

BIDDER: \_\_\_\_\_

# BID FORMS

WAUNAKEE UTILITIES  
WAUNAKEE, WISCONSIN  
WELL NO. 6 WELL FACILITY  
CONTRACT 4-2025

Prepared by:

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Issued for Bid  
October 24, 2025



SECTION 00 41 00

BID

WAUNAKEE UTILITIES  
WAUNAKEE, WISCONSIN  
WELL NO. WELL 6 FACILITY  
CONTRACT 4-2025

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ARTICLE 1–BID RECIPIENT

1.01 Bids to be received until 1 P.M., local time, November 18, 2025.

1.02 Online electronic Bidding through QuestCDN.com is the only way the Bid will be accepted. To access the electronic Bid Form, download the Project Documents and click the Online Bidding button.

1.03 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with OWNER in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2–BIDDER'S ACKNOWLEDGEMENTS: ACCEPTANCE PERIOD, INSTRUCTIONS, AND RECEIPT OF ADDENDA

2.01 Bid Acceptance Period

A. This Bid will remain subject to acceptance for 85 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of OWNER.

2.02 Instructions to Bidders

A. Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security.

2.03 In submitting this Bid, Bidder represents the following:

A. Bidder has examined and carefully studied the Bidding Documents, and any data and reference items identified in the Bidding Documents, and hereby acknowledges receipt of the addenda.

2.04 Bidder will sign and deliver the required number of counterparts of the Agreement with the bonds, insurance certificates, and other documents required by the Bidding Requirements within 15 days after the date of OWNER's Notice of Award.

### ARTICLE 3–BIDDER’S REPRESENTATIONS

3.01 Bidder's Representations

A. In submitting this Bid, Bidder represents the following:

1. Bidder has examined and carefully studied the Bidding Documents, including Addenda.

2. Bidder has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

3. Bidder is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.

4. Bidder has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.

5. Bidder has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.

6. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, if selected as CONTRACTOR; and (c) Bidder's (CONTRACTOR's) safety precautions and programs.

7. Based on the information and observations referred to in the preceding paragraph, Bidder agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.

8. Bidder is aware of the general nature of work to be performed by OWNER and others at the Site that relates to the Work as indicated in the Bidding Documents.

9. Bidder has given ENGINEER written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by ENGINEER is acceptable to CONTRACTOR.

10. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

11. The submission of this Bid constitutes an incontrovertible representation by Bidder that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

#### ARTICLE 4–BIDDER'S CERTIFICATIONS

##### 4.01 Bidder certifies the following:

A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation.

B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.

C. Bidder has not solicited or induced any individual or entity to refrain from Bidding.

D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:

1. Corrupt practice means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the Bidding process.

2. Fraudulent practice means an intentional misrepresentation of facts made (a) to influence the Bidding process to the detriment of OWNER, (b) to establish Bid prices at artificial non-competitive levels, or (c) to deprive OWNER of the benefits of free and open competition.

3. Collusive practice means a scheme or arrangement between two or more Bidders, with or without the knowledge of OWNER, a purpose of which is to establish Bid prices at artificial, non-competitive levels.

4. Coercive practice means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the Bidding process or affect the execution of the Contract.



## ARTICLE 5–BASIS OF BID

5.01 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

The following abbreviations may be used in this Bid:

|       |   |                           |      |   |                           |
|-------|---|---------------------------|------|---|---------------------------|
| CIP   | - | Complete in Place         | LS   | - | Lump Sum                  |
| CY    | - | Cubic Yard                | LT   | - | Left                      |
| DI    | - | Ductile Iron              | MBF  | - | Thousand Board Feet       |
| DIA   | - | Diameter                  | MFOB | - | Thousand Freight-On-Board |
| EA    | - | Each                      | MH   | - | Manhole                   |
| EST   | - | Estimate(d)               | RCP  | - | Reinforced Concrete Pipe  |
| EXCL  | - | Excluding                 | RT   | - | Right                     |
| FT    | - | Feet                      | SF   | - | Square Foot               |
| GAL   | - | Gallon                    | STA  | - | Station                   |
| HERCP | - | Horizontal Elliptical RCP | SY   | - | Square Yard               |
| HRS   | - | Hours                     | T    | - | Ton                       |
| IN    | - | Inch                      | VLF  | - | Vertical Linear Foot      |
| INCL  | - | Including                 | W/   | - | With                      |
| LBS   | - | Pounds                    | W/O  | - | Without                   |
| LF    | - | Linear Foot               |      |   |                           |

**BIDDERS SHOULD NOT ADD ANY CONDITIONS OR QUALIFYING STATEMENTS TO THIS BID OR THE BID MAY BE DECLARED IRREGULAR AS NOT BEING RESPONSIVE TO THE INSTRUCTIONS TO BIDDERS.**

BID

WAUNAKEE UTILITIES  
WAUNAKEE, WISCONSIN  
WELL NO. 6 WELL FACILITY  
CONTRACT 4-2025

LUMP SUM BID:

\_\_\_\_\_ Dollars \$ \_\_\_\_\_  
(Words) (Numbers)

See Section 01 29 00—Contract Considerations for discussion of Cash Allowances to include in the Bid.

# BID

## WAUNAKEE UTILITIES WAUNAKEE, WISCONSIN WELL NO. 6 WELL FACILITY CONTRACT 4-2025

### CASH ALLOWANCES

The following Cash Allowances shall be included in the Lump Sum Base Bid. The Cash Allowances for non-Lump Sum items shall be equal to the product of the quantity included in the Lump Sum Base Bid and the Unit Price. The Cash Allowances will be adjusted in the event that estimated quantities to be included in the Lump Sum Base Bid are different from final measured quantities. A single Unit Price shall be bid for each item. Failure to include one or more of the following Unit Price items may result in rejection of the entire Bid as nonconforming. For items with a quantity of 1, the Cash Allowance shall be adjusted based on actual final costs.

| Item Number | Description                                                                                                           | Estimated Quantity Included in the Lump Sum Base Bid | Unit | Bid Unit Price | Total Bid Price Included in the Lump Sum Base Bid |
|-------------|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|------|----------------|---------------------------------------------------|
| 1.          | Unsuitable Foundation Material for Structures and Roads<br>(Section 31 23 00–Excavation, Fill, Backfill, and Grading) | 350                                                  | CY   | \$             | \$                                                |
| 2.          | Unsuitable Foundation Material for Utility Trenches<br>(Section 31 23 00–Excavation, Fill, Backfill, and Grading)     | 50                                                   | CY   | \$             | \$                                                |
| 3.          | Natural Gas Utility Service<br>(Section 33 52 16–Fuel Gas Distribution Utilities)                                     | 1                                                    | LS   | \$5,000.00     | \$5,000.00                                        |

## ARTICLE 6–TIME OF COMPLETION

6.01 Bidder agrees that the Work will be substantially complete on or before November 1, 2026, and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before December 1, 2026.

6.02 Bidder accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work within the Contract Times.

## ARTICLE 7–ATTACHMENTS TO THIS BID

7.01 The following documents are attached to and made a condition of this Bid:

- A. Required Bid security in the form of \_\_\_\_\_  
(Surety2000, Certified Check, Bank Money Order, or Bond)
- B. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such license, if applicable, within the time for acceptance of Bids.
- C. Where applicable, Bidder shall provide CONTRACTOR's License Number for the state of the Project, where noted at end of Bid or Bidder shall provide evidence of Bidder's ability to obtain a State Contractor's License and a covenant by Bidder to obtain said license within the time for acceptance of Bids.

## ARTICLE 8–DEFINED TERMS

8.01 The terms used in this Bid with initial or all capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

## ARTICLE 9–COMMUNICATIONS

9.01 Communications concerning this Bid shall be addressed to the address of Bidder indicated below:

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

Street: \_\_\_\_\_

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

Phone No.: \_\_\_\_\_ Fax No.: \_\_\_\_\_

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

## ARTICLE 10–BID SUBMITTAL

Submitted on \_\_\_\_\_

State Contractor License Number \_\_\_\_\_ (if applicable).

If Bidder is:

An Individual

By: \_\_\_\_\_  
(Individual's signature)

Name (typed or printed): \_\_\_\_\_

Doing business as: \_\_\_\_\_

Business address: \_\_\_\_\_

Phone No.: \_\_\_\_\_ Fax No.: \_\_\_\_\_

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

A Partnership

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

By: \_\_\_\_\_  
(Signature of general partner -- attach evidence of authority to sign)

Name (typed or printed): \_\_\_\_\_

Business address: \_\_\_\_\_

Phone No.: \_\_\_\_\_ Fax No.: \_\_\_\_\_

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

A Corporation

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

State of Incorporation: \_\_\_\_\_

Type (General Business, Professional, Service, Limited Liability): \_\_\_\_\_

By: \_\_\_\_\_  
(Signature -- attach evidence of authority to sign)

Name (typed or printed): \_\_\_\_\_

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

Attest \_\_\_\_\_  
(Signature of Corporate Secretary)

Business address: \_\_\_\_\_

Phone No.: \_\_\_\_\_ Fax No.: \_\_\_\_\_

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

Date of Qualification to do business in (State where the Project is located) is \_\_\_\_\_

Sworn and subscribed to before me this  
\_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_  
\_\_\_\_\_

Notary Public or Other Officer  
Authorized to Administer Oaths.  
My Commission expires: \_\_\_\_\_

*A Limited Liability Company* (Note: If member-managed, an authorized member must sign; if manager-managed, the authorized manager must sign. Attach evidence of authority to sign on behalf of LLC).

\_\_\_\_\_  
(Fill in complete name of LLC)

State of Formation: \_\_\_\_\_

By: \_\_\_\_\_  
(Signature)

\_\_\_\_\_, [Member] [Manager]  
(Print Name)

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

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

Email: \_\_\_\_\_

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

A Joint Venture

Name of Joint Venture: \_\_\_\_\_

First Joint Venturer Name: \_\_\_\_\_

By: \_\_\_\_\_  
(Signature of first joint venture partner -- attach evidence of authority to sign)

Name (typed or printed): \_\_\_\_\_

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

Business address: \_\_\_\_\_

Phone No.: \_\_\_\_\_ Fax No.: \_\_\_\_\_

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

Second Joint Venturer Name: \_\_\_\_\_

By: \_\_\_\_\_  
(Signature of second joint venture partner -- attach evidence of authority to sign)

Name (typed or printed): \_\_\_\_\_

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

Business address: \_\_\_\_\_

Phone No.: \_\_\_\_\_ Fax No.: \_\_\_\_\_

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

Phone No., Fax No., and postal and E-mail address for receipt of official communications:

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

(Each joint venturer must sign. The manner of signing for each individual, partnership, and corporation that is a party to the joint venture should be in the manner indicated above.)

Sworn and subscribed to before me this  
\_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_  
\_\_\_\_\_

Notary Public or Other Officer  
Authorized to Administer Oaths.  
My Commission expires: \_\_\_\_\_

END OF SECTION

## 10% BID BOND

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

|                                                                                                                                                                                                               |                                                                                                                                                                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Bidder</b><br>Name: [Full formal name of Bidder]<br>Address ( <i>principal place of business</i> ):<br>[Address of Bidder's principal place of business]                                                   | <b>Surety</b><br>Name: [Full formal name of Surety]<br>Address ( <i>principal place of business</i> ):<br>[Address of Surety's principal place of business]    |
| <b>Owner</b><br>Name: [Full formal name of Owner]<br>Address ( <i>principal place of business</i> ):<br>[Address of Owner's principal place of business]                                                      | <b>Bid</b><br>Project ( <i>name and location</i> ):<br>[Owner project/contract name, and location of the project]<br><br>Bid Due Date: [Enter date bid is due] |
| <b>Bond</b><br>Penal Sum: [Amount]<br>Date of Bond: [Date]                                                                                                                                                    |                                                                                                                                                                |
| Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth in this Bid Bond, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative. |                                                                                                                                                                |
| <b>Bidder</b>                                                                                                                                                                                                 | <b>Surety</b>                                                                                                                                                  |
| By: _____<br>( <i>Full formal name of Bidder</i> )                                                                                                                                                            | By: _____<br>( <i>Full formal name of Surety</i> ) ( <i>corporate seal</i> )                                                                                   |
| Name: _____<br>( <i>Signature</i> )                                                                                                                                                                           | Name: _____<br>( <i>Signature</i> ) ( <i>Attach Power of</i> )                                                                                                 |
| Title: _____<br>( <i>Printed or typed</i> )                                                                                                                                                                   | Title: _____<br>( <i>Printed or typed</i> )                                                                                                                    |
| Attest: _____<br>( <i>Signature</i> )                                                                                                                                                                         | Attest: _____<br>( <i>Signature</i> )                                                                                                                          |
| Name: _____<br>( <i>Printed or typed</i> )                                                                                                                                                                    | Name: _____<br>( <i>Printed or typed</i> )                                                                                                                     |
| Title: _____                                                                                                                                                                                                  | Title: _____                                                                                                                                                   |
| Notes: (1) Note: Addresses are to be used for giving any required notice. (2) Provide execution by any additional parties, such as joint venturers, if necessary.                                             |                                                                                                                                                                |



1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond will be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder occurs upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation will be null and void if:
  - 3.1. Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
  - 3.2. All Bids are rejected by Owner, or
  - 3.3. Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions does not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.
6. No suit or action will be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety, and in no case later than one year after the Bid due date.
7. Any suit or action under this Bond will be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder must be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Postal Service registered or certified mail, return receipt requested, postage pre-paid, and will be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond will be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute governs and the remainder of this Bond that is not in conflict therewith continues in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

Professional

Engineering

Services

Well No. 6  
Well Facility

Contract 4-2025

## Project Manual

Waunakee Utilities

Waunakee, Wisconsin

Issued for Bid

October 24, 2025



PLAN HOLDER: \_\_\_\_\_

Set No.: \_\_\_\_\_

PROJECT MANUAL

WAUNAKEE UTILITIES  
WAUNAKEE, WISCONSIN  
WELL NO. 6 WELL FACILITY  
CONTRACT 4-2025



Prepared by:

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SECTION 00 01 10

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WAUNAKEE, WISCONSIN  
WELL NO. 6 WELL FACILITY  
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## **BIDDING AND CONTRACTING REQUIREMENTS**

SECTION 00 11 13

ADVERTISEMENT TO BID

WAUNAKEE UTILITIES  
WAUNAKEE, WISCONSIN  
WELL NO. 6 WELL FACILITY  
CONTRACT 4-2025

Waunakee Utilities (OWNER) is requesting Bids for the construction of the following Project:

Well No. 6 Well Facility  
Contract 4-2025

Electronic Bids for the construction of the Project will be received by OWNER until November 18, 2025, at 1 P.M., local time. At that time the Bids received will be publicly downloaded and read aloud over Zoom teleconference. The login information for the teleconference is as follows: (309) 205-3325, Conference ID 980 6976 5205.

The Project includes the following Work: A single-story masonry well facility consisting of a pump room, restroom, mechanical room, and two chemical storage rooms.

Complete digital Project Bidding Documents are available at [www.strand.com](http://www.strand.com) or at [www.questcdn.com](http://www.questcdn.com). Download the digital Bidding Documents for \$75 by inputting Quest project number 9918631 on the website's project search page. Please contact QuestCDN.com at (952) 233-1632 or [info@questcdn.com](mailto:info@questcdn.com) for assistance with free membership registration, downloading, and working with this digital Project information.

For this Project, Bids will **ONLY** be received and accepted via the online electronic Bid service through QuestCDN.com. To access the electronic Bid Form, download the Project Documents and click the Online Bidding button.

The Issuing Office is Strand Associates, Inc.<sup>®</sup>, 910 West Wingra Drive, Madison, WI 53715.

All Bidders submitting a sealed Bid shall obtain the Bidding Documents from QuestCDN.com.

Bidders who submit a Bid must be a Plan Holder of record at the Issuing Office. Bids from Bidders who are not on the Plan Holders List may be returned as not being responsive.

The Bid must be accompanied by Bid security made payable to OWNER in an amount of 10% of the Bidder's maximum Bid price.

Waunakee Utilities reserves the right to reject any or all Bids, to waive any technicality, and to accept any Bid which it deems advantageous. All Bids shall remain subject to acceptance for 85 days after the time set for receiving Bids.

Contract award shall be made based on the lowest responsive and responsible Bidder.

The Strand Associates, Inc.<sup>®</sup> project manager is Michael J. Forslund, P.E. and can be contacted at Strand Associates, Inc.<sup>®</sup>, 910 West Wingra Drive, Madison, WI 53715, (608) 251-4843, regarding the Project.

For further requirements regarding Bid submittal, qualifications, procedures, and Contract award, refer to the Instructions to Bidders that are included in the Bidding Documents.

Published by the authority of the      Waunakee Utilities  
Tim Herlitzka, General Manager

Dated at Waunakee Utilities, Wisconsin  
October 24, 2025 and October 31, 2025

END OF SECTION

## SECTION 00 21 13

### INSTRUCTIONS TO BIDDERS

- A. These Instructions to Bidders establish requirements for Bidding and Award of Contract.
- B. These articles are not necessarily numbered consecutively.
- C. Table of Contents

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#### ARTICLE 1–DEFINED TERMS

1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and the Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below which are applicable to both the singular and plural thereof:

- A. Issuing Office–The office from which the Bidding Documents are to be issued and which registers planholders.

#### ARTICLE 2–BIDDING DOCUMENTS

2.01 Bidder shall obtain a complete set of Bidding Requirements and proposed Contract Documents (together, the Bidding Documents). See the Agreement for a list of the Contract Documents. It is Bidder's

responsibility to determine that it is using a complete set of documents in the preparation of a Bid. Bidder assumes sole responsibility for errors or misinterpretations resulting from the use of incomplete documents, by Bidder itself or by its prospective Subcontractors and Suppliers.

2.02 Bidding Documents are made available for the sole purpose of obtaining Bids for completion of the Project and permission to download or distribution of the Bidding Documents does not confer a license or grant permission or authorization for any other use. Authorization to download documents, or other distribution, includes the right for plan holders to print documents solely for their use, and the use of their prospective Subcontractors and Suppliers, provided the plan holder pays all costs associated with printing or reproduction. Printed documents may not be re-sold under any circumstances.

### 2.03 Electronic Documents

A. When the Bidding Requirements indicate that electronic (digital) copies of the Bidding Documents are available, such documents will be made available to the Bidders as Electronic Documents in the manner specified.

