.
- B. Within 2 weeks following completion of any field tests, submit the completed test sign-off form to the Engineer.

##### 1.3 GENERAL

- A. Field testing of the equipment supplied by the SCADA Switchgear Network Panel (SSNP) provider, and updated facility PCS HMI by the designated system integrator (Concentric) will be conducted by and is the responsibility of the SSNP provider, and system integrator (Concentric). The Engineer will actively participate in the test. The Engineer reserves the right to test any specified function whether or not explicitly stated in the test submittal. The Engineer has the final authority on whether or not a test is successful.

- B. Meet the following criteria prior to the start of the field test.
1. Complete submittals and resolve disputes.
  2. Ensure that the Engineer has reviewed and approved test procedures and schedules.
  3. Set a test date that is agreeable to all.
  4. All parties agree that the complete system is ready for testing.
  5. Any retesting required shall be scheduled at mutually agreeable time for all interested parties.

## PART 2 PRODUCTS

NOT USED

## PART 3 EXECUTION

### 3.1 GENERAL

- A. Perform field testing to verify the operation of the switchgear electrical metering, and associated electrical equipment interfaced to the existing plant wide control system. Field testing is a procedure witnessed by the Engineer and the Contractor. Begin testing immediately after installation of each major subsystem. Dedicated Equipment Functional Tests as well as a Comprehensive Integrated Test shall be performed. Perform field testing sequentially and organize by plant area and by unit process within each area. Field tests include:
1. Function tests of MV switchgear power metering and device metering.
  2. Function tests of LV switchgear power metering and device metering.
  3. Function tests of the medium voltage RVSS (Backwash Pumps).
  4. Function tests of the Distribution Panels.
  5. Function tests of the Transformers.
  6. Function tests of the Mimic Panel.
  7. Function tests of the Generator Master Control Panel.
  8. Functional tests of the UPS Systems.

9. Functional tests of the Battery Charging Systems.
  10. Comprehensive Integrated System Test.
- B. Meet the following conditions prior to the start of any testing:
1. Correct deficiencies noted during in-factory testing.
  2. Have documentation on-site pertinent to the part of the system being tested. The latest up to date vendor memory mapping and data register information shall be provided from the vendors two (2) prior to ensure readiness of the SSNP Provider and System Integrator.
  3. Have on site, labeled, and properly stored, spare parts, expendables and test equipment pertinent to the part of the system being tested.
  4. Ensure that the Engineer has reviewed and approved test schedules and test procedures.
  5. Have all parties certify that the system has been pre-checked and is ready for witnessed testing.
- C. Schedule all field testing through the Engineer on a daily basis.
1. The Engineer may redirect testing from one plant area or unit process to another. This shall not result in a claim for additional costs or delay by the contractor.
  2. Perform no testing which may affect plant operation without Engineer's concurrence.
- D. Perform tests by following the operation and maintenance manuals word-for-word unless approved otherwise by the Engineer. Lack of complete, detailed manuals will be cause for declaring the test to have failed regardless of the actual test results.
- E. Begin testing by performing the following steps:
1. Check equipment against shop drawing lists and submittals.
  2. Verify that the equipment has been installed in accordance with Contract Documents and manufacturer's directions.
  3. Power up the equipment and run diagnostics to verify error-free operation.
  4. Load software

- F. The Engineer will participate in all testing activities except when Engineer decides that his/her presence is not necessary.
  - 1. This participation will serve as a learning experience for plant operations and maintenance personnel.
  - 2. This participation does not relieve the Contractor from the specified requirements for testing.
  - 3. Recognize and adjust for the Engineer involvement in developing test procedures and schedules.

### 3.2 LOOP TESTS

- A. Loop tests will be performed for each new electrical meter to the PCS.
  - 1. All field devices, new electrical meters and equipment interfacing with the Ethernet Switch or PCS under test shall have been calibrated and/or tested in accordance with the requirements of the individual specification sections.
- B. Check each loop from the end element to the respective control display. Include instruments, control devices, panels, termination cabinets, I/O cards and other devices in the loop to ensure proper operation.
- C. Document loop checks and submit to the Engineer. Include:
  - 1. Equipment/Device number
  - 2. Equipment/Device location
  - 3. Loop number.
  - 4. Loop description.
  - 5. Termination information.
  - 6. Loop drawing reference.
  - 7. Type of test(s) performed.
  - 8. Date tested.
  - 9. Problem description, if any.
  - 10. Signature of tester and date.
  - 11. Signature of Engineer and date.

- D. Summarize loops found to contain defective or inoperable equipment on separate sheets and submit to the Engineer.
  - 1. Correct and recheck your work.
  - 2. The Engineer will coordinate correction of defective work by others. Perform rechecking as a part of this Contract.
  - 3. Limit rechecking of defective work by others to 10 percent of the total number of loops. Do not perform additional checkout work unless directed by the Engineer.

### 3.3 FUNCTION TESTS

- A. Successful completion of Loop testing shall be a prerequisite for the start of functional system testing.
- B. Test each operator workstation (OWS) for operation as a stand-alone device as part of the fully integrated system and include:
  - 1. Process control displays and point linkage capability.
- C. Test data handling and access functions. Use live data from the plant and include:
  - 1. Plant-wide database.
  - 2. Process control displays.
  - 3. Alarm/event handling.
  - 4. Historical data storage, transfer and retrieval of data from the PCS System.
  - 5. Report generation and printing.
  - 6. User entry functions.
  - 7. Calculations.
- D. Demonstrate the following support and maintenance functions:
  - 1. Configuration capability.
  - 2. System backup and reloading.
  - 3. System status displays and use.
  - 4. Diagnostics.

5. Power fail/restart.
- E. Test all control strategies.
- F. Document and submit test results to the Engineer. Include:
  1. Description of function.
  2. Tests performed.
  3. Copies of messages, displays, reports, and trends, which verify operation.
  4. Signature of tester and date.
  5. Signature of Engineer and date.
  6. Problems, if any, with description.

#### 3.4 INTEGRATED SYSTEM TEST

- A. Perform integrated system testing to verify the operation and performance of the complete, integrated PCS.
  1. Begin integrated system testing after all other field tests have been completed.
  2. Conduct the test for two calendar weeks, 24 hours per day.
  3. Provide full-time, on-site assistance during business days and within four hours after call in for the test duration.
4. The City's designated Engineer will monitor and participate in the test.
- B. Include:
  1. Data communication, both normal and failure modes.
  2. Fully loaded system response times.
  3. Other system operations the Engineer may elect to perform.
- C. Correct deficiencies within 24 hours of notice. If deficiencies remain uncorrected at the end of the test period, the test period will be extended on a day-to-day basis until specified operation can be demonstrated.

END OF SECTION

**40 96 15**  
**Process Control System IO List**

LOOP	POINT NAME	NEW POINT NAME	DESCRIPTION	ILR OR LON	IUR OR LOFF	ENG UNITS	FROM	TO	SIGNAL TYPE
<b>MEDIUM VOLTAGE SWITCHGEAR</b>									
		EYQ1001	INCOMING FEED A OVER VOLTAGE			VOLT	MVSWGR	SNC	CAI
		EYQ1001	INCOMING FEED A OVER VOLTAGE			VOLT	MVSWGR	SNC	CAI
		EYF1001A	INCOMING FEED A VOLTAGE PHASE LOSS A			VOLT	MVSWGR	SNC	CAI
		EYF1001B	INCOMING FEED A VOLTAGE PHASE LOSS B			VOLT	MVSWGR	SNC	CAI
		EYF1001C	INCOMING FEED A VOLTAGE PHASE LOSS C			VOLT	MVSWGR	SNC	CAI
		IYF1001A	INCOMING FEED A CURRENT PHASE LOSS A			AMP	MVSWGR	SNC	CAI
		IYF1001B	INCOMING FEED A CURRENT PHASE LOSS B			AMP	MVSWGR	SNC	CAI
		IYF1001C	INCOMING FEED A CURRENT PHASE LOSS C			AMP	MVSWGR	SNC	CAI
		EYR1001A	INCOMING FEED PHASE VOLTAGE REVERSAL A			VOLT	MVSWGR	SNC	CAI
		EYR1001B	INCOMING FEED A PHASE VOLTAGE REVERSAL B			VOLT	MVSWGR	SNC	CAI

		EYR1001C	INCOMING FEED A PHASE VOLTAGE REVERSAL C			VOLT	MVSWGR	SNC	CAI
		EIAB1001	INCOMING FEED A VOLTAGE A-B			VOLT	MVSWGR	SNC	CAI
		EIBC1001B	INCOMING FEED A VOLTAGE B-C			VOLT	MVSWGR	SNC	CAI
		EIAC1001	INCOMING FEED A VOLTAGE A-C			VOLT	MVSWGR	SNC	CAI
		EIAN1001	INCOMING FEED A VOLTAGE A-N			VOLT	MVSWGR	SNC	CAI
		EIBN1001	INCOMING FEED A VOLTAGE B-N			VOLT	MVSWGR	SNC	CAI
		EICN1001	INCOMING FEED A VOLTAGE C-N			VOLT	MVSWGR	SNC	CAI
		EYF1001	INCOMING FEED A VOLTAGE PHASE UNBALANCE			VOLT	MVSWGR	SNC	CAI
		JII1001A	INCOMING FEED A KILOWATTS			KW	MVSWGR	SNC	CAI
		EAR1001	INCOMING FEED A KILOVARS			KVAR	MVSWGR	SNC	CAI
		ATHD1001	INCOMING FEED A THD		100	PCT	MVSWGR	SNC	CAI
		KVA1001	INCOMING FEED A KVA			KVA	MVSWGR	SNC	CAI
		EF1001	INCOMING FEED A PF		1.00		MVSWGR	SNC	CAI

		JII1001B	INCOMING FEED A KWH				MVSWGR	SNC	CAI
		JMN1001	INCOMING FEED A BREAKER	CLOSED	OPEN		MVSWGR	SNC	CDI
		JMN1001	INCOMING FEED A BREAKER	TRIP	NORMAL		MVSWGR	SNC	CDI
		JMF1001	INCOMING FEED A BREAKER	LOCKOUT	NORMAL		MVSWGR	SNC	CDI
		JMN1001-3	INCOMING FEED A TIE BREAKER	CLOSED	OPEN		MVSWGR	SNC	CDI
		JMN1001-3	INCOMING FEED A TIE BREAKER	TRIP	NORMAL		MVSWGR	SNC	CDI
		JMF1001-3	INCOMING FEED A TIE BREAKER	LOCKOUT	NORMAL		MVSWGR	SNC	CDI
		SYN1001-3	INCOMING FEED A TIE BREAKER	SYNCHRONIZING			MVSWGR	SNC	CDI
		SYN1001-3	INCOMING FEED A TIE BREAKER	SYNCHRONIZING CHECK			MVSWGR	SNC	CDI
		EI1001-3	INCOMING FEED A TIE BREAKER	UNDERVOLTAGE		VOLT	MVSWGR	SNC	CAI
		JM1001-3	INCOMING FEED A TIE BREAKER	DIRECTIONAL POWER		KW	MVSWGR	SNC	CAI
		II1001-3	INCOMING FEED A TIE BREAKER	INSTANTANEOUS OVERCURRENT		AMPS	MVSWGR	SNC	CAI
		II1001-3	INCOMING FEED A TIE BREAKER	OVERCURRENT NEUTRAL		AMPS	MVSWGR	SNC	CAI