1. Bidding Documents will be provided in Adobe PDF (Portable Document Format) (.pdf) that is readable by Adobe Acrobat Reader Version 6.0 or later. It is the intent of ENGINEER and OWNER that such Electronic Documents are to be exactly representative of the paper copies of the documents. However, because OWNER and ENGINEER cannot totally control the transmission and receipt of Electronic Documents nor CONTRACTOR's means of reproduction of such documents, OWNER and ENGINEER cannot and do not guarantee that Electronic Documents and reproductions prepared from those versions are identical in every manner to the paper copies.

B. Unless otherwise stated in the Bidding Documents, the Bidder may use and rely upon complete sets of Electronic Documents of the Bidding Documents, described in Paragraph 2.03.A above. However, Bidder assumes all risks associated with differences arising from transmission/receipt of Electronic Documents versions of Bidding Documents and reproductions prepared from those versions and, further, assumes all risks, costs, and responsibility associated with use of the Electronic Documents versions to derive information that is not explicitly contained in printed paper versions of the documents, and for Bidder's reliance upon such derived information.

## ARTICLE 3—QUALIFICATIONS OF BIDDERS

3.01 To demonstrate Bidder's qualifications to perform the Work, within five days of OWNER's request, Bidder shall submit the Qualifications Statement.

3.02 Bidder must be prepared to submit evidence of Bidder's qualifications to do business in the state where the Project is located prior to award of the Contract.

3.03 A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.

3.04 Bidders shall submit the documentation listed in Paragraph 7.01 of the Bid Form (Section 00 41 00).

3.05 No requirement in this Article 3 to submit information will prejudice the right of OWNER to seek additional pertinent information regarding Bidder's qualifications.

3.06 Bidder is advised to carefully review those portions of the Bidding Documents requiring Bidder's representations and certifications.

#### ARTICLE 4—PRE-BID CONFERENCE

4.01 A pre-bid conference will not be held for this Project.

#### ARTICLE 5—SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE

##### 5.01 Site and Other Areas

A. The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by OWNER for the use of CONTRACTOR. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by CONTRACTOR.

##### 5.02 Existing Site Conditions

###### A. Subsurface and Physical Conditions; Hazardous Environmental Conditions

1. The Supplementary Conditions identify the following regarding existing conditions at or adjacent to the Site:

a. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data.

b. Those drawings known to OWNER of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data.

c. Reports and drawings known to OWNER relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.

d. Technical Data contained in such reports and drawings.

2. OWNER will make copies of reports and drawings referenced above available to any Bidder on request. These reports and drawings are not part of the Contract Documents, but the Technical Data contained therein upon whose accuracy Bidder is entitled to rely, as provided in the General Conditions, has been identified and established in the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

3. If the Supplementary Conditions do not identify Technical Data, the default definition of Technical Data set forth in Article 1 of the General Conditions will apply.

B. Underground Facilities: Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05 of the General Conditions, and not in the drawings referred to in Paragraph 5.02.A of these Instructions to Bidders. Information and data regarding the presence or

location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

#### 5.03 Other Site-Related Documents

- A. No other Site-related documents are available.

#### 5.04 Site Visit and Testing by Bidders

- A. Bidder is required to visit the Site and conduct a thorough visual examination of the Site and adjacent areas. During the visit the Bidder must not disturb any ongoing operations at the Site.
- B. Bidders visiting the Site are required to arrange their own transportation to the Site.
- C. All access to the Site other than during a regularly scheduled Site visit must be coordinated through the following OWNER contact for visiting the Site: Randy Dorn, (608) 849-4107. Bidder must conduct the required Site visit during normal working hours.
- D. Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.
- E. On request, and to the extent OWNER has control over the Site, and schedule permitting, OWNER will provide Bidder general access to the Site to conduct such additional examinations, investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. OWNER will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on OWNER's authority regarding the Site. Bidder is responsible for establishing access needed to reach specific selected test sites.
- F. Bidder must comply with all applicable Laws and Regulations regarding excavation and location of utilities, obtain all permits, and comply with all terms and conditions established by OWNER or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.
- G. Bidder must fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

#### 5.05 OWNER's Safety Program

- A. Site visits and work at the Site may be governed by an OWNER safety program. If an OWNER safety program exists, it will be noted in the Supplementary Conditions.

#### 5.06 Other Work at the Site

- A. Reference is made to Article 8 of the Supplementary Conditions for the identification of the general nature of other work of which OWNER is aware (if any) that is to be performed at the Site by OWNER or others (such as utilities and other prime contractors) and relates to the Work contemplated by these Bidding Documents. If OWNER is party to a written contract for such other work, then on request, OWNER will provide to each Bidder access to examine such contracts (other than portions thereof related to price and other confidential matters), if any.

## ARTICLE 6–BIDDER’S REPRESENTATIONS AND CERTIFICATIONS

### 6.01 Express Representations and Certifications in Bid Form, Agreement

A. The Bid Form that each Bidder will submit contains express representations regarding the Bidder's examination of Project documentation, Site visit, and preparation of the Bid, and certifications regarding lack of collusion or fraud in connection with the Bid. Bidder should review these representations and certifications, and assure that Bidder can make the representations and certifications in good faith, before executing and submitting its Bid.

B. If Bidder is awarded the Contract, Bidder (as CONTRACTOR) will make similar express representations and certifications when it executes the Agreement.

## ARTICLE 7–INTERPRETATIONS AND ADDENDA

7.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to ENGINEER in writing. Interpretations or clarifications considered necessary by ENGINEER in response to such questions will be issued by Addenda mailed or delivered to all parties recorded by Issuing Office as having received the Bidding Documents.

7.02 All requests for interpretation must be received at least five days prior to the day set for receiving Bids. Addenda will be issued not later than three days prior to the day set for receiving Bids. Failure of any Bidder to receive any such Addendum or interpretation shall not relieve such Bidder from any obligations under the Bid as submitted. All Addenda so issued shall become part of the Contract Documents.

7.03 Only responses set forth in an Addendum will be binding. Oral and other interpretations or clarifications will be without legal effect. Responses to questions are not part of the Contract Documents unless set forth in an Addendum that expressly modifies or supplements the Contract Documents.

## ARTICLE 8–BID SECURITY

8.01 A Bid must be accompanied by Bid security made payable to OWNER in an amount of 10% of the Bidder's maximum Bid price and in the form of Surety2000, a certified check, bank money order, or a Bid Bond (on form attached) issued by a surety meeting the requirements of Paragraph 6.01 of the General Conditions. A PDF copy of the Bid Bond can be attached to electronically submitted Bids.

8.02 The Bid security of the apparent Successful Bidder will be retained until OWNER awards the contract to such Bidder, and such Bidder has executed the Contract, furnished the required Contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract and furnish the required Contract security within 15 days after the Notice of Award, OWNER may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited, in whole in the case of a Penal Sum Bid Bond, and to the extent of OWNER's damages in the case of a damages-form bond. Such forfeiture will be OWNER's exclusive remedy if Bidder defaults.

8.03 The Bid security of other Bidders that OWNER believes to have a reasonable chance of receiving the award may be retained by OWNER until the earlier of 7 days after the Effective Date of the Contract or 86 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.



8.04 Bid security of other Bidders that OWNER believes do not have a reasonable chance of receiving the award will be released within 7 days after the Bid opening.

#### ARTICLE 9—CONTRACT TIMES

9.01 The number of days within which, or the dates by which, the Work is to be (a) substantially completed and (b) ready for final payment, and (c) Milestones (if any) are to be achieved, are set forth in the Agreement.

9.02 Provisions for liquidated damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in the Agreement.

#### ARTICLE 10—SUBSTITUTE OR “OR EQUAL” ITEMS

10.01 The Contract, if awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without evaluation of Alternative Equipment Manufacturers listed in the Lump Sum Base Bid, if any, and without evaluation of possible substitute or “or equal” items. Whenever it is specified or described in the Bidding Documents that an Alternative Equipment Manufacturers listed in the Lump Sum Base Bid or that a substitute or “or equal” item of material or equipment may be furnished or used by CONTRACTOR if acceptable to ENGINEER, application for such acceptance will not be evaluated by ENGINEER until after the Effective Date of the Contract.

10.02 All prices that Bidder sets forth in its Bid shall be based on the presumption that CONTRACTOR will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of “or-equal” or substitution requests are made at Bidder’s sole risk.

#### ARTICLE 11—SUBCONTRACTORS, SUPPLIERS, AND OTHERS

11.01 A Bidder must be prepared to retain specific Subcontractors and Suppliers for the performance of the Work if required to do so by the Bidding Documents or in the Specifications. If a prospective Bidder objects to retaining any such Subcontractor or Supplier and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.

11.02 Subsequent to the submittal of the Bid, OWNER may not require the Successful Bidder or CONTRACTOR to retain any Subcontractor, Supplier, or other individual or entity against which CONTRACTOR has reasonable objection.

11.03 The apparent Successful Bidder, and any other Bidder so requested, shall within five days after Bid opening, submit to OWNER a list of the Subcontractors or Suppliers proposed for the Work. If requested by OWNER, such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, or other individual or entity. If OWNER or ENGINEER, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, OWNER may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder shall submit a substitute, Bidder’s Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and OWNER may consider such price adjustment in evaluating Bids and making the Contract award.

11.04 If apparent Successful Bidder declines to make any such substitution, OWNER may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers, or other individuals or entities. Declining to make requested substitutions will constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against

which OWNER or ENGINEER makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to OWNER and ENGINEER subject to subsequent revocation of such acceptance as provided in Paragraph 7.07 of the General Conditions.

## ARTICLE 12—PREPARATION OF BID

12.01 The Bid Form is included with the Bidding Documents.

A. All blanks on the Bid Form shall be completed and the Bid Forms shall be signed. A Bid price shall be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein.

B. If the Bid Form expressly indicates that submitting pricing on a specific alternate item is optional, and Bidder elects to not furnish pricing for such optional alternate item, then Bidder may enter the words “No Bid” or “Not Applicable.”

C. All blanks on the Bid Form must be filled and all required documents uploaded before QuestCDN.com will accept the Bid. The Bid shall be signed electronically where required and in accordance with the instructions included in this Article.

12.02 A Bid by a corporation shall be executed in the corporate name by a corporate officer (whose title must appear under the signature), accompanied by evidence of authority to sign. The corporate address and state of incorporation shall be shown.

12.03 A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address and state of incorporation shall be shown.

12.04 A Bid by a limited liability company shall be executed in the name of the firm by a member, if the LLC is member-managed, or by a manager, if manager-managed, and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be shown.

12.05 A Bid by an individual shall show the Bidder’s name and official address.

12.06 A Bid by a joint venture must be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The joint venture must have been formally established prior to submittal of a Bid, and the official address of the joint venture must be shown.

12.07 All names shall be printed below the signatures.

12.08 Postal and e-mail addresses and telephone number for communications regarding the Bid shall be shown.

12.09 The Bid must contain evidence of Bidder's authority to do business in the state where the Project is located, or Bidder must certify in writing that it will obtain such authority within the time for acceptance of Bids and attach such certification to the Bid.

12.10 If Bidder is required to be licensed to submit a Bid or perform the Work in the state where the Project is located, the Bid must contain evidence of Bidder's licensure, or Bidder must certify in writing that it will obtain such licensure within the time for acceptance of Bids and attach such certification to the Bid. Bidder's state contractor license number, if any, must also be shown on the Bid Form.

12.11 All Bids shall be signed in the presence of and be notarized by a Notary Public or other Officer authorized to administer oaths.

#### ARTICLE 13–BASIS OF BID

##### 13.01 Lump Sum

A. Bidders shall submit a Bid on a Lump Sum basis as set forth in the Bid Form.

13.02 Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum. For Bids submitted on a Lump Sum basis, discrepancies between words and figures will be resolved in favor of the words.

13.03 For Cash Allowances the Contract Price shall include such amounts as the Bidder deems proper for Contractor's overhead, costs, profit, and other expenses on account of Cash Allowances, if any, named in the Contract Documents as provided for in Paragraph 13.02.B of the General Conditions. The final Contract Price will be adjusted to reflect actual costs on account of Cash Allowances.

13.04 The following Cash Allowances shall be included in the Bid for Contract(s).

|                                                         |                                                          |
|---------------------------------------------------------|----------------------------------------------------------|
| Unsuitable Foundation Material for Structures and Roads | Section 31 23 00–Excavation, Fill, Backfill, and Grading |
| Unsuitable Foundation Material for Utility Trenches     | Section 31 23 00–Excavation, Fill, Backfill, and Grading |
| Natural Gas Utility Service                             | Section 31 52 16–Fuel Gas Distribution Utilities         |

#### ARTICLE 14–SUBMITTAL OF BID

14.01 Bids will be received for all divisions of the Specifications and all other provisions of the Bidding Documents.

14.02 A Bid shall be submitted no later than the date and time prescribed and at the place indicated in the Advertisement or Invitation to Bid.

14.03 Bids received after the date and time prescribed for the opening of Bids, or not submitted at the correct location or in the designated manner, will not be accepted and will be returned to the Bidder unopened.

#### ARTICLE 15–MODIFICATION AND WITHDRAWAL OF BIDS

15.01 A Bid may be modified or withdrawn by an appropriate document duly executed in the manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time set for receiving Bids.

15.02 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with OWNER and promptly thereafter demonstrates to the reasonable satisfaction of OWNER that there was a material and substantial mistake in the preparation of its Bid, the Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, the Bidder will be disqualified from further Bidding on the Work.

## ARTICLE 16—OPENING OF BIDS

16.01 Bids will be downloaded at the time and place indicated in the Advertisement or Invitation to Bid and, unless obviously nonresponsive, read aloud publicly. An abstract of the amounts of the Base Bids and major alternatives and components, if any, will be made available to Bidders after the opening of Bids.

## ARTICLE 17—BIDS TO REMAIN SUBJECT TO ACCEPTANCE

17.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but OWNER may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

## ARTICLE 18—EVALUATION OF BIDS AND AWARD OF CONTRACT

18.01 OWNER reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. OWNER also reserves the right to waive all minor Bid informalities not involving price, time, or changes in the Work.

18.02 OWNER will reject the Bid of any Bidder that OWNER finds, after reasonable inquiry and evaluation, to not be responsible.

18.03 If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, whether in the Bid itself or in a separate communication to OWNER or ENGINEER, then OWNER will reject the Bid as nonresponsive.

18.04 In evaluating Bids, OWNER will consider whether or not the Bids comply with the prescribed requirements, and such alternatives, unit prices, and other data as may be requested in the Bid Form or prior to the Notice of Award.

18.05 In evaluating Bids, OWNER will consider the qualifications of Bidders and may consider the qualifications and experience of Subcontractors, Suppliers, and other individuals or entities proposed for those portions of the Work for which the identity of Subcontractors, Suppliers, and other individuals or entities must be submitted as provided in the Supplementary Conditions. OWNER also may consider the operating costs, maintenance requirements, performance data, and guarantees of major items of materials and equipment proposed for incorporation in the work when such data is required to be submitted prior to the Notice of Award.

18.06.1 OWNER may conduct such investigations as OWNER deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualifications, and financial ability of Bidders, proposed Subcontractors, Suppliers, individuals or entities to perform the Work in accordance with the Contract Documents to OWNER's satisfaction within the prescribed time. Bidder shall furnish to OWNER all such information and data for this purpose as OWNER may request. OWNER reserves the right to reject any Bid if the evidence submitted by, or investigation of, such Bidder fails to satisfy OWNER that such Bidder is properly qualified to carry out the obligations of the Contract Documents and to complete the work contemplated therein.

18.06.2 OWNER shall be satisfied that Bidder involved (1) maintains a permanent place of business, (2) has adequate plant and equipment to do the work properly and expeditiously, (3) has a suitable financial status to meet obligations incident to the work, (4) has appropriate technical experience, and (5) can submit a satisfactory performance record.

18.07 If a Contract is to be awarded, it will be awarded to the responsible Bidder with the lowest responsive Bid whose evaluation by OWNER indicates to OWNER that the award will be in the best interests of the Project.

18.08 If a Contract is to be awarded, OWNER will give the successful Bidder a Notice of Award within 60 days after the time set for opening Bids.

#### ARTICLE 19—BONDS AND INSURANCE

19.01 Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth OWNER's requirements as to performance and payment bonds, other required bonds (if any), and insurance. When the Successful Bidder delivers the executed Agreement to OWNER, it must be accompanied by required bonds and insurance documentation.

19.02 Article 8, Bid Security, of these Instructions, addresses any requirements for providing Bid Bonds as part of the Bidding process.

#### ARTICLE 20—SIGNING OF AGREEMENT

20.01 When OWNER gives a Notice of Award to the Successful Bidder, it shall be accompanied by the required number of unexecuted counterparts of the Agreement along with all other Contract Documents which are identified in the Agreement as attached thereto. Within 15 days thereafter, Successful Bidder shall execute and deliver the required number of counterparts of the Agreement and attached documents to ENGINEER with the required Bonds and insurances. Within 10 days after receipt of properly executed documents and Bonds and insurances which meet all requirements of the Contract Documents, ENGINEER will deliver one fully signed counterpart to Successful Bidder.

#### ARTICLE 21—RETAINAGE

21.01 Provisions concerning retainage are set forth in the Agreement.

#### ARTICLE 22—WAGE RATE DETERMINATION

22.01 A wage rate determination is not a requirement of this Project.

#### ARTICLE 23—INCOME TAX

23.01 Bidders, whether a corporation, partnership, or individual, who are nonresidents of the state of Wisconsin, shall comply with Section 71.80 (16) of the Wisconsin Statutes.

#### ARTICLE 24—OTHER TAXES

24.01 The Bid shall include all taxes in effect at the time the Bid is submitted. Bidders who are uncertain as to what items are subject to tax, or who require further explanation or clarification, are requested to contact the State of Wisconsin Department of Revenue. Refer to the Supplementary Conditions SC-7.10 for additional information on taxes including exemptions for sales and use taxes.

#### ARTICLE 25—LAWS, ORDINANCES, AND REGULATIONS

25.01 Bidder must familiarize itself with all laws, ordinances, and regulations by federal, state, city, or other governmental agency, which by reason of being neglected or violated may affect the Work

contemplated and must secure and pay the fee required for any permits which may be necessary unless such fees are otherwise indicated to be paid in the Bidding Documents.