		II1001-3	INCOMING FEED A TIE BREAKER	TIME OVERCURRENT			MVSWGR	SNC	CAI
		II1001-3	INCOMING FEED A TIE BREAKER	TIME OVERCURRENT NEUTRAL			MVSWGR	SNC	CAI
		II1001-3	INCOMING FEED A TIE BREAKER	DIRECTIONAL OVERCURRENT		AMPS	MVSWGR	SNC	CAI
		II1001-3	INCOMING FEED A TIE BREAKER	DIRECTIONAL OVERCURRENT NEUTRAL		AMPS	MVSWGR	SNC	CAI
		EI1001-3	INCOMING FEED A TIE BREAKER	OVERVOLTAGE		VOLT	MVSWGR	SNC	CAI
		EYQ1002	INCOMING FEED B OVER VOLTAGE			VOLT	MVSWGR	SNC	CAI
		EYQ1002	INCOMING FEED B OVER VOLTAGE			VOLT	MVSWGR	SNC	CAI
		EYF1002A	INCOMING FEED B VOLTAGE PHASE LOSS A			VOLT	MVSWGR	SNC	CAI
		EYF1002B	INCOMING FEED B VOLTAGE PHASE LOSS B			VOLT	MVSWGR	SNC	CAI
		EYF1002C	INCOMING FEED B VOLTAGE PHASE LOSS C			VOLT	MVSWGR	SNC	CAI
		IYF1002A	INCOMING FEED B CURRENT PHASE LOSS A			AMP	MVSWGR	SNC	CAI
		IYF1002B	INCOMING FEED B CURRENT PHASE LOSS B			AMP	MVSWGR	SNC	CAI
		IYF1002C	INCOMING FEED B CURRENT PHASE LOSS C			AMP	MVSWGR	SNC	CAI

		EYR1002A	INCOMING FEED PHASE VOLTAGE REVERSAL A			VOLT	MVSWGR	SNC	CAI
		EYR1002B	INCOMING FEED B PHASE VOLTAGE REVERSAL B			VOLT	MVSWGR	SNC	CAI
		EYR1002C	INCOMING FEED B PHASE VOLTAGE REVERSAL C			VOLT	MVSWGR	SNC	CAI
		EIAB1002	INCOMING FEED B VOLTAGE A-B			VOLT	MVSWGR	SNC	CAI
		EIBC1002B	INCOMING FEED B VOLTAGE B-C			VOLT	MVSWGR	SNC	CAI
		EIAC1002	INCOMING FEED B VOLTAGE A-C			VOLT	MVSWGR	SNC	CAI
		EIAN1002	INCOMING FEED B VOLTAGE A-N			VOLT	MVSWGR	SNC	CAI
		EIBN1002	INCOMING FEED B VOLTAGE B-N			VOLT	MVSWGR	SNC	CAI
		EICN1002	INCOMING FEED B VOLTAGE C-N			VOLT	MVSWGR	SNC	CAI
		EYF1002	INCOMING FEED B VOLTAGE PHASE UNBALANCE			VOLT	MVSWGR	SNC	CAI
		JII1002A	INCOMING FEED B KILOWATTS			KW	MVSWGR	SNC	CAI
		EAR1002	INCOMING FEED B KILOVARS			KVAR	MVSWGR	SNC	CAI

		ATHD1002	INCOMING FEED B THD		100	PCT	MVSWGR	SNC	CAI
		KVA1002	INCOMING FEED B KVA			KVA	MVSWGR	SNC	CAI
		EF1002	INCOMING FEED B PF		1.00	PCT	MVSWGR	SNC	CAI
		JII1002B	INCOMING FEED B KWH			KHH	MVSWGR	SNC	CAI
		JMN1002	INCOMING FEED B BREAKER	CLOSED	OPEN		MVSWGR	SNC	CDI
		JMN1002	INCOMING FEED B BREAKER	TRIP	NORMAL		MVSWGR	SNC	CDI
		JMF1002	INCOMING FEED B BREAKER	LOCKOUT	NORMAL		MVSWGR	SNC	CDI
		JMN1002-3	INCOMING FEED B TIE BREAKER	CLOSED	OPEN		MVSWGR	SNC	CDI
		JMN1002-3	INCOMING FEED B TIE BREAKER	TRIP	NORMAL		MVSWGR	SNC	CDI
		JMF1002-3	INCOMING FEED B TIE BREAKER	LOCKOUT	NORMAL		MVSWGR	SNC	CDI
		SYN1001-3	INCOMING FEED B TIE BREAKER SYNCHRONIZING				MVSWGR	SNC	CAI
		SYN1001-3	INCOMING FEED B TIE BREAKER SYNCHRONIZING CHECK				MVSWGR	SNC	CAI
		EI1001-3	INCOMING FEED B TIE BREAKER UNDERVOLTAGE			VOLT	MVSWGR	SNC	CAI

		JM1001-3	INCOMING FEED B TIE BREAKER DIRECTIONAL POWER			KW	MVSWGR	SNC	CAI
		II1001-3	INCOMING FEED B TIE BREAKER INSTANTANEOUS OVERCURRENT			AMP	MVSWGR	SNC	CAI
		II1001-3	INCOMING FEED B TIE BREAKER OVERCURRENT NEUTRAL			AMP	MVSWGR	SNC	CAI
		II1001-3	INCOMING FEED B TIE BREAKER TIME OVERCURRENT				MVSWGR	SNC	CAI
		II1001-3	INCOMING FEED B TIE BREAKER TIME OVERCURRENT NEUTRAL				MVSWGR	SNC	CAI
		II1001-3	INCOMING FEED B TIE BREAKER DIRECTIONAL OVERCURRENT			AMP	MVSWGR	SNC	CAI
		II1001-3	INCOMING FEED B TIE BREAKER DIRECTIONAL OVERCURRENT NEUTRAL			AMP	MVSWGR	SNC	CAI
		EI1001-3	INCOMING FEED B TIE BREAKER OVERVOLTAGE			VOLT	MVSWGR	SNC	CAI
		JMN1003	TRANSFORMER T3 BREAKER	CLOSED	OPEN		MVSWGR	SNC	CDI
		JMN1003	TRANSFORMER T3 BREAKER	OPEN	CLOSED		MVSWGR	SNC	CDI

		JMF1003	TRANSFORMER T3 BREAKER	TRIP	NORMAL		MVSWGR	SNC	CDI
		JMB1003	TRANSFORMER T3 BREAKER	LOCKOUT			MVSWGR	SNC	CDI
		JMN1004	TRANSFORMER T4 BREAKER	CLOSED	OPEN		MVSWGR	SNC	CDI
		JMN1004	TRANSFORMER T4 BREAKER	OPEN	CLOSED		MVSWGR	SNC	CDI
		JMF1004	TRANSFORMER T4 BREAKER	TRIP	NORMAL		MVSWGR	SNC	CDI
		JMB1004	TRANSFORMER T4 BREAKER	LOCKOUT			MVSWGR	SNC	CDI
		JMN1101	WP1 BREAKER	CLOSED	OPEN		MVSWGR	SNC	CDI
		JMN1101	WP1 BREAKER	OPEN	CLOSED		MVSWGR	SNC	CDI
		JMF1001	WP1 BREAKER	TRIPPED	NORMAL		MVSWGR	SNC	CDI
		JMB1101	WP1 BREAKER	LOCKOUT			MVSWGR	SNC	CDI
		EYF1101	WP1 VOLTAGE PHASE LOSS A	NORMAL	LOSS		MVSWGR	SNC	CAI
		IYF1101	WP1 CURRENT PHASE LOSS B	NORMAL	LOSS		MVSWGR	SNC	CAI
		IYF1101	WP1 CURRENT PHASE LOSS C	NORMAL	LOSS		MVSWGR	SNC	CAI
		J1101	WP1 KILOWATTS			KW	MVSWGR	SNC	CAI

		EAR1101	WP1 KILOVARS			KVAR	MVSWGR	SNC	CAI
		KVA1101	WP1 KVA			KVA	MVSWGR	SNC	CAI
		EF1101	WP1 POWER FACTOR			PCT	MVSWGR	SNC	CAI
		JMN1102	WP1 BREAKER	CLOSED	OPEN		MVSWGR	SNC	CDI
		JMN1102	WP1 BREAKER	OPEN	CLOSED		MVSWGR	SNC	CDI
		JMF1001	WP1 BREAKER	TRIPPED	NORMAL		MVSWGR	SNC	CDI
		JMB1102	WP1 BREAKER	LOCKOUT			MVSWGR	SNC	CDI
		EYF1102	WP1 VOLTAGE PHASE LOSS A	NORMAL	LOSS		MVSWGR	SNC	CAI
		EYF1102	WP1 VOLTAGE PHASE LOSS B	NORMAL	LOSS		MVSWGR	SNC	CAI
		EYF1102	WP1 VOLTAGE PHASE LOSS C	NORMAL	LOSS		MVSWGR	SNC	CAI
		IYF1102	WP1 CURRENT PHASE LOSS A	NORMAL	LOSS		MVSWGR	SNC	CAI
		IYF1102	WP1 CURRENT PHASE LOSS B	NORMAL	LOSS		MVSWGR	SNC	CAI
		IYF1102	WP1 CURRENT PHASE LOSS C	NORMAL	LOSS		MVSWGR	SNC	CAI
		J1102	WP1 KILOWATTS			KW	MVSWGR	SNC	CAI
		EAR1102	WP1 KILOVARS			KVAR	MVSWGR	SNC	CAI

		KVA1102	WPI KVA			KVA	MVSWGR	SNC	CAI
		EF1102	WPI POWER FACTOR			PCT	MVSWGR	SNC	CAI
		EI1001	INCOMING FEED A LINE DIFFERNENTIAL			PCT	MVSWGR	SNC	CAI
		EI1002	INCOMING FEED B LINE DIFFERNENTIAL			PCT	MVSWGR	SNC	CAI
		EI1003	INCOMING FEED C LINE DIFFERNENTIAL			PCT	MVSWGR	SNC	CAI
		JMN1901	GENERATOR A BREAKER CLOSED	CLOSED	OPEN		MVSWGR	SNC	CDI
		JMN1901	GENERATOR A BREAKER OPEN	OPEN	CLOSED		MVSWGR	SNC	CDI
		JMB1901	GENERATOR A BREAKER TRIPPED	TRIPPED	NORMAL		MVSWGR	SNC	CDI
		JMF1901	GENERATOR A BREAKER LOCKOUT	LOCKOUT	NORMAL		MVSWGR	SNC	CDI
		EI1901	GENERATOR A INCOMING FEED VOLTS			VOLTS	MVSWGR	SNC	CAI
		JSI1901	GENERATOR A INCOMING FEED FREQUENCY			HZ	MVSWGR	SNC	CAI
		GSC1901	GENERATOR A INCOMING FEED GENRATOR SYNCHRONIZIM CHECK				MVSWGR	SNC	CAI