END OF SECTION

SECTION 00 41 00

BID

WAUNAKEE UTILITIES  
WAUNAKEE, WISCONSIN  
WELL NO. WELL 6 FACILITY  
CONTRACT 4-2025

A. Table of Contents

- ARTICLE 1. BID RECIPIENT
- ARTICLE 2. BIDDER'S ACKNOWLEDGEMENTS: ACCEPTANCE PERIOD, INSTRUCTIONS, AND RECEIPT OF ADDENDA
- ARTICLE 3. BIDDER'S REPRESENTATIONS
- ARTICLE 4. BIDDER'S CERTIFICATIONS
- ARTICLE 5. BASIS OF BID
- ARTICLE 6. TIME OF COMPLETION
- ARTICLE 7. ATTACHMENTS TO THIS BID
- ARTICLE 8. DEFINED TERMS
- ARTICLE 9. COMMUNICATIONS
- ARTICLE 10. BID SUBMITTAL

ARTICLE 1–BID RECIPIENT

1.01 Bids to be received until 1 P.M., local time, November 18, 2025.

1.02 Online electronic Bidding through QuestCDN.com is the only way the Bid will be accepted. To access the electronic Bid Form, download the Project Documents and click the Online Bidding button.

1.03 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with OWNER in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2–BIDDER'S ACKNOWLEDGEMENTS: ACCEPTANCE PERIOD, INSTRUCTIONS, AND RECEIPT OF ADDENDA

2.01 Bid Acceptance Period

A. This Bid will remain subject to acceptance for 85 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of OWNER.

2.02 Instructions to Bidders

A. Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security.

2.03 In submitting this Bid, Bidder represents the following:

A. Bidder has examined and carefully studied the Bidding Documents, and any data and reference items identified in the Bidding Documents, and hereby acknowledges receipt of the addenda.

2.04 Bidder will sign and deliver the required number of counterparts of the Agreement with the bonds, insurance certificates, and other documents required by the Bidding Requirements within 15 days after the date of OWNER's Notice of Award.

### ARTICLE 3–BIDDER’S REPRESENTATIONS

#### 3.01 Bidder’s Representations

A. In submitting this Bid, Bidder represents the following:

1. Bidder has examined and carefully studied the Bidding Documents, including Addenda.

2. Bidder has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

3. Bidder is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.

4. Bidder has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.

5. Bidder has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.

6. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, if selected as CONTRACTOR; and (c) Bidder's (CONTRACTOR's) safety precautions and programs.

7. Based on the information and observations referred to in the preceding paragraph, Bidder agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.

8. Bidder is aware of the general nature of work to be performed by OWNER and others at the Site that relates to the Work as indicated in the Bidding Documents.

9. Bidder has given ENGINEER written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by ENGINEER is acceptable to CONTRACTOR.



10. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

11. The submission of this Bid constitutes an incontrovertible representation by Bidder that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

#### ARTICLE 4–BIDDER'S CERTIFICATIONS

##### 4.01 Bidder certifies the following:

A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation.

B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.

C. Bidder has not solicited or induced any individual or entity to refrain from Bidding.

D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:

1. Corrupt practice means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the Bidding process.

2. Fraudulent practice means an intentional misrepresentation of facts made (a) to influence the Bidding process to the detriment of OWNER, (b) to establish Bid prices at artificial non-competitive levels, or (c) to deprive OWNER of the benefits of free and open competition.

3. Collusive practice means a scheme or arrangement between two or more Bidders, with or without the knowledge of OWNER, a purpose of which is to establish Bid prices at artificial, non-competitive levels.

4. Coercive practice means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the Bidding process or affect the execution of the Contract.

## ARTICLE 5–BASIS OF BID

5.01 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

The following abbreviations may be used in this Bid:

|       |   |                           |      |   |                           |
|-------|---|---------------------------|------|---|---------------------------|
| CIP   | - | Complete in Place         | LS   | - | Lump Sum                  |
| CY    | - | Cubic Yard                | LT   | - | Left                      |
| DI    | - | Ductile Iron              | MBF  | - | Thousand Board Feet       |
| DIA   | - | Diameter                  | MFOB | - | Thousand Freight-On-Board |
| EA    | - | Each                      | MH   | - | Manhole                   |
| EST   | - | Estimate(d)               | RCP  | - | Reinforced Concrete Pipe  |
| EXCL  | - | Excluding                 | RT   | - | Right                     |
| FT    | - | Feet                      | SF   | - | Square Foot               |
| GAL   | - | Gallon                    | STA  | - | Station                   |
| HERCP | - | Horizontal Elliptical RCP | SY   | - | Square Yard               |
| HRS   | - | Hours                     | T    | - | Ton                       |
| IN    | - | Inch                      | VLF  | - | Vertical Linear Foot      |
| INCL  | - | Including                 | W/   | - | With                      |
| LBS   | - | Pounds                    | W/O  | - | Without                   |
| LF    | - | Linear Foot               |      |   |                           |

**BIDDERS SHOULD NOT ADD ANY CONDITIONS OR QUALIFYING STATEMENTS TO THIS BID OR THE BID MAY BE DECLARED IRREGULAR AS NOT BEING RESPONSIVE TO THE INSTRUCTIONS TO BIDDERS.**

BID

WAUNAKEE UTILITIES  
WAUNAKEE, WISCONSIN  
WELL NO. 6 WELL FACILITY  
CONTRACT 4-2025

LUMP SUM BID:

\_\_\_\_\_ Dollars \$ \_\_\_\_\_  
(Words) (Numbers)

See Section 01 29 00—Contract Considerations for discussion of Cash Allowances to include in the Bid.

# BID

## WAUNAKEE UTILITIES WAUNAKEE, WISCONSIN WELL NO. 6 WELL FACILITY CONTRACT 4-2025

### CASH ALLOWANCES

The following Cash Allowances shall be included in the Lump Sum Base Bid. The Cash Allowances for non-Lump Sum items shall be equal to the product of the quantity included in the Lump Sum Base Bid and the Unit Price. The Cash Allowances will be adjusted in the event that estimated quantities to be included in the Lump Sum Base Bid are different from final measured quantities. A single Unit Price shall be bid for each item. Failure to include one or more of the following Unit Price items may result in rejection of the entire Bid as nonconforming. For items with a quantity of 1, the Cash Allowance shall be adjusted based on actual final costs.

| Item Number | Description                                                                                                           | Estimated Quantity Included in the Lump Sum Base Bid | Unit | Bid Unit Price | Total Bid Price Included in the Lump Sum Base Bid |
|-------------|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|------|----------------|---------------------------------------------------|
| 1.          | Unsuitable Foundation Material for Structures and Roads<br>(Section 31 23 00–Excavation, Fill, Backfill, and Grading) | 350                                                  | CY   | \$             | \$                                                |
| 2.          | Unsuitable Foundation Material for Utility Trenches<br>(Section 31 23 00–Excavation, Fill, Backfill, and Grading)     | 50                                                   | CY   | \$             | \$                                                |
| 3.          | Natural Gas Utility Service<br>(Section 33 52 16–Fuel Gas Distribution Utilities)                                     | 1                                                    | LS   | \$5,000.00     | \$5,000.00                                        |

## ARTICLE 6–TIME OF COMPLETION

6.01 Bidder agrees that the Work will be substantially complete on or before November 1, 2026, and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before December 1, 2026.

6.02 Bidder accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work within the Contract Times.

## ARTICLE 7–ATTACHMENTS TO THIS BID

7.01 The following documents are attached to and made a condition of this Bid:

- A. Required Bid security in the form of \_\_\_\_\_  
(Surety2000, Certified Check, Bank Money Order, or Bond)
- B. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such license, if applicable, within the time for acceptance of Bids.
- C. Where applicable, Bidder shall provide CONTRACTOR's License Number for the state of the Project, where noted at end of Bid or Bidder shall provide evidence of Bidder's ability to obtain a State Contractor's License and a covenant by Bidder to obtain said license within the time for acceptance of Bids.

## ARTICLE 8–DEFINED TERMS

8.01 The terms used in this Bid with initial or all capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

## ARTICLE 9–COMMUNICATIONS

9.01 Communications concerning this Bid shall be addressed to the address of Bidder indicated below:

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

Street: \_\_\_\_\_

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

Phone No.: \_\_\_\_\_ Fax No.: \_\_\_\_\_

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

## ARTICLE 10–BID SUBMITTAL

Submitted on \_\_\_\_\_

State Contractor License Number \_\_\_\_\_ (if applicable).

If Bidder is:

An Individual

By: \_\_\_\_\_  
(Individual's signature)

Name (typed or printed): \_\_\_\_\_

Doing business as: \_\_\_\_\_

Business address: \_\_\_\_\_

Phone No.: \_\_\_\_\_ Fax No.: \_\_\_\_\_

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

A Partnership

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

By: \_\_\_\_\_  
(Signature of general partner -- attach evidence of authority to sign)

Name (typed or printed): \_\_\_\_\_

Business address: \_\_\_\_\_

Phone No.: \_\_\_\_\_ Fax No.: \_\_\_\_\_

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

A Corporation

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

State of Incorporation: \_\_\_\_\_

Type (General Business, Professional, Service, Limited Liability): \_\_\_\_\_

By: \_\_\_\_\_  
(Signature -- attach evidence of authority to sign)

Name (typed or printed): \_\_\_\_\_

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

Attest \_\_\_\_\_  
(Signature of Corporate Secretary)

Business address: \_\_\_\_\_

Phone No.: \_\_\_\_\_ Fax No.: \_\_\_\_\_

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

Date of Qualification to do business in (State where the Project is located) is \_\_\_\_\_

Sworn and subscribed to before me this  
\_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_

Notary Public or Other Officer  
Authorized to Administer Oaths.  
My Commission expires: \_\_\_\_\_

*A Limited Liability Company* (Note: If member-managed, an authorized member must sign; if manager-managed, the authorized manager must sign. Attach evidence of authority to sign on behalf of LLC).

\_\_\_\_\_  
(Fill in complete name of LLC)

State of Formation: \_\_\_\_\_

By: \_\_\_\_\_  
(Signature)

\_\_\_\_\_, [Member] [Manager]  
(Print Name)

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

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

Email: \_\_\_\_\_

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

A Joint Venture

Name of Joint Venture: \_\_\_\_\_

First Joint Venturer Name: \_\_\_\_\_

By: \_\_\_\_\_  
(Signature of first joint venture partner -- attach evidence of authority to sign)

Name (typed or printed): \_\_\_\_\_

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

Business address: \_\_\_\_\_

Phone No.: \_\_\_\_\_ Fax No.: \_\_\_\_\_

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

Second Joint Venturer Name: \_\_\_\_\_

By: \_\_\_\_\_  
(Signature of second joint venture partner -- attach evidence of authority to sign)

Name (typed or printed): \_\_\_\_\_

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

Business address: \_\_\_\_\_

Phone No.: \_\_\_\_\_ Fax No.: \_\_\_\_\_

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

Phone No., Fax No., and postal and E-mail address for receipt of official communications:

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

(Each joint venturer must sign. The manner of signing for each individual, partnership, and corporation that is a party to the joint venture should be in the manner indicated above.)

Sworn and subscribed to before me this  
\_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_  
\_\_\_\_\_

Notary Public or Other Officer  
Authorized to Administer Oaths.  
My Commission expires: \_\_\_\_\_

END OF SECTION



## 10% BID BOND

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

|                                                                                                                                                                                                               |                                                                                                                                                                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Bidder</b><br>Name: [Full formal name of Bidder]<br>Address ( <i>principal place of business</i> ):<br>[Address of Bidder's principal place of business]                                                   | <b>Surety</b><br>Name: [Full formal name of Surety]<br>Address ( <i>principal place of business</i> ):<br>[Address of Surety's principal place of business]    |
| <b>Owner</b><br>Name: [Full formal name of Owner]<br>Address ( <i>principal place of business</i> ):<br>[Address of Owner's principal place of business]                                                      | <b>Bid</b><br>Project ( <i>name and location</i> ):<br>[Owner project/contract name, and location of the project]<br><br>Bid Due Date: [Enter date bid is due] |
| <b>Bond</b><br>Penal Sum: [Amount]<br>Date of Bond: [Date]                                                                                                                                                    |                                                                                                                                                                |
| Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth in this Bid Bond, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative. |                                                                                                                                                                |
| <b>Bidder</b>                                                                                                                                                                                                 | <b>Surety</b>                                                                                                                                                  |
| By: _____<br>( <i>Full formal name of Bidder</i> )                                                                                                                                                            | By: _____<br>( <i>Full formal name of Surety</i> ) ( <i>corporate seal</i> )                                                                                   |
| Name: _____<br>( <i>Signature</i> )                                                                                                                                                                           | Name: _____<br>( <i>Signature</i> ) ( <i>Attach Power of</i> )                                                                                                 |
| Title: _____<br>( <i>Printed or typed</i> )                                                                                                                                                                   | Title: _____<br>( <i>Printed or typed</i> )                                                                                                                    |
| Attest: _____<br>( <i>Signature</i> )                                                                                                                                                                         | Attest: _____<br>( <i>Signature</i> )                                                                                                                          |
| Name: _____<br>( <i>Printed or typed</i> )                                                                                                                                                                    | Name: _____<br>( <i>Printed or typed</i> )                                                                                                                     |
| Title: _____                                                                                                                                                                                                  | Title: _____                                                                                                                                                   |
| Notes: (1) Note: Addresses are to be used for giving any required notice. (2) Provide execution by any additional parties, such as joint venturers, if necessary.                                             |                                                                                                                                                                |

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond will be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder occurs upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation will be null and void if:
  - 3.1. Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
  - 3.2. All Bids are rejected by Owner, or
  - 3.3. Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions does not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.
6. No suit or action will be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety, and in no case later than one year after the Bid due date.
7. Any suit or action under this Bond will be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder must be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Postal Service registered or certified mail, return receipt requested, postage pre-paid, and will be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond will be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute governs and the remainder of this Bond that is not in conflict therewith continues in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

SECTION 00 52 00

AGREEMENT

---

THIS AGREEMENT is by and between \_\_\_\_\_  
(hereinafter called OWNER) and \_\_\_\_\_  
(hereinafter called CONTRACTOR).

Terms used in this Agreement have the meanings stated in the General Conditions and the Supplementary Conditions.

OWNER and CONTRACTOR, in consideration of the mutual covenants set forth herein, agree as follows:

Article 1. WORK

1.01 CONTRACTOR shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

Article 2. THE PROJECT

2.01 The Project for which the Work under the Contract Documents may be the whole or only a part is generally described as follows:

Article 3. ENGINEER

3.01 OWNER has retained Strand Associates, Inc.<sup>®</sup> ("ENGINEER") to act as OWNER's representative, assume all duties and responsibilities of ENGINEER, and have the rights and authority assigned to ENGINEER in the Contract.

3.02 The part of the Project that pertains to the Work has been designed by ENGINEER.

## Article 4. CONTRACT TIMES

### 4.01 Time of the Essence

A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

### 4.02 Dates for Substantial Completion and Final Payment

A. The Work will be substantially complete on or before November 1, 2026, and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before December 1, 2026.

### 4.03 Liquidated Damages

A. CONTRACTOR and OWNER recognize that time is of the essence as stated in Paragraph 4.01 above and that OWNER will suffer financial and other losses if the Work is not completed and Milestones not achieved within the Contract Times, as duly modified. The parties also recognize the delays, expense, and difficulties involved in proving, in a legal or arbitration proceeding, the actual loss suffered by OWNER if the Work is not completed on time. Accordingly, instead of requiring any such proof, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty):

1. Substantial Completion and Ready for Final Payment: CONTRACTOR shall pay OWNER \$600 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified in Paragraph 4.02.A above for Substantial Completion until the Work is completed and ready for final payment. This amount is comprised of \$300 per day for engineering, construction administration services, and construction observation services, and \$300 per day for administration, labor, expenses, and other costs that will be incurred by OWNER.

2. Completion of Remaining Work: After Substantial Completion, if CONTRACTOR shall neglect, refuse, or fail to complete the remaining Work within the Contract Time (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, CONTRACTOR shall pay OWNER \$600 for each day that expires after such time until the Work is completed and ready for final payment. This amount is comprised of \$300 per day for engineering, construction administration services, and construction observation services, and \$300 per day for administration, labor, expenses, and other costs that will be incurred by OWNER.

3. Liquidated damages for failing to timely attain Substantial Completion and final completion are not additive, and will not be imposed concurrently.

## Article 5. CONTRACT PRICE

5.01 OWNER shall pay CONTRACTOR for completion of the Work in accordance with the Contract Documents an amount in current funds as follows, subject to adjustment under the Contract:

A. For all Work, at the prices stated in CONTRACTOR's Bid, attached hereto as an exhibit.

B. All specific Cash Allowances are included in the Contract Price and have been computed in accordance with Paragraph 13.02 of the General Conditions.

## Article 6. PAYMENT PROCEDURES

### 6.01 Submittal and Processing of Payments

A. CONTRACTOR shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by ENGINEER as provided in the General Conditions.

### 6.02 Progress Payments; Retainage

A. OWNER shall make progress payments on account of the Contract Price on the basis of CONTRACTOR's Applications for Payment as established at the preconstruction conference during performance of the Work as provided in Paragraphs 6.02.A.1 and 6.02.A.2 below. All such payments will be measured by the schedule of values established in Paragraph 2.05.A of the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Requirements:

1. Prior to Substantial Completion, OWNER will retain an amount equal to 5% of each progress payment application until 50% of the Work has been completed. At 50% completion, further progress payment applications shall be paid in full to CONTRACTOR and no additional amounts will be retained unless ENGINEER certifies to OWNER that the job is not proceeding satisfactorily. Amounts previously retained shall not be paid to CONTRACTOR until substantial completion of the Work. At 50% completion of the Work, or any time thereafter when the character and progress of the Work is not satisfactory to OWNER on recommendation of ENGINEER, additional amounts may be retained, but in no event shall the total retainage be more than 10% of the value of the work completed.

2. Upon Substantial Completion, OWNER shall pay an amount sufficient to increase total payments to CONTRACTOR to 98% of the Work completed, less such amounts as ENGINEER shall determine in accordance with Paragraph 15.01.C.5 and 15.01.C.6 of the General Conditions and less 100% of ENGINEER's estimate of the value of Work to be completed or corrected as shown on the tentative list of items to be completed or corrected attached to the certificate of Substantial Completion.

### 6.03 Final Payment

A. Upon final completion and acceptance of the Work in accordance with Paragraph 15.06 of the General Conditions, OWNER shall pay the remainder of the Contract Price as recommended by ENGINEER as provided in said Paragraph 15.06.