		TSC1901	GENERATOR A INCOMING FEED TIE SYNCHRONIZIM CHECK				MVSWGR	SNC	CAI
		EI1901	GENERATOR A INCOMING FEED UNDERVOLTAGE			VOLTS	MVSWGR	SNC	CAI
		EI1901	GENERATOR A INCOMING FEED INVERSE-TIME UNDERVOLTAGE			VOLTS	MVSWGR	SNC	CAI
		EI1901	GENERATOR A INCOMING FEED SYNCHRONISM UNDERVOLTAGE			VOLTS	MVSWGR	SNC	CAI
		JVI1901	GENERATOR A INCOMING FEED DIRECTIONAL POWER			KW	MVSWGR	SNC	CAI
		II1901	GENERATOR A INCOMING FEED OVERCURRENT PHASE A, B, C			AMP	MVSWGR	SNC	CAI
		II1901	GENERATOR A INCOMING FEED OVERCURRENT GROUND			AMP	MVSWGR	SNC	CAI
		II1901	GENERATOR A INCOMING FEED OVERCURRNT NEGATIVE SEQUENCE			AMP	MVSWGR	SNC	CAI
		EI1901	GENERATOR A INCOMING FEED INVERSE-TIME OVERVOLTAGE			VOLTS	MVSWGR	SNC	CAI
		EI1901	GENERATOR A INCOMING FEED			VOLTS	MVSWGR	SNC	CAI

			SYNCHRONIZIM OVERVOLTAGE						
		EI1901	GENERATOR A INCOMING FEED OVERVOLTAGE PHASE A, B, C			VOLTS	MVSWGR	SNC	CAI
		EI1901	GENERATOR A INCOMING FEED OVERVOLTAGE GROUND			VOLTS	MVSWGR	SNC	CAI
		EI1901	GENERATOR A INCOMING FEED OVERVOLTAGE NEGATIVE SEQUENCE			VOLTS	MVSWGR	SNC	CAI
		EI1901	GENERATOR A INCOMING FEED LOSS OF POTENTIAL				MVSWGR	SNC	CAI
		II1901	GENERATOR A INCOMING FEED DIRECTIONAL OVERCURRENT PHASE A, B, C			AMP	MVSWGR	SNC	CAI
		II1901	GENERATOR A INCOMING FEED DIRECTIONAL OVERCURRENT GROUND			AMP	MVSWGR	SNC	CAI
		II1901	GENERATOR A INCOMING FEED DIRECTIONAL OVERCURRENT NEGATIVE SEQUENCE			AMP	MVSWGR	SNC	CAI
		JMN1902	GENERATOR B BREAKER CLOSED	CLOSED	OPEN		MVSWGR	SNC	CDI

		JMN1902	GENERATOR B BREAKER OPEN	OPEN	CLOSED		MVSWGR	SNC	CDI
		JMB1902	GENERATOR B BREAKER TRIPPED	TRIPPED	NORMAL		MVSWGR	SNC	CDI
		JMF1902	GENERATOR B BREAKER LOCKOUT	LOCKOUT	NORMAL		MVSWGR	SNC	CDI
		EI1902	GENERATOR B INCOMING FEED VOLTS			VOLTS	MVSWGR	SNC	CAI
		JSI1902	GENERATOR B INCOMING FEED FREQUENCY			HZ	MVSWGR	SNC	CAI
		GSC1902	GENERATOR B INCOMING FEED GENERATOR SYNCHRONIZIM CHECK				MVSWGR	SNC	CAI
		TSC1902	GENERATOR B INCOMING FEED TIE SYNCHRONIZIM CHECK				MVSWGR	SNC	CAI
		EI1902	GENERATOR B INCOMING FEED UNDERVOLTAGE			VOLTS	MVSWGR	SNC	CAI
		EI1902	GENERATOR B INCOMING FEED INVERSE-TIME UNDERVOLTAGE			VOLTS	MVSWGR	SNC	CAI
		EI1902	GENERATOR B INCOMING FEED SYNCHRONISM UNDERVOLTAGE			VOLTS	MVSWGR	SNC	CAI

		JVI1902	GENERATOR B INCOMING FEED DIRECTIONAL POWER			KW	MVSWGR	SNC	CAI
		II1902	GENERATOR B INCOMING FEED OVERCURRENT PHASE A, B, C			AMP	MVSWGR	SNC	CAI
		II1902	GENERATOR B INCOMING FEED OVERCURRENT GROUND			AMP	MVSWGR	SNC	CAI
		II1902	GENERATOR B INCOMING FEED OVERCURRNT NEGATIVE SEQUENCE			AMP	MVSWGR	SNC	CAI
		EI1902	GENERATOR B INCOMING FEED INVERSE-TIME OVERVOLTAGE			VOLTS	MVSWGR	SNC	CAI
		EI1902	GENERATOR B INCOMING FEED SYNCHRONIZIM OVERVOLTAGE			VOLTS	MVSWGR	SNC	CAI
		EI1902	GENERATOR B INCOMING FEED OVERVOLTAGE PHASE A, B, C			VOLTS	MVSWGR	SNC	CAI
		EI1902	GENERATOR B INCOMING FEED OVERVOLTAGE GROUND			VOLTS	MVSWGR	SNC	CAI
		EI1902	GENERATOR B INCOMING FEED OVERVOLTAGE NEGATIVE SEQUENCE			VOLTS	MVSWGR	SNC	CAI