### 6.04 Consent of Surety

A. OWNER will not make final payment unless CONTRACTOR submits written consent of the surety to such payment.

## Article 7. HIERARCHY

7.01 In resolving inconsistencies among two or more sections of the Contract Documents, precedence shall be given in the following order:

- |          |                                                   |
|----------|---------------------------------------------------|
| First:   | WRITTEN AMENDMENTS                                |
| Second:  | CHANGE ORDERS/FIELD ORDERS/WORK CHANGE DIRECTIVES |
| Third:   | ADDENDA                                           |
| Fourth:  | AGREEMENT                                         |
| Fifth:   | SUPPLEMENTARY CONDITIONS                          |
| Sixth:   | GENERAL CONDITIONS                                |
| Seventh: | SPECIFICATIONS                                    |
| Eighth:  | DRAWINGS                                          |

For categories that have the same order of precedence, the document that includes the latest date shall control. Figure dimensions (numerical) on Drawings shall take precedence over dimensions measured utilizing a scale.

## Article 8. REPRESENTATIONS, CERTIFICATIONS, AND STIPULATIONS

### 8.01 CONTRACTOR's Representations

A. In order to induce OWNER to enter into this Contract, CONTRACTOR makes the following representations:

1. CONTRACTOR has examined and carefully studied the Contract Documents, including Addenda.
2. CONTRACTOR has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
3. CONTRACTOR is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
4. CONTRACTOR has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site, if any, that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.
5. CONTRACTOR has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.
6. CONTRACTOR has considered the information known to CONTRACTOR itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by CONTRACTOR; and (c) CONTRACTOR's safety precautions and programs.

7. Based on the information and observations referred to in the preceding paragraph, CONTRACTOR agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.

8. CONTRACTOR is aware of the general nature of work to be performed by OWNER and others at the Site that relates to the Work as indicated in the Contract Documents.

9. CONTRACTOR has given ENGINEER written notice of all conflicts, errors, ambiguities, or discrepancies that CONTRACTOR has discovered in the Contract Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by ENGINEER is acceptable to CONTRACTOR.

10. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

11. CONTRACTOR's entry into this Contract constitutes an incontrovertible representation by CONTRACTOR that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

## 8.02 CONTRACTOR's Certifications

A. CONTRACTOR certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 8.02:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of OWNER, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive OWNER of the benefits of free and open competition;

3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of OWNER, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

## Article 9. CONTRACT DOCUMENTS

### 9.01 Contents

A. The Contract Documents consist of the following:

1. This Agreement (pages 00 52 00-1 through 00 52 00-\_\_\_\_, inclusive);
2. Performance Bond (pages 00 61 13.13-1 through 00 61 13.13-4, inclusive);

3. Payment Bond (pages 00 61 13.16-1 through 00 61 13.16-4, inclusive);
4. Other bonds
  - a. \_\_\_\_\_ (pages \_\_\_\_\_ to \_\_\_\_\_ , inclusive);
  - b. \_\_\_\_\_ (pages \_\_\_\_\_ to \_\_\_\_\_ , inclusive);
  - c. \_\_\_\_\_ (pages \_\_\_\_\_ to \_\_\_\_\_ , inclusive);
5. General Conditions (pages 00 72 00-1 through 00 72 00-\_\_\_\_, inclusive);
6. Supplementary Conditions (pages 00 73 00-1 through 00 73 00-\_\_\_\_, inclusive);
7. Specifications as listed in the table of contents of the Project Manual;
8. Drawings—Sheets No. \_\_\_\_ through No. \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
inclusive incorporated herein by reference with each sheet bearing the following general title:

\_\_\_\_\_  
\_\_\_\_\_  
as well as drawings listed in the table of contents that are bound at the back of these Specifications.

9. Addenda (\_\_\_\_\_).
10. Exhibits to this Agreement (enumerated as follows:)
  - a. CONTRACTOR's Bid (pages \_\_\_\_ to \_\_\_\_);
  - b. Documentation submitted by CONTRACTOR prior to Notice of Award  
(\_\_\_\_\_);
  - c. (\_\_\_\_\_);
11. The following may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
  - a. Notice to Proceed (pages {\_\_\_\_} to {\_\_\_\_}, inclusive);
  - b. Erosion Control Certification (pages {\_\_\_\_} to {\_\_\_\_}, inclusive);



- c. Work Change Directives (not attached to this Agreement);
- d. Change Order(s) (not attached to this Agreement);
- e. Warranty Bond, if any.

B. The Contract Documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above).

C. There are no Contract Documents other than those listed above in this Article 9.

D. The Contract Documents may only be amended, modified, or supplemented as provided in Paragraph 11.01 of the General Conditions.

## Article 10. MISCELLANEOUS

### 10.01 Severability

A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon OWNER and CONTRACTOR, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

### 10.02 Integration

A. The parties' entire agreement is contained in the Contract Documents, and the provisions of the Contract Documents supersede all prior discussions or writings between the parties.

IN WITNESS WHEREOF, OWNER and CONTRACTOR have signed this Agreement in duplicate. One counterpart each has been delivered to OWNER and CONTRACTOR. All portions of the Contract Documents have been signed or identified by OWNER and CONTRACTOR or identified by ENGINEER on their behalf.

This Agreement will be effective on \_\_\_\_\_, \_\_\_\_\_ (which is the Effective Date of the Contract).

OWNER \_\_\_\_\_  
\_\_\_\_\_  
Signature and Title

ATTEST:

By: \_\_\_\_\_  
Signature and Title

Address for Giving Notices:

Name: \_\_\_\_\_  
Street: \_\_\_\_\_  
City, State, Zip Code: \_\_\_\_\_  
Phone: \_\_\_\_\_  
Facsimile: \_\_\_\_\_  
E-mail: \_\_\_\_\_  
Designated Representative: \_\_\_\_\_

CONTRACTOR \_\_\_\_\_

\_\_\_\_\_  
Signature and Title

ATTEST:

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

\_\_\_\_\_  
Signature and Title

Address for Giving Notices:

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

Street: \_\_\_\_\_

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

Phone: \_\_\_\_\_

Facsimile: \_\_\_\_\_

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

Designated Representative: \_\_\_\_\_

License No.: \_\_\_\_\_

(Where applicable)

(If CONTRACTOR is a corporation, limited liability company, or a partnership, attach evidence of authority to sign.)

Approved as to form:

\_\_\_\_\_  
OWNER's Attorney

\_\_\_\_\_  
Date

Provision has been made to pay the liability that will accrue under this Agreement:

Countersigned:

\_\_\_\_\_  
OWNER's Comptroller or Treasurer

\_\_\_\_\_  
Date

## INSTRUCTIONS FOR EXECUTING CONTRACT

The full name and business address of CONTRACTOR should be inserted and the Agreement should be signed with CONTRACTOR's official signature. Please have the name of the signing party printed under all signatures to the Agreement.

If CONTRACTOR is operating as a partnership, each partner should sign the Agreement. If the Agreement is not signed by each partner, there should be attached to the Agreement a duly authenticated power of attorney evidencing the signer's (signers') authority to sign such Agreement for and on behalf of the partnership.

If CONTRACTOR is an individual, the trade name (if CONTRACTOR is operating under a trade name) should be indicated in the Agreement and the Agreement should be signed by such individual. If signed by other than CONTRACTOR, there should be attached to the Agreement a duly authenticated power of attorney evidencing the signer's authority to execute such Agreement for and on behalf of CONTRACTOR.

If CONTRACTOR is operating as a limited liability company, and it is member-managed, each member should sign the Agreement, or an authorized member should sign. If the LLC is manager-managed, an authorized manager should sign. If the Agreement is not signed by each member, there should be attached to the Agreement a duly authenticated power of attorney evidencing the signer's (signers') authority to sign such Agreement for and on behalf of the LLC.

If CONTRACTOR is a corporation, the Secretary of the corporation should sign the certificate below. If the Agreement itself is signed by the Secretary of the corporation, the certificate below should be executed by some other officer of the corporation. In lieu of the following certificate, there may be attached to the Agreement copies of so much of the records of the corporation which will show the official character and authority of the officers signing, duly certified by the Secretary or Assistant Secretary to be true copies.

I, \_\_\_\_\_, certify that I am the \_\_\_\_\_  
(Print Name) (Title of Individual Signing this Certificate)

of the corporation named as CONTRACTOR herein above; that \_\_\_\_\_  
(Print Name of Officer Signing Agreement)

who signed the foregoing Agreement on behalf of CONTRACTOR was then

\_\_\_\_\_ of said corporation; that said Agreement was duly signed  
(Title of Officer Signing Agreement)

for and on behalf of said Corporation by authority of its governing body, and is within the scope of its corporate powers.

\_\_\_\_\_  
(Individual Signature)

END OF SECTION

SECTION 00 55 00  
NOTICE TO PROCEED

---

Dated: \_\_\_\_\_

TO: \_\_\_\_\_  
(CONTRACTOR)

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

PROJECT: \_\_\_\_\_

OWNER'S CONTRACT NO.: \_\_\_\_\_

CONTRACT FOR: \_\_\_\_\_  
\_\_\_\_\_

(Insert name of Contract as it appears in the Bidding Documents)

You are notified that the Contract Time under the above Contract will commence to run on \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_. On that date, you are to start performing your obligations under the Contract Documents.

Before you may start any work at the site, Paragraph 2.01.B of the General Conditions provides that you must deliver to OWNER (with copies to ENGINEER and other identified additional insureds) certificates of insurance, copies of endorsements, and other evidence of insurance which you are required to purchase and maintain in accordance with the Contract Documents.

Also before you may start any work at the site, you must \_\_\_\_\_

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

(Add Other Requirements)

\_\_\_\_\_  
(OWNER)

By: \_\_\_\_\_  
(Authorized Signature)

\_\_\_\_\_  
(Title)

END OF SECTION

SECTION 00 55 10

EROSION CONTROL CERTIFICATION

---

Dated: \_\_\_\_\_

TO: \_\_\_\_\_  
(OWNER)

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

PROJECT: \_\_\_\_\_

OWNER'S CONTRACT NO.: \_\_\_\_\_

CONTRACT FOR: \_\_\_\_\_  
\_\_\_\_\_  
(Insert name of Contract as it appears in the Bidding Documents)

I certify under penalty of law that I understand the terms and conditions of the General National Pollutant Discharge Elimination System (NPDES) Permit that authorizes the stormwater discharges associated with industrial activities from the construction site and as may be detailed in the Contract Documents.

I agree to indemnify and hold OWNER harmless from any claims, demands, suits, causes of action, settlements, fines, or judgments and the costs of litigation, including, but not limited to, reasonable attorneys fees and costs of investigation and arising from a condition, obligation, or requirement assumed or to be performed by CONTRACTOR for storm water pollution and erosion control.

Fines and other costs incurred against OWNER for CONTRACTOR's failure to provide the required erosion control practices will be paid by CONTRACTOR.

\_\_\_\_\_  
(CONTRACTOR)

By: \_\_\_\_\_  
(Authorized Signature)

\_\_\_\_\_  
(Title)

END OF SECTION





1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.
2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond will arise after:
  - 3.1. The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice may indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 will be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement does not waive the Owner's right, if any, subsequently to declare a Contractor Default;
  - 3.2. The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and
  - 3.3. The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.
4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 does not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.
5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:
  - 5.1. Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;
  - 5.2. Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;
  - 5.3. Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

- 5.4. Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:
- 5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or
  - 5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.
6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment, or the Surety has denied liability, in whole or in part, without further notice, the Owner shall be entitled to enforce any remedy available to the Owner.
7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner will not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety will not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:
- 7.1. the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;
  - 7.2. additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and
  - 7.3. liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.
8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.
9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price will not be reduced or set off on account of any such unrelated obligations. No right of action will accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.
10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.
11. Any proceeding, legal or equitable, under this Bond must be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and must be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit will be applicable.

12. Notice to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears.
13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted therefrom and provisions conforming to such statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.
14. Definitions
  - 14.1. *Balance of the Contract Price*—The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.
  - 14.2. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.
  - 14.3. *Contractor Default*—Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.
  - 14.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
  - 14.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.
15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.
16. ~~Modifications to this Bond are as follows: [Describe modification]~~

## PAYMENT BOND

|                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Contractor</b><br>Name: [Full formal name of Contractor]<br>Address ( <i>principal place of business</i> ):<br>[Address of Contractor's principal place of business]                                                                                  | <b>Surety</b><br>Name: [Full formal name of Surety]<br>Address ( <i>principal place of business</i> ):<br>[Address of Surety's principal place of business]                                                                      |
| <b>Owner</b><br>Name: [Full formal name of Owner]<br>Mailing address ( <i>principal place of business</i> ):<br>[Address of Owner's principal place of business]                                                                                         | <b>Contract</b><br>Description ( <i>name and location</i> ):<br>[Owner's project/contract name, and location of the project]<br><br>Contract Price: [Amount, from Contract]<br>Effective Date of Contract: [Date, from Contract] |
| <b>Bond</b><br>Bond Amount: [Amount]<br>Date of Bond: [Date]<br>( <i>Date of Bond cannot be earlier than Effective Date of Contract</i> )<br>Modifications to this Bond form:<br><input type="checkbox"/> None <input type="checkbox"/> See Paragraph 18 |                                                                                                                                                                                                                                  |
| Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Payment Bond, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.                                |                                                                                                                                                                                                                                  |
| Contractor as Principal                                                                                                                                                                                                                                  | Surety                                                                                                                                                                                                                           |
| By: _____<br>( <i>Full formal name of Contractor</i> )<br>_____<br>( <i>Signature</i> )                                                                                                                                                                  | By: _____<br>( <i>Full formal name of Surety</i> ) ( <i>corporate seal</i> )<br>_____<br>( <i>Signature</i> )( <i>Attach Power of Attorney</i> )                                                                                 |
| Name: _____<br>( <i>Printed or typed</i> )                                                                                                                                                                                                               | Name: _____<br>( <i>Printed or typed</i> )                                                                                                                                                                                       |
| Title: _____                                                                                                                                                                                                                                             | Title: _____                                                                                                                                                                                                                     |
| Attest: _____<br>( <i>Signature</i> )                                                                                                                                                                                                                    | Attest: _____<br>( <i>Signature</i> )                                                                                                                                                                                            |
| Name: _____<br>( <i>Printed or typed</i> )                                                                                                                                                                                                               | Name: _____<br>( <i>Printed or typed</i> )                                                                                                                                                                                       |
| Title: _____                                                                                                                                                                                                                                             | Title: _____                                                                                                                                                                                                                     |
| <i>Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.</i>                                      |                                                                                                                                                                                                                                  |

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.
2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond will arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.
4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.
5. The Surety's obligations to a Claimant under this Bond will arise after the following:
  - 5.1. Claimants who do not have a direct contract with the Contractor
    - 5.1.1. have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
    - 5.1.2. have sent a Claim to the Surety (at the address described in Paragraph 13).
  - 5.2. Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).
6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.
7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:
  - 7.1. Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and
  - 7.2. Pay or arrange for payment of any undisputed amounts.

- 7.3. The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 will not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.
8. The Surety's total obligation will not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond will be credited for any payments made in good faith by the Surety.
  9. Amounts owed by the Owner to the Contractor under the Construction Contract will be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfying obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.
  10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.
  11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.
  12. No suit or action will be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit will be applicable.
  13. Notice and Claims to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, will be sufficient compliance as of the date received.
  14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted here from and provisions conforming to such statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.
  15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

## 16. Definitions

16.1. *Claim*—A written statement by the Claimant including at a minimum:

16.1.1. The name of the Claimant;

16.1.2. The name of the person for whom the labor was done, or materials or equipment furnished;

16.1.3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;

16.1.4. A brief description of the labor, materials, or equipment furnished;

16.1.5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;

16.1.6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;

16.1.7. The total amount of previous payments received by the Claimant; and

16.1.8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

16.2. *Claimant*—An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond is to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

16.3. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

16.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

16.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.

17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.

~~18. Modifications to this Bond are as follows: [Describe modification]~~

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



Endorsed By





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# STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

## ARTICLE 1—DEFINITIONS AND TERMINOLOGY

### 1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. 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, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.
  3. *Application for Payment*—The document prepared by Contractor, in a form acceptable to Engineer, to request progress or final payments, and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
  4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
  5. *Bidder*—An individual or entity that submits a Bid to Owner.
  6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.
  7. *Bidding Requirements*—The Advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.
  8. *Change Order*—A document 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, or other revision to the Contract, issued on or after the Effective Date of the Contract.
  9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.
  10. *Claim*
    - a. A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment of Contract Price or Contract Times; contesting an initial decision by Engineer concerning the

requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract.

- b. A demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal, or seeking resolution of a contractual issue that Engineer has declined to address.
  - c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, made pursuant to Paragraph 12.01.A.4, concerning disputes arising after Engineer has issued a recommendation of final payment.
  - d. A demand for money or services by a third party is not a Claim.
- 11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
  - 12. *Contract*—The entire and integrated written contract between Owner and Contractor concerning the Work.
  - 13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.
  - 14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents.
  - 15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.
  - 16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.
  - 17. *Cost of the Work*—See Paragraph 13.01 for definition.
  - 18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.
  - 19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.
  - 20. *Electronic Document*—Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.
  - 21. *Electronic Means*—Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow: (a) the transmission or communication of Electronic Documents; (b) the documentation of transmissions, including sending and receipt; (c) printing of the transmitted Electronic Document by the



recipient; (d) the storage and archiving of the Electronic Document by sender and recipient; and (e) the use by recipient of the Electronic Document for purposes permitted by this Contract. Electronic Means does not include the use of text messaging, or of Facebook, Twitter, Instagram, or similar social media services for transmission of Electronic Documents.

22. *Engineer*—The individual or entity named as such in the Agreement.
23. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.
24. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto.
  - a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.
  - b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.
  - c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.
25. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and binding decrees, resolutions, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
26. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
27. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date, or by a time prior to Substantial Completion of all the Work.
28. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.
29. *Notice to Proceed*—A written notice 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.
30. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.
31. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising Contractor's plan to accomplish the Work within the Contract Times.
32. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

33. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative (RPR) includes any assistants or field staff of Resident Project Representative.
34. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
35. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals.
36. *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.
37. *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.
38. *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, and such other lands or areas furnished by Owner which are designated for the use of Contractor.
39. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
40. *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.
41. *Submittal*—A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers' instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.
42. *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 of such Work.

43. *Successful Bidder*—The Bidder to which the Owner makes an award of contract.
44. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
45. *Supplier*—A manufacturer, fabricator, supplier, distributor, 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 a Subcontractor.
46. *Technical Data*
- a. Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (1) existing subsurface conditions at or adjacent to the Site, or existing physical conditions at or adjacent to the Site including existing surface or subsurface structures (except Underground Facilities) or (2) Hazardous Environmental Conditions at the Site.
  - b. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then Technical Data is defined, with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06, as the data contained in boring logs, recorded measurements of subsurface water levels, assessments of the condition of subsurface facilities, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical, environmental, or other Site or facilities conditions report prepared for the Project and made available to Contractor.
  - c. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data, and instead Underground Facilities are shown or indicated on the Drawings.
47. *Underground Facilities*—All active or not-in-service underground lines, pipelines, conduits, ducts, encasements, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or systems at the Site, including but not limited to those facilities or systems that produce, transmit, distribute, or convey telephone or other communications, cable television, fiber optic transmissions, power, electricity, light, heat, gases, oil, crude oil products, liquid petroleum products, water, steam, waste, wastewater, storm water, other liquids or chemicals, or traffic or other control systems. An abandoned facility or system is not an Underground Facility.
48. *Unit Price Work*—Work to be paid for on the basis of unit prices.
49. *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; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.
50. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

## 1.02 Terminology

- A. The words and terms discussed in Paragraphs 1.02.B, C, D, and E are not defined terms that require initial capital letters, but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. *Intent of Certain Terms or Adjectives:* 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 Article 10 or any other provision of the Contract Documents.
- C. *Day:* The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. *Defective:* The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
  - 1. does not conform to the Contract Documents;
  - 2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
  - 3. 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 15.03 or Paragraph 15.04).
- E. *Furnish, Install, Perform, Provide*
  - 1. The word “furnish,” when used in connection with services, materials, or equipment, means 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, means 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, means to furnish and install said services, materials, or equipment complete and ready for intended use.
  - 4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words “furnish,” “install,” “perform,” or “provide,” then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

- F. *Contract Price or Contract Times*: References to a change in “Contract Price or Contract Times” or “Contract Times or Contract Price” or similar, indicate that such change applies to (1) Contract Price, (2) Contract Times, or (3) both Contract Price and Contract Times, as warranted, even if the term “or both” is not expressed.
- G. 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 Performance and Payment Bonds; Evidence of Insurance*

- A. *Performance and Payment Bonds*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner the performance bond and payment bond (if the Contract requires Contractor to furnish such bonds).
- B. *Evidence of Contractor’s Insurance*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each additional insured (as identified in the Contract), the certificates, endorsements, and other evidence of insurance required to be provided by Contractor in accordance with Article 6, except to the extent the Supplementary Conditions expressly establish other dates for delivery of specific insurance policies.
- C. *Evidence of Owner’s Insurance*: After receipt of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each additional insured (as identified in the Contract), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

### 2.02 *Copies of Documents*

- A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully signed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.
- B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

### 2.03 *Before Starting Construction*

- A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise required by the Contract Documents), 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;
  - 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.

2.04 *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 2.03.A, procedures for handling Shop Drawings, Samples, and other Submittals, processing Applications for Payment, electronic or digital transmittals, 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 and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *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 the schedules submitted in accordance with Paragraph 2.03.A. No progress payment will 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 the component parts of the Work.
  - 4. If a schedule is not acceptable, Contractor will have an additional 10 days to revise and resubmit the schedule.

2.06 *Electronic Transmittals*

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may send, and shall accept, Electronic Documents transmitted by Electronic Means.
- B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the Electronic Documents.

## ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

### 3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one Contract Document 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.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.
- F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.
- G. Nothing in the Contract Documents creates:
  - 1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or
  - 2. any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity, except as may otherwise be required by Laws and Regulations.

### 3.02 *Reference Standards*

- A. *Standards Specifications, Codes, Laws and Regulations*
  - 1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, means the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract 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, reference standard, or code, and no instruction of a Supplier, will be effective to change the duties or responsibilities of Owner, Contractor, or Engineer from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner or Engineer 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 part of the Contract Documents prepared by or for Engineer.

### 3.03 *Reporting and Resolving Discrepancies*

#### A. *Reporting Discrepancies*

1. *Contractor's Verification of Figures and Field Measurements:* Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.
2. *Contractor's Review of Contract Documents:* If, before or 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) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) 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 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.
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 part of the Contract Documents prepared by or for Engineer take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:
  - a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); 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 *Requirements of the Contract Documents*

- A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer in writing all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work.



- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.
- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly notify Owner and Contractor in writing that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

### 3.05 *Reuse of Documents*

- A. Contractor and its Subcontractors and Suppliers 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 versions, or 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; or
  - 2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein precludes Contractor from retaining copies of the Contract Documents for record purposes.

## **ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK**

### 4.01 *Commencement of Contract Times; Notice to Proceed*

- A. The Contract Times will commence to run on the 30th day after the Effective Date of the Contract 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 Contract. In no event will the Contract Times commence to run later than the 60th day after the day of Bid opening or the 30th day after the Effective Date of the Contract, whichever date is earlier.

### 4.02 *Starting the Work*

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work may be done at the Site prior to such date.

### 4.03 *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.

#### 4.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 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 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.
  - 2. Proposed adjustments in the Progress Schedule that will change the Contract Times must be submitted in accordance with the requirements of Article 11.
- B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work will be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

#### 4.05 *Delays in Contractor's Progress*

- A. If Owner, Engineer, 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 Contract Price or Contract Times.
- B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.
- C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Such an adjustment will be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:
  - 1. Severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
  - 2. Abnormal weather conditions;
  - 3. Acts or failures to act of third-party utility owners or other third-party entities (other than those third-party utility owners or other third-party entities performing other work at or adjacent to the Site as arranged by or under contract with Owner, as contemplated in Article 8); and
  - 4. Acts of war or terrorism.

- D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:
1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.
  2. Contractor shall not be entitled to an adjustment in Contract Price for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.
  3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 11.
- E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:
1. The circumstances that form the basis for the requested adjustment;
  2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;
  3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;
  4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and
  5. The impact on Contract Price, in accordance with the provisions of Paragraph 11.07.
- Contractor shall also furnish such additional supporting documentation as Owner or Engineer may require including, where appropriate, a revised progress schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work.
- F. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5, together with the provisions of Paragraphs 4.05.D and 4.05.E.
- G. Paragraph 8.03 addresses delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

## **ARTICLE 5—SITE; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS**

### **5.01 *Availability of Lands***

- A. Owner shall furnish the Site. Owner shall notify Contractor in writing 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.

- 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 permanent improvements are to be made 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.

## 5.02 *Use of Site and Other Areas*

### A. *Limitation on Use of Site and Other Areas*

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas, or to improvements, structures, utilities, or similar facilities located at such adjacent lands or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.
  2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.13, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or in a court of competent jurisdiction; and (c) to the fullest extent permitted by Laws and Regulations, 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 any such claim, and against all 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 directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.
- B. *Removal of Debris During Performance of the Work:* During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris will 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 and adjacent areas 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 of 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 structures or land to stresses or pressures that will endanger them.

### 5.03 *Subsurface and Physical Conditions*

- A. *Reports and Drawings:* The Supplementary Conditions identify:

1. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data;
2. Those drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data; and
3. Technical Data contained in such reports and drawings.

- B. *Underground Facilities:* Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05, and not in the drawings referred to in Paragraph 5.03.A. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

- C. *Reliance by Contractor on Technical Data:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b.

- D. *Limitations of Other Data and Documents:* Except for such reliance on 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;
  2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings;
  3. the contents of other Site-related documents made available to Contractor, such as record drawings from other projects at or adjacent to the Site, or Owner's archival documents concerning the Site; or
  4. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

#### 5.04 *Differing Subsurface or Physical Conditions*

- A. *Notice by Contractor:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site:
1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate;
  2. is of such a nature as to require a change in the Drawings or Specifications;
  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 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

- B. *Engineer's Review:* After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine whether it is necessary for Owner to obtain additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- C. *Owner's Statement to Contractor Regarding Site Condition:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.
- D. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the subsurface or physical condition in question may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the condition in question has been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- E. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, 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 fall within any one or more of the categories described in Paragraph 5.04.A;
  - 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 Paragraph 13.03; and,
  - c. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
    - a. Contractor knew of the existence of such condition at the time Contractor made a 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 otherwise;
    - b. The existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
    - c. Contractor failed to give the written notice required by Paragraph 5.04.A.
  3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.
  4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.
- F. *Underground Facilities; Hazardous Environmental Conditions:* Paragraph 5.05 governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.06 governs rights and responsibilities regarding Hazardous Environmental Conditions. The provisions of Paragraphs 5.03 and 5.04 are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

#### 5.05 *Underground Facilities*

- A. *Contractor's Responsibilities:* Unless it is otherwise expressly provided in the Supplementary Conditions, the cost of all of the following are included in the Contract Price, and Contractor shall have full responsibility for:
1. reviewing and checking all information and data regarding existing Underground Facilities at the Site;
  2. complying with applicable state and local utility damage prevention Laws and Regulations;

3. verifying the actual location of those Underground Facilities shown or indicated in the Contract Documents as being within the area affected by the Work, by exposing such Underground Facilities during the course of construction;
  4. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
  5. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.
- B. *Notice by Contractor:* If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated on the Drawings, or was not shown or indicated on the Drawings with reasonable accuracy, then 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 7.15), notify Owner and Engineer in writing regarding such Underground Facility.
- C. *Engineer's Review:* Engineer will:
1. promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy;
  2. identify and communicate with the owner of the Underground Facility; prepare recommendations to Owner (and if necessary issue any preliminary instructions to Contractor) regarding the Contractor's resumption of Work in connection with the Underground Facility in question;
  3. obtain any pertinent cost or schedule information from Contractor; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and
  4. advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
- D. *Owner's Statement to Contractor Regarding Underground Facility:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.
- E. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the Underground Facility may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the Underground Facility in question and conditions affected by its presence have been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- F. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, to the extent that any existing Underground Facility at the Site that was not shown



or indicated on the Drawings, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

- a. 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 Paragraph 13.03;
  - b. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E; and
  - c. Contractor gave the notice required in Paragraph 5.05.B.
2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.
  3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.
  4. The information and data shown or indicated on the Drawings with respect to existing Underground Facilities at the Site is based on information and data (a) furnished by the owners of such Underground Facilities, or by others, (b) obtained from available records, or (c) gathered in an investigation conducted in accordance with the current edition of ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, by the American Society of Civil Engineers. If such information or data is incorrect or incomplete, Contractor's remedies are limited to those set forth in this Paragraph 5.05.F.

#### 5.06 *Hazardous Environmental Conditions at Site*

A. *Reports and Drawings:* The Supplementary Conditions identify:

1. those reports known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site;
2. drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
3. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b. Except for such reliance on 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;
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 removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.
- D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.
- E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) 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 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.
- F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.
- G. 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, as a result of such Work stoppage, such special conditions under which Work is agreed to be resumed by Contractor, or any costs or expenses incurred in response to the Hazardous Environmental Condition, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off. Entitlement to any such adjustment is subject to the provisions of Paragraphs 4.05.D, 4.05.E, 11.07, and 11.08.
- H. 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, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

- I. 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, arbitration, or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I obligates Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- J. 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 failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J obligates Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

## **ARTICLE 6—BONDS AND INSURANCE**

### **6.01 *Performance, Payment, and Other Bonds***

- A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of Contractor's obligations under the Contract. These bonds must remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the terms of a prescribed bond form, the Supplementary Conditions, or other provisions of the Contract.
- B. Contractor shall also furnish such other bonds (if any) as are required by the Supplementary Conditions or other provisions of the Contract.
- C. All bonds must be in the form included in the Bidding Documents or otherwise specified by Owner prior to execution of the Contract, except as provided otherwise by Laws or

Regulations, and must be issued and signed by a surety named in “Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies” as published in Department Circular 570 (as amended and supplemented) by the Bureau of the Fiscal Service, U.S. Department of the Treasury. A bond 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 must show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

- D. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue bonds in the required amounts.
- E. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer in writing and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which must comply with the bond and surety requirements above.
- F. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner’s termination rights under Article 16.
- G. Upon request to Owner from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Owner shall provide a copy of the payment bond to such person or entity.
- H. Upon request to Contractor from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Contractor shall provide a copy of the payment bond to such person or entity.

#### 6.02 *Insurance—General Provisions*

- A. Owner and Contractor shall obtain and maintain insurance as required in this article and in the Supplementary Conditions.
- B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized in the state or jurisdiction in which the Project is located to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.
- C. Alternative forms of insurance coverage, including but not limited to self-insurance and “Occupational Accident and Excess Employer’s Indemnity Policies,” are not sufficient to meet the insurance requirements of this Contract, unless expressly allowed in the Supplementary Conditions.
- D. Contractor shall deliver to Owner, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Contractor has obtained and is maintaining the policies and coverages required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, full disclosure of all relevant exclusions, and evidence of insurance required to be purchased and maintained by

Subcontractors or Suppliers. In any documentation furnished under this provision, Contractor, Subcontractors, and Suppliers may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those applicable to this Contract.

- E. Owner shall deliver to Contractor, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Owner has obtained and is maintaining the policies and coverages required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, and full disclosure of all relevant exclusions. In any documentation furnished under this provision, Owner may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those relevant to this Contract.
- F. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, will not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.
- G. In addition to the liability insurance required to be provided by Contractor, the Owner, at Owner's option, may purchase and maintain Owner's own liability insurance. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.
- H. Contractor shall require:
  - 1. Subcontractors to purchase and maintain worker's compensation, commercial general liability, and other insurance that is appropriate for their participation in the Project, and to name as additional insureds Owner and Engineer (and any other individuals or entities identified in the Supplementary Conditions as additional insureds on Contractor's liability policies) on each Subcontractor's commercial general liability insurance policy; and
  - 2. Suppliers to purchase and maintain insurance that is appropriate for their participation in the Project.
- I. If either party does not purchase or maintain the insurance required of such party by the Contract, 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.
- J. If Contractor has failed to obtain and maintain required insurance, Contractor's entitlement to enter or remain at the Site will end immediately, and Owner may impose an appropriate set-off against payment for any associated costs (including but not limited to the cost of purchasing necessary insurance coverage), and exercise Owner's termination rights under Article 16.
- K. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect (but is in no way obligated) to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price will be adjusted accordingly.

- L. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests. Contractor is responsible for determining whether such coverage and limits are adequate to protect its interests, and for obtaining and maintaining any additional insurance that Contractor deems necessary.
- M. The insurance and insurance limits required herein will not be deemed as a limitation on Contractor's liability, or that of its Subcontractors or Suppliers, under the indemnities granted to Owner and other individuals and entities in the Contract or otherwise.
- N. All the policies of insurance required to be purchased and maintained under this Contract will contain a provision or endorsement that the coverage afforded will not be canceled, or renewal refused, until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured and Engineer.

6.03 *Contractor's Insurance*

- A. *Required Insurance:* Contractor shall purchase and maintain Worker's Compensation, Commercial General Liability, and other insurance pursuant to the specific requirements of the Supplementary Conditions.
- B. *General Provisions:* The policies of insurance required by this Paragraph 6.03 as supplemented must:
  - 1. include at least the specific coverages required;
  - 2. be written for not less than the limits provided, or those required by Laws or Regulations, whichever is greater;
  - 3. remain in effect at least until the Work is complete (as set forth in Paragraph 15.06.D), and longer if expressly required elsewhere in this Contract, and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract;
  - 4. apply with respect to the performance of the Work, whether such performance is 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; and
  - 5. include all necessary endorsements to support the stated requirements.
- C. *Additional Insureds:* The Contractor's commercial general liability, automobile liability, employer's liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies, if required by this Contract, must:
  - 1. include and list as additional insureds Owner and Engineer, and any individuals or entities identified as additional insureds in the Supplementary Conditions;
  - 2. include coverage for the respective officers, directors, members, partners, employees, and consultants of all such additional insureds;
  - 3. afford primary coverage to these additional insureds for all claims covered thereby (including as applicable those arising from both ongoing and completed operations);

4. not seek contribution from insurance maintained by the additional insured; and
5. as to commercial general liability insurance, apply to additional insureds with respect to liability caused in whole or in part by Contractor's acts or omissions, or the acts and omissions of those working on Contractor's behalf, in the performance of Contractor's operations.

6.04 *Builder's Risk and Other Property Insurance*

- A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the Work's full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). The specific requirements applicable to the builder's risk insurance are set forth in the Supplementary Conditions.
- B. *Property Insurance for Facilities of Owner Where Work Will Occur*: Owner is responsible for obtaining and maintaining property insurance covering each existing structure, building, or facility in which any part of the Work will occur, or to which any part of the Work will attach or be adjoined. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, providing coverage consistent with that required for the builder's risk insurance, and will be maintained until the Work is complete, as set forth in Paragraph 15.06.D.
- C. *Property Insurance for Substantially Complete Facilities*: Promptly after Substantial Completion, and before actual occupancy or use of the substantially completed Work, Owner will obtain property insurance for such substantially completed Work, and maintain such property insurance at least until the Work is complete, as set forth in Paragraph 15.06.D. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, and provide coverage consistent with that required for the builder's risk insurance. The builder's risk insurance may terminate upon written confirmation of Owner's procurement of such property insurance.
- D. *Partial Occupancy or Use by Owner*: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide advance notice of such occupancy or use to the builder's risk insurer, and obtain an endorsement consenting to the continuation of coverage prior to commencing such partial occupancy or use.
- E. *Insurance of Other Property; Additional Insurance*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, then the entity or individual owning such property item will be responsible for insuring it. If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.04, it may do so at Contractor's expense.

6.05 *Property Losses; Subrogation*

- A. The builder's risk insurance policy purchased and maintained in accordance with Paragraph 6.04 (or an installation floater policy if authorized by the Supplementary Conditions), will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against

Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors.

1. Owner and Contractor waive all rights against each other and the 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, risks, 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 Engineer, its consultants, all individuals or entities identified in the Supplementary Conditions as builder's risk or installation floater insureds, 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.
  2. None of the above waivers extends to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.
- B. Any property insurance policy maintained by Owner covering any loss, damage, or consequential loss to Owner's existing structures, buildings, or facilities in which any part of the Work will occur, or to which any part of the Work will attach or adjoin; to adjacent structures, buildings, or facilities of Owner; or to part or all of the completed or substantially completed Work, during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06, will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them, and that the insured is allowed to waive the insurer's rights of subrogation in a written contract executed prior to the loss, damage, or consequential loss.
1. 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 all losses and damages caused by, arising out of, or resulting from fire or any of the perils, risks, or causes of loss covered by such policies.
- C. The waivers in this Paragraph 6.05 include the waiver of rights 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 insured peril, risk, or cause of loss.
- D. Contractor shall be responsible for assuring that each Subcontract contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, 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 fire or other peril, risk, or cause of loss covered by builder's risk insurance, installation floater, and any other property insurance applicable to the Work.