		EI1902	GENERATOR B INCOMING FEED LOSS OF POTENTIAL				MVSWGR	SNC	CAI
		II1902	GENERATOR B INCOMING FEED DIRECTIONAL OVERCURRENT PHASE A, B, C			AMP	MVSWGR	SNC	CAI
		II1902	GENERATOR B INCOMING FEED DIRECTIONAL OVERCURRENT GROUND			AMP	MVSWGR	SNC	CAI
		II1902	GENERATOR B INCOMING FEED DIRECTIONAL OVERCURRENT NEGATIVE SEQUENCE			AMP	MVSWGR	SNC	CAI
		JMN1903	TEMPORARY GENERATOR FEED BREAKER CLOSED	CLOSED	OPEN		MVSWGR	SNC	CDI
		JMN1903	TEMPORARY GENERATOR FEED BREAKER OPEN	OPEN	CLOSED		MVSWGR	SNC	CDI
		JMB1903	TEMPORARY GENERATOR FEED BREAKER TRIPPED	TRIPPED	NORMAL		MVSWGR	SNC	CDI
		JMF1903	TEMPORARY GENERATOR FEED BREAKER LOCKOUT	LOCKOUT	NORMAL		MVSWGR	SNC	CDI
<b>LOW VOLTAGE SWITCHGEAR</b>									
		JMN1003	MAIN FEED A BREAKER CLOSED	CLOSED	OPEN		LVSWGR	SNC	CDI

		JMN1003	MAIN FEED A BREAKER OPEN	OPEN	CLOSED		LVSWGR	SNC	CDI
		JMB1003	MAIN FEED A BREAKER TRIPPED	TRIPPED	NORMAL		LVSWGR	SNC	CDI
		JMF1003	MAIN FEED A BREAKER LOCKOUT	LOCKOUT	NORMAL		LVSWGR	SNC	CDI
		SPA1003	PHASE A PROTECTED	NORMAL	LOSS		LVSWGR	SNC	CAI
		SPB1003	PHASE B PROTECTED	NORMAL	LOSS		LVSWGR	SNC	CAI
		SPC1003	PHASE C PROTECTED	NORMAL	LOSS		LVSWGR	SNC	CAI
		SG1003	NEUTRAL-GROUND PROTECTED	NORMAL	LOSS		LVSWGR	SNC	CAI
		SLA1003	PHASE A LOSS OF PROTECTION	LOSS	NORMAL		LVSWGR	SNC	CAI
		SLB1003	PHASE B LOSS OF PROTECTION	LOSS	NORMAL		LVSWGR	SNC	CAI
		SLC1003	PHASE C LOSS OF PROTECTION	LOSS	NORMAL		LVSWGR	SNC	CAI
		SLG1003	NEUTRAL-GROUND LOSS OF PROTECTION	LOSS	NORMAL		LVSWGR	SNC	CAI
		EYF1003	VOLTAGE PHASE LOSS A,B,C	NORMAL	LOSS		LVSWGR	SNC	CAI
		IYF1003	CURRENT PHASE LOSS A, B, C	NORMAL	LOSS		LVSWGR	SNC	CAI
		JII1003	KILOWATTS			KW	LVSWGR	SNC	CAI

		EAR1003	KILOVARS			KVAR	LVSWGR	SNC	CAI
		KVA1003	KVA			KVA	LVSWGR	SNC	CAI
		EF1003	POWER FACTOR			PCT	LVSWGR	SNC	CAI
		JMN1004	MAIN FEED B BREAKER CLOSED	CLOSED	OPEN		LVSWGR	SNC	CDI
		JMN1004	MAIN FEED B BREAKER OPEN	OPEN	CLOSED		LVSWGR	SNC	CDI
		JMB1004	MAIN FEED B BREAKER TRIPPED	TRIPPED	NORMAL		LVSWGR	SNC	CDI
		JMF1004	MAIN FEED B BREAKER LOCKOUT	LOCKOUT	NORMAL		LVSWGR	SNC	CDI
		SPA1004	PHASE A PROTECTED	NORMAL	LOSS		LVSWGR	SNC	CAI
		SPB1004	PHASE B PROTECTED	NORMAL	LOSS		LVSWGR	SNC	CAI
		SPC1004	PHASE C PROTECTED	NORMAL	LOSS		LVSWGR	SNC	CAI
		SG1004	NEUTRAL-GROUND PROTECTED	NORMAL	LOSS		LVSWGR	SNC	CAI
		SLA1004	PHASE A LOSS OF PROTECTION	LOSS	NORMAL		LVSWGR	SNC	CAI
		SLB1004	PHASE B LOSS OF PROTECTION	LOSS	NORMAL		LVSWGR	SNC	CAI
		SLC1004	PHASE C LOSS OF PROTECTION	LOSS	NORMAL		LVSWGR	SNC	CAI