6.06 *Receipt and Application of Property Insurance Proceeds*

- A. Any insured loss under the builder's risk and other policies of property insurance required by Paragraph 6.04 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.
- B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.04 shall maintain such proceeds in a segregated account, and distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.
- C. If no other special agreement is reached, Contractor shall repair or replace the damaged Work, using allocated insurance proceeds.

**ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES**

7.01 *Contractor's Means and Methods of Construction*

- A. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.
- B. If the Contract Documents note, or Contractor determines, that professional engineering or other design services are needed to carry out Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures, or for Site safety, then Contractor shall cause such services to be provided by a properly licensed design professional, at Contractor's expense. Such services are not Owner-delegated professional design services under this Contract, and neither Owner nor Engineer has any responsibility with respect to (1) Contractor's determination of the need for such services, (2) the qualifications or licensing of the design professionals retained or employed by Contractor, (3) the performance of such services, or (4) any errors, omissions, or defects in such services.

7.02 *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.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who will not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.03 *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 maintain good discipline and order at the Site.

- B. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of Contractor's employees; of Suppliers and Subcontractors, and their employees; and of any other individuals or entities performing or furnishing any of the Work, just as Contractor is responsible for Contractor's own acts and omissions.
- C. 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 will be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

#### 7.04 *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, whether or not such items are specifically called for in the Contract Documents.
- B. All materials and equipment incorporated into the Work must be new and of good quality, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications will 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 must 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.

#### 7.05 *"Or Equals"*

- A. *Contractor's Request; Governing Criteria:* Whenever an item of equipment or material is specified or described in the Contract Documents by using the names of one or more proprietary items or specific Suppliers, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item 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 is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material, or items from other proposed Suppliers, under the circumstances described below.
  - 1. If Engineer in its sole discretion determines that an item of equipment or material proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer will deem it an "or equal" item. For the purposes of this paragraph, a proposed item of equipment or material will be considered functionally equal to an item so named if:
    - a. in the exercise of reasonable judgment Engineer determines that the proposed item:
      - 1) is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

- 2) 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;
  - 3) has a proven record of performance and availability of responsive service; and
  - 4) is not objectionable to Owner.
- b. Contractor certifies that, if the proposed item is approved and incorporated into the Work:
- 1) there will be no increase in cost to the Owner or increase in Contract Times; and
  - 2) the item will conform substantially to the detailed requirements of the item named in the Contract Documents.
- B. *Contractor's Expense*: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.
- C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal," which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.
- D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request will result in any change in Contract Price. The Engineer's denial of an "or-equal" request will be final and binding, and may not be reversed through an appeal under any provision of the Contract.
- E. *Treatment as a Substitution Request*: If Engineer determines that an item of equipment or material proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the item a proposed substitute pursuant to Paragraph 7.06.

#### 7.06 Substitutes

- A. *Contractor's Request; Governing Criteria*: Unless the specification or description of an item of equipment or material required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material under the circumstances described below. To the extent possible such requests must be made before commencement of related construction at the Site.
1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of equipment or material from anyone other than Contractor.
  2. The requirements for review by Engineer will be as set forth in Paragraph 7.06.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.

3. Contractor shall make written application to Engineer for review of a proposed substitute item of equipment or material that Contractor seeks to furnish or use. The application:
  - a. will certify that the proposed substitute item will:
    - 1) perform adequately the functions and achieve the results called for by the general design;
    - 2) be similar in substance to the item specified; and
    - 3) be suited to the same use as the item specified.
  - b. will state:
    - 1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times;
    - 2) 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
    - 3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.
  - c. will identify:
    - 1) all variations of the proposed substitute item from the item specified; and
    - 2) available engineering, sales, maintenance, repair, and replacement services.
  - d. will contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.
- B. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.
- C. *Special Guarantee*: Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- D. *Reimbursement of Engineer's Cost*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. 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.

- E. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.
- F. *Effect of Engineer's Determination*: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request will be final and binding, and may not be reversed through an appeal under any provision of the Contract. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.06.D, by timely submittal of a Change Proposal.

7.07 *Concerning Subcontractors and Suppliers*

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner. The Contractor's retention of a Subcontractor or Supplier for the performance of parts of the Work will not relieve Contractor's obligation to Owner to perform and complete the Work in accordance with the Contract Documents.
- B. Contractor shall retain specific Subcontractors and Suppliers for the performance of designated parts of the Work if required by the Contract to do so.
- C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor or Supplier to furnish or perform any of the Work against which Contractor has reasonable objection.
- D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within 5 days.
- E. Owner may require the replacement of any Subcontractor or Supplier. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors or Suppliers for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor or Supplier so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor or Supplier.
- F. If Owner requires the replacement of any Subcontractor or Supplier retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.
- G. No acceptance by Owner of any such Subcontractor or Supplier, whether initially or as a replacement, will constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.

- H. On a monthly basis, Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.
- I. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors and Suppliers.
- J. The divisions and sections of the Specifications and the identifications of any Drawings do not control Contractor in dividing the Work among Subcontractors or Suppliers, or in delineating the Work to be performed by any specific trade.
- K. All Work performed for Contractor by a Subcontractor or Supplier must be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract for the benefit of Owner and Engineer.
- L. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor for Work performed for Contractor by the Subcontractor or Supplier.
- M. Contractor shall restrict all Subcontractors and Suppliers from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed in this Contract.

7.08 *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 an 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 will be disclosed 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.

#### 7.09 *Permits*

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits, licenses, and certificates of occupancy. Owner shall assist Contractor, when 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 the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

#### 7.10 *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.

#### 7.11 *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. Neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and 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 such Work or other action. It is not Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this does not relieve Contractor of its obligations under Paragraph 3.03.
- C. Owner or Contractor may give written notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such written notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

#### 7.12 *Record Documents*

- A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

### 7.13 *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.
- B. Contractor shall designate a qualified and experienced safety representative whose duties and responsibilities are the prevention of Work-related accidents and the maintenance and supervision of safety precautions and programs.
- C. 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, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- D. All damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.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 at its expense (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).
- E. 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.
- F. Contractor shall notify Owner; the owners of adjacent property; the owners of Underground Facilities and other utilities (if the identity of such owners is known to Contractor); and other contractors and utility owners performing work at or adjacent to the Site, in writing, when Contractor knows that prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.
- G. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.
- H. 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.



- I. Contractor's duties and responsibilities for safety and protection will continue until all the Work is completed, Engineer has issued a written notice to Owner and Contractor in accordance with Paragraph 15.06.C that the Work is acceptable, and Contractor has left the Site (except as otherwise expressly provided in connection with Substantial Completion).
- J. Contractor's duties and responsibilities for safety and protection will resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.14 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of safety data sheets (formerly known as 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.

7.15 *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 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 by an emergency, or are required as a result of Contractor's response to an emergency. If Engineer determines that a change in the Contract Documents is required because of an emergency or Contractor's response, a Work Change Directive or Change Order will be issued.

7.16 *Submittals*

A. *Shop Drawing and Sample Requirements*

- 1. Before submitting a Shop Drawing or Sample, Contractor shall:
  - a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
  - b. determine and verify:
    - 1) all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal;
    - 2) the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
    - 3) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto;
  - c. confirm that the Submittal is complete with respect to all related data included in the Submittal.
- 2. Each Shop Drawing or Sample must bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that Submittal, and that Contractor approves the Submittal.

3. With each Shop Drawing or Sample, Contractor shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Contract Documents. This notice must be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.
- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.
1. *Shop Drawings*
    - a. Contractor shall submit the number of copies required in the Specifications.
    - b. Data shown on the Shop Drawings must 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 7.16.C.
  2. *Samples*
    - a. Contractor shall submit the number of Samples required in the Specifications.
    - b. Contractor shall 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 7.16.C.
  3. 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. *Engineer's Review of Shop Drawings and Samples*
1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. 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, comply with the requirements of 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, or to safety precautions or programs incident thereto.
  3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
  4. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.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 will

document any such approved variation from the requirements of the Contract Documents in a Field Order or other appropriate Contract modification.

5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for complying with the requirements of Paragraphs 7.16.A and B.
6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, will not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
7. Neither Engineer's receipt, review, acceptance, or approval of a Shop Drawing or Sample will result in such item becoming a Contract Document.
8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.C.4.

*D. Resubmittal Procedures for Shop Drawings and Samples*

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.
2. Contractor shall furnish required Shop Drawing and Sample submittals with sufficient information and accuracy to obtain required approval of an item with no more than two resubmittals. Engineer will record Engineer's time for reviewing a third or subsequent resubmittal of a Shop Drawing or Sample, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges.
3. If Contractor requests a change of a previously approved Shop Drawing or Sample, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

*E. Submittals Other than Shop Drawings, Samples, and Owner-Delegated Designs*

1. The following provisions apply to all Submittals other than Shop Drawings, Samples, and Owner-delegated designs:
  - a. Contractor shall submit all such Submittals to the Engineer in accordance with the Schedule of Submittals and pursuant to the applicable terms of the Contract Documents.
  - b. Engineer will provide timely review of all such Submittals in accordance with the Schedule of Submittals and return such Submittals with a notation of either Accepted or Not Accepted. Any such Submittal that is not returned within the time established in the Schedule of Submittals will be deemed accepted.
  - c. Engineer's review will be only to determine if the Submittal is acceptable under the requirements of the Contract Documents as to general form and content of the Submittal.

- d. If any such Submittal is not accepted, Contractor shall confer with Engineer regarding the reason for the non-acceptance, and resubmit an acceptable document.
- 2. Procedures for the submittal and acceptance of the Progress Schedule, the Schedule of Submittals, and the Schedule of Values are set forth in Paragraphs 2.03, 2.04, and 2.05.
- F. Owner-delegated Designs: Submittals pursuant to Owner-delegated designs are governed by the provisions of Paragraph 7.19.

**7.17 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 is entitled to rely on Contractor's warranty and guarantee.
- B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.08. The time in which Owner may enforce its warranty and guarantee rights under this Paragraph 7.17 is limited only by applicable Laws and Regulations restricting actions to enforce such rights; provided, however, that after the end of the correction period under Paragraph 15.08:
  - 1. Owner shall give Contractor written notice of any defective Work within 60 days of the discovery that such Work is defective; and
  - 2. Such notice will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the notice.
- C. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
  - 1. abuse, or improper modification, 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.
- D. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents, a release of Contractor's obligation to perform the Work in accordance with the Contract Documents, or a release of Owner's warranty and guarantee rights under this Paragraph 7.17:
  - 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;
  - 6. The issuance of a notice of acceptability by Engineer;
  - 7. The end of the correction period established in Paragraph 15.08;
  - 8. Any inspection, test, or approval by others; or

9. Any correction of defective Work by Owner.
- E. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract will govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

#### 7.18 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, 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 losses, damages, costs, and judgments (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 from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage 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 7.18.A will 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.

#### 7.19 *Delegation of Professional Design Services*

- A. Owner may require Contractor to provide professional design services for a portion of the Work by express delegation in the Contract Documents. Such delegation will specify the performance and design criteria that such services must satisfy, and the Submittals that Contractor must furnish to Engineer with respect to the Owner-delegated design.
- B. Contractor shall cause such Owner-delegated professional design services to be provided pursuant to the professional standard of care by a properly licensed design professional, whose signature and seal must appear on all drawings, calculations, specifications, certifications, and Submittals prepared by such design professional. Such design professional must issue all certifications of design required by Laws and Regulations.
- C. If a Shop Drawing or other Submittal related to the Owner-delegated design is prepared by Contractor, a Subcontractor, or others for submittal to Engineer, then such Shop Drawing or other Submittal must bear the written approval of Contractor's design professional when submitted by Contractor to Engineer.

- D. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by the design professionals retained or employed by Contractor under an Owner-delegated design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.
- E. Pursuant to this Paragraph 7.19, Engineer's review, approval, and other determinations regarding design drawings, calculations, specifications, certifications, and other Submittals furnished by Contractor pursuant to an Owner-delegated design will be only for the following limited purposes:
  - 1. Checking for conformance with the requirements of this Paragraph 7.19;
  - 2. Confirming that Contractor (through its design professionals) has used the performance and design criteria specified in the Contract Documents; and
  - 3. Establishing that the design furnished by Contractor is consistent with the design concept expressed in the Contract Documents.
- F. Contractor shall not be responsible for the adequacy of performance or design criteria specified by Owner or Engineer.
- G. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.

## **ARTICLE 8—OTHER WORK AT THE SITE**

### **8.01 *Other Work***

- A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.
- B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any third-party utility work that Owner has arranged to take place at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford proper and safe access to the Site to each contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work.
- D. 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.

- E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, 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.
- F. The provisions of this article are not applicable to work that is performed by third-party utilities or other third-party entities without a contract with Owner, or that is performed without having been arranged by Owner. If such work occurs, then any related delay, disruption, or interference incurred by Contractor is governed by the provisions of Paragraph 4.05.C.3.

#### 8.02 *Coordination*

- A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:
  - 1. The identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;
  - 2. An itemization of the specific matters to be covered by such authority and responsibility; and
  - 3. The extent of such authority and responsibilities.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

#### 8.03 *Legal Relationships*

- A. If, in the course of performing other work for Owner at or adjacent to the Site, the Owner's employees, any other contractor working for Owner, or any utility owner that Owner has arranged to perform work, causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment will take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract, and any remedies available to Contractor under Laws or Regulations concerning utility action or inaction. When applicable, any such equitable adjustment in Contract Price will be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times or Contract Price is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

- B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site.
  - 1. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this Paragraph 8.03.B.
  - 2. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due Contractor.
- C. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) 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 any such claims, and against all 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 damage, delay, disruption, or interference.

## **ARTICLE 9—OWNER'S RESPONSIBILITIES**

### **9.01    *Communications to Contractor***

- A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

### **9.02    *Replacement of Engineer***

- A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents will be that of the former Engineer.

### **9.03    *Furnish Data***

- A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

### **9.04    *Pay When Due***

- A. Owner shall make payments to Contractor when they are due as provided in the Agreement.



9.05 *Lands and Easements; Reports, Tests, and Drawings*

- A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.
- B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.
- C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

- A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

- A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

- A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *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.

9.10 *Undisclosed Hazardous Environmental Condition*

- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *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 (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

- 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.
- B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

## ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

### 10.01 *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.

### 10.02 *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 10.07. 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.

### 10.03 *Resident Project Representative*

- A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in the Supplementary Conditions and in Paragraph 10.07.
- B. If Owner designates an individual or entity who is not Engineer's consultant, agent, or employee to represent Owner at the Site, then the responsibilities and authority of such individual or entity will be as provided in the Supplementary Conditions.

### 10.04 *Engineer's Authority*

- A. Engineer has the authority to reject Work in accordance with Article 14.
- B. Engineer's authority as to Submittals is set forth in Paragraph 7.16.
- C. Engineer's authority as to design drawings, calculations, specifications, certifications and other Submittals from Contractor in response to Owner's delegation (if any) to Contractor of professional design services, is set forth in Paragraph 7.19.
- D. Engineer's authority as to changes in the Work is set forth in Article 11.

E. Engineer's authority as to Applications for Payment is set forth in Article 15.

**10.05 *Determinations for Unit Price Work***

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

**10.06 *Decisions on Requirements of Contract Documents and Acceptability of Work***

A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

**10.07 *Limitations on Engineer's Authority and Responsibilities***

A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, 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, will 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 Contractor under Paragraph 15.06.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 10.07 also apply to the Resident Project Representative, if any.

**10.08 *Compliance with Safety Program***

A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs of which Engineer has been informed.

## ARTICLE 11—CHANGES TO THE CONTRACT

### 11.01 *Amending and Supplementing the Contract*

- A. The Contract may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
- B. If an amendment or supplement to the Contract includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order.
- C. All changes to the Contract that involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, must be supported by Engineer's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of the Engineer.

### 11.02 *Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders covering:
  - 1. Changes in 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;
  - 2. Changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;
  - 3. Changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.05, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters; and
  - 4. Changes that embody the substance of any final and binding results under: Paragraph 11.03.B, resolving the impact of a Work Change Directive; Paragraph 11.09, concerning Change Proposals; Article 12, Claims; Paragraph 13.02.D, final adjustments resulting from allowances; Paragraph 13.03.D, final adjustments relating to determination of quantities for Unit Price Work; and similar provisions.
- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.02.A, it will be deemed to be of full force and effect, as if fully executed.

### 11.03 *Work Change Directives*

- A. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.07 regarding change of Contract Price.

- B. If Owner has issued a Work Change Directive and:
  - 1. Contractor believes that an adjustment in Contract Times or Contract Price is necessary, then Contractor shall submit any Change Proposal seeking such an adjustment no later than 30 days after the completion of the Work set out in the Work Change Directive.
  - 2. Owner believes that an adjustment in Contract Times or Contract Price is necessary, then Owner shall submit any Claim seeking such an adjustment no later than 60 days after issuance of the Work Change Directive.

#### 11.04 *Field Orders*

- A. Engineer may authorize minor changes in the Work if the changes 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. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly.
- B. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

#### 11.05 *Owner-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. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.
- B. Such changes in the Work may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work must be performed under the applicable conditions of the Contract Documents.
- C. Nothing in this Paragraph 11.05 obligates Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

#### 11.06 *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, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.C.2.

#### 11.07 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment of Contract Price must comply with the provisions of Article 12.
- B. 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, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03);
  2. Where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.07.C.2); or
  3. Where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.07.C).
- C. *Contractor's Fee:* When applicable, the Contractor's fee for overhead and profit will 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 13.01.B.1 and 13.01.B.2, the Contractor's fee will be 15 percent;
    - b. For costs incurred under Paragraph 13.01.B.3, the Contractor's fee will be 5 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 11.07.C.2.a and 11.07.C.2.b is that the Contractor's fee will be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of 5 percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted Work the maximum total fee to be paid by Owner will be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;
    - d. No fee will be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
    - e. The amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in Cost of the Work will be the amount of the actual net decrease in Cost of the Work and a deduction of an additional amount equal to 5 percent of such actual net decrease in Cost of the Work; and
    - f. When both additions and credits are involved in any one change or Change Proposal, the adjustment in Contractor's fee will be computed by determining the sum of the costs in each of the cost categories in Paragraph 13.01.B (specifically, payroll costs, Paragraph 13.01.B.1; incorporated materials and equipment costs, Paragraph 13.01.B.2; Subcontract costs, Paragraph 13.01.B.3; special consultants costs, Paragraph 13.01.B.4; and other costs, Paragraph 13.01.B.5) and applying to each such cost category sum the appropriate fee from Paragraphs 11.07.C.2.a through 11.07.C.2.e, inclusive.

#### 11.08 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment in the Contract Times must comply with the provisions of Article 12.
- B. Delay, disruption, and interference in the Work, and any related changes in Contract Times, are addressed in and governed by Paragraph 4.05.

#### 11.09 *Change Proposals*

- A. *Purpose and Content:* Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; contest an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; challenge a set-off against payment due; or seek other relief under the Contract. The Change Proposal will specify any proposed change in Contract Times or Contract Price, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only one issue, or a set of closely related issues.

- B. *Change Proposal Procedures*

- 1. *Submittal:* Contractor shall submit each Change Proposal to Engineer within 30 days after the start of the event giving rise thereto, or after such initial decision.
- 2. *Supporting Data:* The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal.
  - a. Change Proposals based on or related to delay, interruption, or interference must comply with the provisions of Paragraphs 4.05.D and 4.05.E.
  - b. Change proposals related to a change of Contract Price must include full and detailed accounts of materials incorporated into the Work and labor and equipment used for the subject Work.

The supporting data must be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event.

- 3. *Engineer's Initial Review:* Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal. If in its discretion Engineer concludes that additional supporting data is needed before conducting a full review and making a decision regarding the Change Proposal, then Engineer may request that Contractor submit such additional supporting data by a date specified by Engineer, prior to Engineer beginning its full review of the Change Proposal.
- 4. *Engineer's Full Review and Action on the Change Proposal:* Upon receipt of Contractor's supporting data (including any additional data requested by Engineer), Engineer will conduct a full review of each Change Proposal and, within 30 days after such receipt of the Contractor's supporting data, either approve the Change Proposal in whole, deny it in whole, or approve it in part and deny it in part. Such actions must be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change

Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

5. *Binding Decision*: Engineer's decision is final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- C. *Resolution of Certain Change Proposals*: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties in writing that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice will be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.
- D. *Post-Completion*: Contractor shall not submit any Change Proposals after Engineer issues a written recommendation of final payment pursuant to Paragraph 15.06.B.

#### 11.10 *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.

### ARTICLE 12—CLAIMS

#### 12.01 *Claims*

- A. *Claims Process*: The following disputes between Owner and Contractor are subject to the Claims process set forth in this article:
  1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;
  2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents;
  3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters; and
  4. Subject to the waiver provisions of Paragraph 15.07, any dispute arising after Engineer has issued a written recommendation of final payment pursuant to Paragraph 15.06.B.
- B. *Submittal of Claim*: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim rests with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge



and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

- C. *Review and Resolution*: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim will be stated in writing and submitted to the other party, with a copy to Engineer.
- D. *Mediation*
  - 1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate will stay the Claim submittal and response process.
  - 2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process will resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process will resume as of the date of the conclusion of the mediation, as determined by the mediator.
  - 3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.
- E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action will be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.
- F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim will be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.
- G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim will be incorporated in a Change Order or other written document to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

## **ARTICLE 13—COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK**

### **13.01 *Cost of the Work***

- A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:
  - 1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

2. When needed to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.
- B. *Costs Included:* Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work will be in amounts no higher than those commonly incurred in the locality of the Project, will not include any of the costs itemized in Paragraph 13.01.C, and will 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 in advance of the subject Work. Such employees include, without limitation, superintendents, foremen, safety managers, safety representatives, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work will be apportioned on the basis of their time spent on the Work. Payroll costs include, but are not limited to, salaries and wages plus the cost of fringe benefits, which include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, will 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 accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts will accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment will 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, which 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 will be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.
  4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed or retained for services specifically related to the Work.
  5. Other costs consisting of 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, 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.

- 1) In establishing included costs for materials such as scaffolding, plating, or sheeting, consideration will be given to the actual or the estimated life of the material for use on other projects; or rental rates may be established on the basis of purchase or salvage value of such items, whichever is less. Contractor will not be eligible for compensation for such items in an amount that exceeds the purchase cost of such item.

c. *Construction Equipment Rental*

- 1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.
  - 2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.
  - 3) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed 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 builder's risk or other property insurance established in accordance with Paragraph 6.04), 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 include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will 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.
  - h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.
  - i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.
- C. *Costs Excluded:* The term Cost of the Work does not include any of the following items:
- 1. Payroll costs and other compensation of Contractor's officers, executives, principals, general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.
  - 2. The cost of purchasing, renting, or furnishing small tools and hand tools.
  - 3. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
  - 4. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
  - 5. Costs due to 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, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
  - 6. Expenses incurred in preparing and advancing Claims.
  - 7. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.
- D. *Contractor's Fee*
- 1. When the Work as a whole is performed on the basis of cost-plus-a-fee, then:
    - a. Contractor's fee for the Work set forth in the Contract Documents as of the Effective Date of the Contract will be determined as set forth in the Agreement.
    - b. for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work, Contractor's fee will be determined as follows:
      - 1) When the fee for the Work as a whole is a percentage of the Cost of the Work, the fee will automatically adjust as the Cost of the Work changes.
      - 2) When the fee for the Work as a whole is a fixed fee, the fee for any additions or deletions will be determined in accordance with Paragraph 11.07.C.2.
  - 2. When the Work as a whole is performed on the basis of a stipulated sum, or any other basis other than cost-plus-a-fee, then Contractor's fee for any Work covered by a Change

Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work will be determined in accordance with Paragraph 11.07.C.2.

- E. *Documentation and Audit*: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor and pertinent Subcontractors will establish and maintain records of the costs in accordance with generally accepted accounting practices. Subject to prior written notice, Owner will be afforded reasonable access, during normal business hours, to all Contractor's accounts, records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and similar data relating to the Cost of the Work and Contractor's fee. Contractor shall preserve all such documents for a period of three years after the final payment by Owner. Pertinent Subcontractors will afford such access to Owner, and preserve such documents, to the same extent required of Contractor.

### 13.02 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*: Contractor agrees that:
1. 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
  2. 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 for any of the foregoing will be valid.
- C. *Owner's Contingency Allowance*: Contractor agrees that an Owner's 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 for Work covered by allowances, and the Contract Price will be correspondingly adjusted.

### 13.03 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. Payments to Contractor for Unit Price Work will be based on actual quantities.
- 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. 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, and the final adjustment of Contract Price will be set forth in a Change Order, subject to the provisions of the following paragraph.

E. *Adjustments in Unit Price*

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:
  - a. the quantity of the item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and
  - b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.
2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.
3. Adjusted unit prices will apply to all units of that item.

**ARTICLE 14—TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK**

14.01 *Access to Work*

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction 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 with such procedures and programs as applicable.

14.02 *Tests, Inspections, and Approvals*

- A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.
- B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work will be governed by the provisions of Paragraph 14.05.
- 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, obtaining, and paying for all inspections and tests required:
1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
  2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
  3. by manufacturers of equipment furnished under the Contract Documents;
  4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
  5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests will be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

- E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.
- F. 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. Such uncovering will be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

#### 14.03 *Defective Work*

- A. *Contractor's Obligation:* It is Contractor's obligation to assure that the Work is not defective.
- B. *Engineer's Authority:* Engineer has the authority to determine whether Work is defective, and to reject defective Work.
- C. *Notice of Defects:* Prompt written notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.
- D. *Correction, or Removal and Replacement:* Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.
- E. *Preservation of Warranties:* When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.
- F. *Costs and Damages:* In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs,

losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

#### 14.04 *Acceptance of Defective Work*

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages 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. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work will be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

#### 14.05 *Uncovering Work*

- A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.
- B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.
- C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then 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, and provide all necessary labor, material, and equipment.
  - 1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages 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 pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.
  - 2. 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, 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, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

#### 14.06 *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, then 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 will 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.

**14.07 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 defective Work as required by Engineer, then Owner may, after 7 days' written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 14.07, 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, 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 incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. 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 14.07.

**ARTICLE 15—PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD**

**15.01 Progress Payments**

- A. *Basis for Progress Payments:* The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments for Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.
- B. *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.
  - 2. 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 must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation

establishing full payment by Contractor for the materials and equipment; (b) at Owner's request, documentation warranting that Owner has received the materials and equipment free and clear of all Liens; and (c) evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

3. Beginning with the second Application for Payment, each Application must include an affidavit of Contractor stating that all previous progress payments received by Contractor have been applied to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
4. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

*C. Review of Applications*

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, 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 13.03, 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; 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;
  - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;
  - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work;
  - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; 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 15.01.C.2.
6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
  - a. the Work is defective, requiring correction or replacement;
  - b. the Contract Price has been reduced by Change Orders;
  - c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
  - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or
  - e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

**D. *Payment Becomes Due***

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

**E. *Reductions in Payment by Owner***

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
  - a. Claims have been made against Owner based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

- b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;
  - c. Contractor has failed to provide and maintain required bonds or insurance;
  - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
  - e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;
  - f. The Work is defective, requiring correction or replacement;
  - g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
  - h. The Contract Price has been reduced by Change Orders;
  - i. An event has occurred that would constitute a default by Contractor and therefore justify a termination for cause;
  - j. Liquidated or other damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;
  - k. 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; or
  - l. Other items entitle Owner to a set-off against the amount recommended.
2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, 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, if Contractor remedies the reasons for such action. The reduction imposed will be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.
  3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld will be treated as an amount due as determined by Paragraph 15.01.D.1 and subject to interest as provided in the Agreement.

#### 15.02 *Contractor's Warranty of Title*

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than 7 days after the time of payment by Owner.

#### 15.03 *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 and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time

submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

- 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 preliminary certificate of Substantial Completion which will fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have 7 days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.
- E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.
- F. 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 punch list.

#### 15.04 *Partial Use or Occupancy*

- 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. At any time, Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be 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 15.03.A through 15.03.E for that part of the Work.
2. At any time, Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work 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 15.03 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 6.04 regarding builder's risk or other property insurance.

#### 15.05 *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, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

#### 15.06 *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, annotated record documents (as provided in Paragraph 7.12), and other documents, Contractor may make application for final payment.
2. The final Application for Payment must be accompanied (except as previously delivered) by:
  - a. all documentation called for in the Contract Documents;
  - b. consent of the surety, if any, to final payment;
  - c. 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.

- d. a list of all duly pending Change Proposals and Claims; and
  - e. 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.
- 3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) 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, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.
- B. *Engineer's Review of Final Application and Recommendation of Payment:* 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 have been fulfilled, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. 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. *Notice of Acceptability:* In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.
- D. *Completion of Work:* The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment and issuance of notice of the acceptability of the Work.
- E. *Final Payment Becomes Due:* Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

#### 15.07 *Waiver of Claims*

- A. By making final payment, Owner waives its claim or right to liquidated damages or other damages for late completion by Contractor, except as set forth in an outstanding Claim,

appeal under the provisions of Article 17, set-off, or express reservation of rights by Owner. Owner reserves all other claims or rights after final payment.

- B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted as a Claim, or appealed under the provisions of Article 17.

#### 15.08 *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 Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
  - 1. correct the defective repairs to the Site or such adjacent areas;
  - 2. correct such defective Work;
  - 3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, and
  - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting from the corrective measures.
- B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.
- C. If, after receipt of a notice of defect within 60 days and within the correction period, 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. Contractor shall pay all 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). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.
- D. 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.
- E. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, 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.



- F. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph are not to be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

## **ARTICLE 16—SUSPENSION OF WORK AND TERMINATION**

### **16.01 *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 written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times directly attributable to any such suspension. Any Change Proposal seeking such adjustments must be submitted no later than 30 days after the date fixed for resumption of Work.

### **16.02 *Owner May Terminate for Cause***

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and 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);
  - 2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;
  - 3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or
  - 4. Contractor's repeated disregard of the authority of Owner or Engineer.
- B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) 10 days' written notice that Owner is considering a declaration that Contractor is in default and termination of the Contract, Owner may proceed to:
  - 1. declare Contractor to be in default, and give Contractor (and any surety) written notice that the Contract is terminated; and
  - 2. enforce the rights available to Owner under any applicable performance bond.
- C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, 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 complete the Work as Owner may deem expedient.
- D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within 7 days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.
- E. If Owner proceeds as provided in Paragraph 16.02.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 the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects,

attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds 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.

- F. 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, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.
- G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond will govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

#### 16.03 *Owner May Terminate for Convenience*

- A. Upon 7 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; and
  - 3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.
- B. Contractor shall not be paid for any loss of anticipated profits or revenue, post-termination overhead costs, or other economic loss arising out of or resulting from such termination.

#### 16.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon 7 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 16.03.
- 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, 7 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 are not intended to preclude Contractor from submitting a Change Proposal 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 17—FINAL RESOLUTION OF DISPUTES**

### **17.01 *Methods and Procedures***

- A. *Disputes Subject to Final Resolution:* The following disputed matters are subject to final resolution under the provisions of this article:
  - 1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full, pursuant to Article 12; and
  - 2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise after final payment has been made.
- B. *Final Resolution of Disputes:* For any dispute subject to resolution under this article, Owner or Contractor may:
  - 1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions;
  - 2. agree with the other party to submit the dispute to another dispute resolution process; or
  - 3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

## **ARTICLE 18—MISCELLANEOUS**

### **18.01 *Giving Notice***

- A. Whenever any provision of the Contract requires the giving of written notice to Owner, Engineer, or Contractor, it will be deemed to have been validly given only if delivered:
  - 1. in person, by a commercial courier service or otherwise, to the recipient's place of business;
  - 2. by registered or certified mail, postage prepaid, to the recipient's place of business; or
  - 3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

### **18.02 *Computation of Times***

- A. When any period of time is referred to in the Contract 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.

18.03 *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. 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.

18.04 *Limitation of Damages*

- A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

- A. A party's non-enforcement of any provision will not constitute a waiver of that provision, nor will it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination of the Contract or of the services of Contractor.

18.07 *Controlling Law*

- A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 *Assignment of Contract*

- A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party to this Contract of any rights under or interests in the Contract will be binding on the other party without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract.

18.09 *Successors and Assigns*

- A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

18.10 *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

A. These Supplementary Conditions amend or supplement EJCDC® C-700, Standard General Conditions of the Construction Contract (2018). The General Conditions remain in full force and effect except as amended.

B. The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

C. The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix “SC” added thereto.

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#### SC-1.01.A Defined Terms

Insert in the first sentence after the phrase “printed with initial capital letters” the following phrase:

“or with all capital letters”

#### SC-1.01.A.8 Change Order

Insert a comma and the word “ENGINEER” immediately after the word “CONTRACTOR” in this definition.

#### SC-1.01.A.18 Drawings

Add the following to the end of Paragraph 1.01.A.18:

The following Drawings are part of the Contract Documents:

Drawings titled, “Well No. 6 Well Facility, Contract 4-2025, Waunakee Utilities, Waunakee, Wisconsin” Sheet No. 1 through No. 42, prepared by Strand Associates, Inc.® incorporated herein by reference and Drawings listed in the table of contents that are bound at the back of these Specifications.

Electronic files were provided for the convenience of CONTRACTOR. The data on which CONTRACTOR may rely is limited to the paper copy.

#### SC-1.01.A.50 Work Change Directive

Amend the phrase “signed by OWNER” in the first sentence of Paragraph 1.01.A.50 to read as follows:

“signed by OWNER and CONTRACTOR.”

Add the following language to the end of Paragraph 1.01.A.50:

A Work Change Directive cannot change Contract Price or Contract Times without a subsequent Change Order.

#### SC-1.01.A.51 Request for Information

Add the following new paragraph immediately after Paragraph 1.01.A.50:

##### 51. Request for Information:

Written request submitted by CONTRACTOR to ENGINEER on a form supplied by ENGINEER requesting clarification, interpretation, or additional information pertaining to Contract Documents.

#### SC-1.01.A.52 Geotechnical Engineer

Add the following new paragraph immediately after Paragraph 1.01.A.51:

##### 52. Geotechnical Engineer

The individual or entity that prepared the geotechnical report that is referenced in the Supplementary Conditions and that provides geotechnical engineering services, if any, during construction of the Project.

#### SC-1.01.A.53 Testing Firm

Add the following new paragraph immediately after Paragraph 1.01.A.52:

##### 53. Testing Firm

The individual or entity that performs materials testing during construction of the Project.

#### SC-2.01 Delivery of Bonds and Evidence of Insurance

Delete Paragraphs 2.01.B. and C. in their entirety and insert the following in their place:

B. Evidence of CONTRACTOR's Insurance: When CONTRACTOR delivers the signed counterparts of the Agreement to OWNER, CONTRACTOR shall also deliver to OWNER copies of the policies (including all endorsements, and identification of applicable self-insured retentions and deductibles) of insurance required to be provided by CONTRACTOR in this Contract. CONTRACTOR may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

#### SC-2.02 Copies of Documents

Amend the first sentence of Paragraph 2.02.A. to read as follows:

OWNER shall furnish to CONTRACTOR two printed copies of the Contract Documents (including one fully signed counterpart of the Agreement) and one copy in electronic portable document format (PDF).

#### SC-2.03 Before Starting Construction

Add the following subparagraph to Paragraph 2.03:

4. a proposed listing of subcontractors and major material and equipment suppliers.  
The list shall include any proposed substitutions in accordance with Paragraph 7.06.

#### SC-2.05 Acceptance of Schedules

Add the following language to the end of Paragraph 2.05.A.2:

The schedule for submittals shall show all submittals complete before 50% of completion of the Work and the schedule for maintenance manuals shall show all submittals complete before 75% of completion of the Work.

Add the following new paragraph immediately after Paragraph 2.05.A:

B. The times included in this paragraph apply to the preliminary schedules. See Division 01 for other submittal and time requirements for the construction progress schedule and submittal schedule.

#### SC-3.03 Reporting Discrepancies

Add the following language at the end of Paragraph 3.03.A:

4. CONTRACTOR shall report apparent discrepancies to ENGINEER using a Request for Information form on a form supplied by ENGINEER. The Request for Information form shall:

- a. be submitted by CONTRACTOR only;
- b. be legible and complete;
- c. not be used for the purposes of only confirming or verifying issues; and,
- d. be prioritized by CONTRACTOR in the event that multiple Requests for Information are outstanding.