		SLG1004	NEUTRAL-GROUND LOSS OF PROTECTION	LOSS	NORMAL		LVSWGR	SNC	CAI
		EYF1003	VOLTAGE PHASE LOSS A,B,C	NORMAL	LOSS		LVSWGR	SNC	CAI
		IYF1003	CURRENT PHASE LOSS A, B, C	NORMAL	LOSS		LVSWGR	SNC	CAI
		JII1003	KILOWATTS			KW	LVSWGR	SNC	CAI
		EAR1003	KILOVARS			KVAR	LVSWGR	SNC	CAI
		KVA1003	KVA			KVA	LVSWGR	SNC	CAI
		EF1003	POWER FACTOR			PCT	LVSWGR	SNC	CAI
		JMN1201	FILTER PLANT MCC BUS 1 BREAKER CLOSED	CLOSED	OPEN		LVSWGR	SNC	CDI
		JMN1201	FILTER PLANT MCC BUS 1 BREAKER OPEN	OPEN	CLOSED		LVSWGR	SNC	CDI
		JMB1201	FILTER PLANT MCC BUS 1 BREAKER TRIPPED	TRIPPED	NORMAL		LVSWGR	SNC	CDI
		JMF1201	FILTER PLANT MCC BUS 1 BREAKER LOCKOUT	LOCKOUT	NORMAL		LVSWGR	SNC	CDI
		EYF1201	VOLTAGE PHASE LOSS A,B,C	NORMAL	LOSS		LVSWGR	SNC	CAI
		IYF1201	CURRENT PHASE LOSS A, B, C	NORMAL	LOSS		LVSWGR	SNC	CAI
		JII1201	KILOWATTS			KW	LVSWGR	SNC	CAI

		EAR1201	KILOVARS			KVAR	LVSWGR	SNC	CAI
		KVA1201	KVA			KVA	LVSWGR	SNC	CAI
		EF1201	POWER FACTOR			PCT	LVSWGR	SNC	CAI
		JMN1202	FILTER PLANT MCC BUS 2 BREAKER CLOSED	CLOSED	OPEN		LVSWGR	SNC	CDI
		JMN1202	FILTER PLANT MCC BUS 2 BREAKER OPEN	OPEN	CLOSED		LVSWGR	SNC	CDI
		JMB1202	FILTER PLANT MCC BUS 2 BREAKER TRIPPED	TRIPPED	NORMAL		LVSWGR	SNC	CDI
		JMF1202	FILTER PLANT MCC BUS 2 BREAKER LOCKOUT	LOCKOUT	NORMAL		LVSWGR	SNC	CDI
		EYF1202	VOLTAGE PHASE LOSS A,B,C	NORMAL	LOSS		LVSWGR	SNC	CAI
		IYF1202	CURRENT PHASE LOSS A, B, C	NORMAL	LOSS		LVSWGR	SNC	CAI
		JII1202	KILOWATTS			KW	LVSWGR	SNC	CAI
		EAR1202	KILOVARS			KVAR	LVSWGR	SNC	CAI
		KVA1202	KVA			KVA	LVSWGR	SNC	CAI
		EF1202	POWER FACTOR			PCT	LVSWGR	SNC	CAI
		JMN0100	DISTRIBUTION PANEL P100 BREAKER CLOSED	CLOSED	OPEN		LVSWGR	SNC	CDI
		JMN0100	DISTRIBUTION PANEL P100 BREAKER OPEN	OPEN	CLOSED		LVSWGR	SNC	CDI

		JMB0100	DISTRIBUTION PANEL P100 BREAKER TRIPPED	TRIPPED	NORMAL		LVSWGR	SNC	CDI
		JMF0100	DISTRIBUTION PANEL P100 BREAKER LOCKOUT	LOCKOUT	NORMAL		LVSWGR	SNC	CDI
		EYF0100	VOLTAGE PHASE LOSS A,B,C	NORMAL	LOSS		LVSWGR	SNC	CAI
		IYF0100	CURRENT PHASE LOSS A, B, C	NORMAL	LOSS		LVSWGR	SNC	CAI
		JII0100	KILOWATTS			KW	LVSWGR	SNC	CAI
		EAR0100	KILOVARS			KVAR	LVSWGR	SNC	CAI
		KVA0100	KVA			KVA	LVSWGR	SNC	CAI
		EF0100	POWER FACTOR			PCT	LVSWGR	SNC	CAI
		JMN0101	DISTRIBUTION PANEL P101 BREAKER CLOSED	CLOSED	OPEN		LVSWGR	SNC	CDI
		JMN0101	DISTRIBUTION PANEL P101 BREAKER OPEN	OPEN	CLOSED		LVSWGR	SNC	CDI
		JMB0101	DISTRIBUTION PANEL P101 BREAKER TRIPPED	TRIPPED	NORMAL		LVSWGR	SNC	CDI
		JMF0101	DISTRIBUTION PANEL P101 BREAKER LOCKOUT	LOCKOUT	NORMAL		LVSWGR	SNC	CDI
		EYF0101	VOLTAGE PHASE LOSS A,B,C	NORMAL	LOSS		LVSWGR	SNC	CAI

		IYF0101	CURRENT PHASE LOSS A, B, C	NORMAL	LOSS		LVSWGR	SNC	CAI
		JII0101	KILOWATTS			KW	LVSWGR	SNC	CAI
		EAR0101	KILOVARS			KVAR	LVSWGR	SNC	CAI
		KVA0101	KVA			KVA	LVSWGR	SNC	CAI
		EF0101	POWER FACTOR			PCT	LVSWGR	SNC	CAI
<b>REDUCED VOLTAGE STARTERS</b>									
		MD1101	RUN COMMAND	START	STOP		WP-1	SNC	CDO
		YA1101	AUTO STATUS	AUTO	NOT AUTO		WPI-1	SNC	CDI
		MN1101	RUN STATUS	RUNNING	STOPPED		WPI-1	SNC	CDI
		MF1101	FAULT	FAULT	NORMAL		WPI-1	SNC	CDI
		ZO1101	DISCHARGE VALVE OPEN	OPEN	NOT OPEN		WPI-1	SNC	CDI
		MD1102	RUN COMMAND	START	STOP		WP-2	SNC	CDO
		YA1102	AUTO STATUS	AUTO	NOT AUTO		WPI-2	SNC	CDI
		MN1102	RUN STATUS	RUNNING	STOPPED		WPI-2	SNC	CDI
		MF1102	FAULT	FAULT	NORMAL		WPI-2	SNC	CDI
		ZO1102	DISCHARGE VALVE OPEN	OPEN	NOT OPEN		WPI-2	SNC	CDI

<b>TRANSFORMER T3</b>									
		TAH1003	WINDING TEMPERATURE HIGH	HIGH	NORMAL		T-3	SNC	CDI
<b>TRANSFORMER T4</b>									
		TAH1004	WINDING TEMPERATURE HIGH	HIGH	NORMAL		T-4	SNC	CDI
<b>BATTERY CHARGER NO.1</b>									
		JNF1911	CHARGER NO.1 FAILURE	NORMAL	FAILURE		BC-1	SNC	CDI
		JVL1911	CHARGE NO.1 BATTERY LOW VOLTAGE	NORMAL	LOW		BC-1	SNC	CDI
		JFA1911	CHARGER NO.1 AC POWER FAILURE	NORMAL	FAILURE		BC-1	SNC	CDI
		JD1911	CHARGER NO.1 DC POWER GROUND FAILURE	NORMAL	FAILURE		BC-1	SNC	CDI
<b>BATTERY CHARGER NO.2</b>									
		JNF1912	CHARGER NO.2 FAILURE	NORMAL	FAILURE		BC-2	SNC	CDI
		JVL1912	CHARGE NO.2 BATTERY LOW VOLTAGE	NORMAL	LOW		BC-2	SNC	CDI
		JFA1912	CHARGER NO.2 AC POWER FAILURE	NORMAL	FAILURE		BC-2	SNC	CDI
		JD1912	CHARGER NO.2 DC POWER GROUND FAILURE	NORMAL	FAILURE		BC-2	SNC	CDI

UNINTERRUPTABLE POWER SUPPLY									
		JMN1913	UPS ON-LINE	ON-LINE	NOT		UPS	SNC	CDI
		JMB1913	UPS ON BATTERY	ON BATTERY	NOT		UPS	SNC	CDI
		JYP1913	UPS ON BYPASS	BYPASS	NOT		UPS	SNC	CDI
		JFN1913	UPS FAULT	NORMAL	FAULT		UPS	SNC	CDI
GENERATOR MASTER CONTROL PANEL									
		MVQ1901	OVERCRANK	OVERCRANK	NORMAL		GMC	SNC	CDI
		TAL1901	LOW COOLANT TEMPERATURE	LOW	NORMAL		GMC	SNC	CDI
		TAQ1901	HIGH COOLANT TEMPERATURE WARNING	HIGH	NORMAL		GMC	SNC	CDI
		TAH1901	HIGH COOLANT TEMPERATURE SHUTDOWN	SHUTDOWN	NORMAL		GMC	SNC	CDI
		PAQ1901	LOW OIL PRESSURE WARNING	LOW	NORMAL		GMC	SNC	CDI
		PAL1901	LOW OIL PRESSURE SHUTDOWN	SHUTDOWN	NORMAL		GMC	SNC	CDI
		SAH1901	OVERSPEED	OVERSPEED	NORMAL		GMC	SNC	CDI
		LAL1901	LOW COOLANT LEVEL	LOW	NORMAL		GMC	SNC	CDI
		UYN1901	EPS SUPPLYING LOAD	ON EPS			GMC	SNC	CDI

		YAX1901	CONTROL SWITCH NOT IN AUTO	NOT IN AUTO	AUTO		GMC	SNC	CDI
		EAH1901	HIGH BATTERY VOLTAGE	HIGH	NORMAL		GMC	SNC	CDI
		EAL1901	LOW BATTERY VOLTAGE	LOW	NORMAL		GMC	SNC	CDI
		EMF1901	BATTERY CHARGER AC FAILURE	FAILURE	NORMAL		GMC	SNC	CDI
		YQN1901	EMERGENCY STOP	ACTIVATED	NORMAL		GMC	SNC	CDI
		MVQ1902	OVERCRANK	OVERCRANK	NORMAL		GMC	SNC	CDI
		TAL1902	LOW COOLANT TEMPERATURE	LOW	NORMAL		GMC	SNC	CDI
		TAQ1902	HIGH COOLANT TEMPERATURE WARNING	HIGH	NORMAL		GMC	SNC	CDI
		TAH1902	HIGH COOLANT TEMPERATURE SHUTDOWN	SHUTDOWN	NORMAL		GMC	SNC	CDI
		PAQ1902	LOW OIL PRESSURE WARNING	LOW	NORMAL		GMC	SNC	CDI
		PAL1902	LOW OIL PRESSURE SHUTDOWN	SHUTDOWN	NORMAL		GMC	SNC	CDI
		SAH1902	OVERSPEED	OVERSPEED	NORMAL		GMC	SNC	CDI
		LAL1902	LOW COOLANT LEVEL	LOW	NORMAL		GMC	SNC	CDI
		UYN1902	EPS SUPPLYING LOAD	ON EPS			GMC	SNC	CDI

		YAX1902	CONTROL SWITCH NOT IN AUTO	NOT IN AUTO	AUTO		GMC	SNC	CDI
		EAH1902	HIGH BATTERY VOLTAGE	HIGH	NORMAL		GMC	SNC	CDI
		EAL1902	LOW BATTERY VOLTAGE	LOW	NORMAL		GMC	SNC	CDI
		EMF1902	BATTERY CHARGER AC FAILURE	FAILURE	NORMAL		GMC	SNC	CDI
		YQN1902	EMERGENCY STOP	ACTIVATED	NORMAL		GMC	SNC	CDI

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