Requests for Information that are not in conformance with the requirements above shall be returned to CONTRACTOR without response.

5. CONTRACTOR shall not be relieved of its responsibility to coordinate the Work to prevent adverse impacts to CONTRACTOR's Project Schedule while submitting Requests for Information.

6. If CONTRACTOR believes the Scope of Work included in the Request for Information has a cost and/or time impact, CONTRACTOR should submit a claim in accordance with Article 12 of these General Conditions.

7. If CONTRACTOR proceeds with work when CONTRACTOR had actual knowledge or should have known that a conflict, error, ambiguity, or discrepancy existed as indicated above, correction of work constructed without such notification to ENGINEER shall be at CONTRACTOR's expense, (except in an emergency as authorized by Paragraph 7.15.A).

#### SC-3.04 Requirements of the Contract Documents

Delete Paragraph 3.04.C in its entirety.

#### SC-4.01 Commencement of Contract Times; Notice to Proceed

In the last sentence of Paragraph 4.01.A, change "60th day" to "85th day."

#### SC-4.03 Reference Points

Add the following new paragraph immediately after Paragraph 4.03.A:

B. CONTRACTOR is referred to the General Requirements for additional requirements for laying out the work.



### SC-5.03 Subsurface and Physical Conditions

Add the following new paragraphs immediately after Paragraph 5.03.D:

E. The following table lists the reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data, and specifically identifies the Technical Data in the report upon which CONTRACTOR may rely:

| Report Title                                                                                                                   | Date of Report   | Technical Data                                                                                                    |
|--------------------------------------------------------------------------------------------------------------------------------|------------------|-------------------------------------------------------------------------------------------------------------------|
| Geotechnical Exploration Report, Proposed Well No. 6 and Elevated Tank, Kilkenny Farms West Development, prepared by CGC, Inc. | November 8, 2024 | Boring methods, level of subsurface water, boring logs, laboratory test methods and results, and boring locations |

ENGINEER accepts no responsibility for accuracy of the soil data or water level information. Soil information, included with these Contract Documents, was not obtained for the purposes of designing excavations and trenches. Soil information was used by ENGINEER for design purposes only. CONTRACTOR shall assure itself by personal examination as to subsurface conditions and shall provide its own investigations and make its own assumptions to comply with OSHA and any other applicable laws and regulations regarding excavation and trenching requirements.

F. No drawings of physical conditions relating to existing surface or subsurface structures at the Site containing technical data, are known to OWNER. CONTRACTOR shall conduct its own personal investigation to determine conditions at the site which may affect the Work, including compliance with OSHA excavation and trenching requirements.

### SC-5.05 Underground Facilities

Add the following paragraph immediately after Paragraph 5.05.F:

G. CONTRACTOR is referred to the General Requirements for requirements for keeping records of Underground Facilities and allowing facility owners to inspect.

### SC-5.06 Hazardous Environmental Conditions at the Site

Delete Paragraphs 5.06.A and 5.06.B in their entirety and insert the following:

A. No reports or drawings related to Hazardous Environmental Conditions at the Site are known to OWNER.

B. Not Used.

### SC-6.01 Performance, Payment and Other Bonds

Add the following new paragraphs immediately after Paragraph 6.01.H:

I. The forms of the performance and payment or other Bonds attached hereto shall be used for the Contract. Note instructions thereon as to the form applicable. Each form contemplates one corporate surety only. In case co-sureties or individual sureties will be furnished, proper forms therefore shall be obtained. Besides the stipulations of Paragraphs 6.01 through 6.03, the surety on the Bonds shall provide a certificate indicating surety is licensed to underwrite contracts in the jurisdiction of the project location which shall be attached to the Bonds.

### SC-6.03 CONTRACTOR's Insurance

Add the following new language to the end of Paragraph 6.03.C.3:

CONTRACTOR shall provide an executed endorsement form CG 20 01 04 13, or equal, supporting this requirement.

Add the following new paragraphs under Paragraphs 6.03.C:

D. Other Additional Insureds: As a supplement to the provisions of Paragraph 6.03.C of the General Conditions, the commercial general liability, automobile liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies must include as additional insureds (in addition to OWNER and ENGINEER) the following: None.

E. Worker's Compensation and Employer's Liability: CONTRACTOR shall purchase and maintain workers' compensation and employer's liability insurance, including, as applicable, United States Longshoreman and Harbor Workers' Compensation Act, Jones Act, stop-gap employer's liability coverage for monopolistic states, and foreign voluntary workers' compensation (from available sources, notwithstanding the jurisdictional requirement of Paragraph 6.02.B of the General Conditions).

| <b>Workers' Compensation and Related Policies</b>                                           | <b>Policy limits of not less than:</b> |
|---------------------------------------------------------------------------------------------|----------------------------------------|
| <b>Workers' Compensation</b>                                                                |                                        |
| State                                                                                       | Statutory                              |
| Applicable Federal (e.g., Longshoreman's)                                                   | Statutory                              |
| Foreign voluntary workers' compensation (employer's responsibility coverage), if applicable | Statutory                              |
| <b>Employer's Liability</b>                                                                 |                                        |
| Each accident                                                                               | \$100,000                              |
| Each employee                                                                               | \$100,000                              |
| Policy limit                                                                                | \$100,000                              |

F. *Commercial General Liability—Claims Covered:* CONTRACTOR shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of CONTRACTOR, on an occurrence basis, against claims for:

1. damages because of bodily injury, sickness or disease, or death of any person other than CONTRACTOR's employees,
2. damages insured by reasonably available personal injury liability coverage, and
3. damages because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.

G. *Commercial General Liability—Form and Content:* CONTRACTOR's commercial liability policy must be written on a 1996 (or later) Insurance Services Organization, Inc. (ISO) commercial general liability form (occurrence form) and include the following coverages and endorsements:

1. Products and completed operations coverage.

- a. Such insurance must be maintained for three years after final payment.
  - b. CONTRACTOR shall furnish OWNER and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
2. Blanket contractual liability coverage, including but not limited to coverage of CONTRACTOR's contractual indemnity obligations in Paragraph 7.18.
  3. Severability of interests and no insured-versus-insured or cross-liability exclusions.
  4. Underground, explosion, and collapse coverage.
  5. Personal injury coverage.
  6. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together), or equal, for each required additional insured. If CONTRACTOR demonstrates to OWNER that the specified ISO endorsements are not commercially available, then CONTRACTOR may satisfy this requirement by providing equivalent endorsements.
  7. Insurance certificates for commercial general, automobile, and umbrella shall specifically indicate by name the additional insureds which are to include OWNER and ENGINEER as well as other persons or entities so identified. Certificates shall be Acord 25-S or equivalent.
  8. Endorsements or General Liability policy shall not exclude supervisory or inspection services.
- H. *Commercial General Liability—Excluded Content:* The commercial general liability insurance policy, including its coverages, endorsements, and incorporated provisions, must not include any of the following:
1. Any modification of the standard definition of "insured contract" (except to delete the railroad protective liability exclusion if CONTRACTOR is required to indemnify a railroad or others with respect to Work within 50 feet of railroad property).
  2. Any exclusion for water intrusion or water damage.
  3. Any provisions resulting in the erosion of insurance limits by defense costs other than those already incorporated in ISO form CG 00 01.
  4. Any exclusion of coverage relating to earth subsidence or movement.
  5. Any exclusion for the insured's vicarious liability, strict liability, or statutory liability (other than worker's compensation).
  6. Any limitation or exclusion based on the nature of CONTRACTOR's work.
  7. Any professional liability exclusion broader in effect than the most recent edition of ISO form CG 22 79.

I. *Commercial General Liability—Minimum Policy Limits*

| <b>Commercial General Liability</b>               | <b>Policy limits of not less than:</b> |
|---------------------------------------------------|----------------------------------------|
| General Aggregate                                 | \$2,000,000                            |
| Products—Completed Operations Aggregate           | \$1,000,000                            |
| Personal and Advertising Injury                   | \$1,000,000                            |
| Bodily Injury and Property Damage—Each Occurrence | \$1,000,000                            |

General Aggregate Limits specified above shall apply separately to this project by attachment of:

“Amendment of Limits of Insurance—Designated Location(s) General Aggregate Limit” Endorsement (ISO Form No. CG 25 04 05 09) or “Designated Construction Project(s) General Aggregate Limit” Endorsement (ISO Form CG 25 03 05 09) or equivalent endorsement coverage.

J. *Automobile Liability*: CONTRACTOR shall purchase and maintain automobile liability insurance 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. The automobile liability policy must be written on an occurrence basis.

| <b>Automobile Liability</b>                               | <b>Policy limits of not less than:</b> |
|-----------------------------------------------------------|----------------------------------------|
| <b>Bodily Injury</b>                                      |                                        |
| Each Person                                               | \$500,000                              |
| Each Accident                                             | \$1,000,000                            |
| <b>Property Damage</b>                                    |                                        |
| Each Accident                                             | \$500,000                              |
| <b>or</b>                                                 |                                        |
| <b>Combined Single Limit</b>                              |                                        |
| Combined Single Limit (Bodily Injury and Property Damage) | \$1,000,000                            |

CONTRACTOR shall also provide an Additional Insured Endorsement for the automobile policy. Endorsement form shall be CA 20 48, or equal.

K. *Umbrella or Excess Liability*: CONTRACTOR shall purchase and maintain umbrella or excess liability insurance written over the underlying employer’s liability, commercial general liability, and automobile liability insurance described in the Paragraphs above. The coverage afforded must be at least as broad as that of each and every one of the underlying policies.

| <b>Excess or Umbrella Liability</b> | <b>Policy limits of not less than:</b> |
|-------------------------------------|----------------------------------------|
| Each Occurrence                     | \$1,000,000                            |
| General Aggregate                   | \$2,000,000                            |

L. *Using Umbrella or Excess Liability Insurance to Meet CGL and Other Policy Limit Requirements*: CONTRACTOR may meet the policy limits specified for employer’s liability, commercial general liability, and automobile liability through the primary policies alone, or through combinations of the primary insurance policy’s policy limits and partial attribution of the policy limits of an umbrella or

excess liability policy that is at least as broad in coverage as that of the underlying policy, as specified herein. If such umbrella or excess liability policy was required under this Contract, at a specified minimum policy limit, such umbrella or excess policy must retain a minimum limit of \$2,000,000 after accounting for partial attribution of its limits to underlying policies, as allowed above.

M. *Contractor's Pollution Liability Insurance:* CONTRACTOR shall purchase and maintain a policy covering third-party injury and property damage, including cleanup costs, as a result of pollution conditions arising from CONTRACTOR's operations and completed operations. This insurance must be maintained for no less than three years after final completion.

| <b>Contractor's Pollution Liability</b> | <b>Policy limits of not less than:</b> |
|-----------------------------------------|----------------------------------------|
| Each Occurrence/Claim                   | \$1,000,000                            |
| General Aggregate                       | \$2,000,000                            |

☐ If box is checked, CONTRACTOR is not required to provide this insurance.

CONTRACTOR's Pollution Liability coverage shall include coverage for fungus, mold, and bacteria.

N. *Contractor's Professional Liability Insurance:* If CONTRACTOR will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then CONTRACTOR shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance must cover negligent acts, errors, or omissions in the performance of professional design or related services by the insured or others for whom the insured is legally liable. The insurance must be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. The retroactive date on the policy must pre-date the commencement of furnishing services on the Project.

| <b>CONTRACTOR's Professional Liability</b> | <b>Policy limits of not less than:</b> |
|--------------------------------------------|----------------------------------------|
| Each Claim                                 | Not Applicable                         |
| Annual Aggregate                           | Not Applicable                         |

☒ If box is checked, CONTRACTOR is not required to provide this insurance.

O. *Railroad Protective Liability Insurance:* Prior to commencing any Work within 50 feet of railroad-owned and controlled property, CONTRACTOR shall (1) endorse its commercial general liability policy with ISO CG 24 17, removing the contractual liability exclusion for work within 50 feet of a railroad, (2) purchase and maintain railroad protective liability insurance meeting the following requirements, (3) furnish a copy of the endorsement to OWNER, and (4) submit a copy of the railroad protective policy and other railroad-required documentation to the railroad, and notify OWNER of such submittal.

| <b>Railroad Protective Liability Insurance</b> | <b>Policy limits of not less than:</b> |
|------------------------------------------------|----------------------------------------|
| Each Claim                                     | Not Applicable                         |
| Aggregate                                      | Not Applicable                         |

☒ If box is checked, CONTRACTOR is not required to provide this insurance.

P. *Unmanned Aerial Vehicle Liability Insurance:* If CONTRACTOR uses unmanned aerial vehicles (UAV—commonly referred to as drones) at the Site or in support of any aspect of the Work, CONTRACTOR shall obtain UAV liability insurance in the amounts stated; name OWNER, ENGINEER, and all individuals and entities identified in the Supplementary Conditions as additional insureds; and provide a certificate to OWNER confirming CONTRACTOR's compliance with this requirement. Such insurance will provide coverage for property damage, bodily injury or death, and invasion of privacy.

| <b>Unmanned Aerial Vehicle Liability Insurance</b> | <b>Policy limits of not less than:</b> |
|----------------------------------------------------|----------------------------------------|
| Each Claim                                         | Not Applicable                         |
| General Aggregate                                  | Not Applicable                         |

☒ If box is checked, CONTRACTOR is not required to provide this insurance.

Q. *Waiver of Subrogation:* CONTRACTOR's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall provide a waiver of subrogation covering OWNER and ENGINEER, and any individuals or entities identified in the Supplementary Conditions. CONTRACTOR shall obtain all necessary endorsements to support these requirements. Endorsement shall be CG 24 04 05 09, or equal.

R. *General Liability, Automobile Liability, and Umbrella Liability* shall include coverage for mental anguish and punitive damages.

S. The specimen Insurance Certificate bound at the end of this section has been prepared as a guide to assist CONTRACTOR and CONTRACTOR's Insurance Agent when preparing the required insurance documentation. This specimen certificate is included as a representation of what acceptable documents will look like. Specific project information must be included when preparing the actual document.

#### SC-6.04 Builder's Risk and Other Property Insurance

Supplement Paragraph 6.04 of the General Conditions with the following provisions:

F. *Builder's Risk Requirements:* The builder's risk insurance must:

1. be written on a builder's risk "all risk" policy form that at a minimum includes insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment stored and in transit, and must not exclude the coverage of the following risks: fire; windstorm; hail; flood; earthquake, volcanic activity, and other earth movement; lightning; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; and water damage (including that caused by flood and hydrostatic pressure).

a. Such policy will include an exception that results in coverage for ensuing losses from physical damage or loss with respect to any defective workmanship, methods, design, or materials exclusions.

b. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake, volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by

endorsement or otherwise, such insurance will be provided through other insurance policies acceptable to OWNER and CONTRACTOR.

2. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including OWNER-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.

3. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of contractors, engineers, and architects).

4. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).

5. extend to cover damage or loss to insured property while in transit.

6. allow for the waiver of the insurer's subrogation rights, as set forth in this Contract.

7. allow for partial occupancy or use by OWNER by endorsement, and without cancellation or lapse of coverage.

8. be maintained in effect until the Work is complete, as set forth in Paragraph 15.06.D of the General Conditions, or until written confirmation of OWNER's procurement of property insurance following Substantial Completion, whichever occurs first.

9. include as named insureds OWNER, CONTRACTOR, Subcontractors (of every tier), and any other individuals or entities required by this Contract to be insured under such builder's risk policy. For purposes of Paragraphs 6.04, 6.05, and 6.06 of the General Conditions, and this and all other corresponding Supplementary Conditions, the parties required to be insured will be referred to collectively as "insureds."

G. *Builder's Risk and Other Property Insurance Deductibles:* The purchaser of any required builder's risk, installation floater, or other property insurance will be responsible for costs not covered because of the application of a policy deductible.

#### SC-7.03.C. Labor; Working Hours

Add the following new subparagraphs immediately after Paragraph 7.03.C:

1. Regular working hours will be 7 A.M. to 7 P.M. Monday to Friday. Permission from OWNER will be needed for Saturday work, which will be evaluated on a case-by-case basis.

2. OWNER's legal holidays are New Year's Day, Friday before Easter, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, Christmas Eve, Christmas Day, and New Year's Eve Day.

Add the following new paragraph immediately after Paragraph 7.03.C:

D. CONTRACTOR shall be responsible for the cost of any overtime pay or other expense incurred by OWNER for ENGINEER's services (including those of the Resident Project Representative, if any), OWNER's representative, and construction observation services, occasioned by the performance of Work on Saturday, Sunday, any legal holiday, or as overtime on any regular work day. If CONTRACTOR is responsible but does not pay, or if the parties are unable to agree as to the amount owed, then OWNER may impose a reasonable set-off against payments due under Article 15.

#### SC-7.04.B Services, Materials, and Equipment Warranty

Add the following to the end of Paragraph 7.04.B:

Suppliers shall be deemed to impliedly warrant that their products and all component materials incorporated into them are suitable and fit for the intended use of such products and shall be free from defect in material, workmanship or design, such warranty to run to the benefit of OWNER and ENGINEER. The foregoing applies whether the products or their component materials are specified in the Contract Documents or are of Supplier's design.

#### SC-7.09 Permits

Delete last sentence of Paragraph 7.09.A and add the following in its place:

See General Requirements and technical specification sections for utility charge provisions.

Add Paragraph 7.09.B as follows:

B. See General Requirements for additional permit information.

#### SC-7.10 Taxes

Add the following new paragraph immediately after Paragraph 7.10.A:

B. OWNER is exempt from payment of sales and compensating use taxes of the State of Wisconsin, the Village of Waunakee, and the County of Dane on all materials to be incorporated into the Work.

1. OWNER will furnish the required certificates of tax exemption to CONTRACTOR for use in the purchase of supplies and materials to be incorporated into the Work.

2. OWNER's exemption does not apply to highway, street, or road construction included in the Work.

3. OWNER's exemption also does not apply to construction tools, machinery, equipment, or other property purchased by or leased by CONTRACTOR, or to supplies or materials not incorporated into the Work.

C. CONTRACTOR, if not a resident, shall comply with the provisions of Section 71.80(16) Wisconsin Statutes.



#### SC-7.12 Record Documents

In Paragraph 7.12.A delete last sentence and insert the following:

Upon completion of the Work, these record documents, samples, and shop drawings shall be delivered by CONTRACTOR to OWNER.

#### SC-7.13 Safety and Protection

Add the following language to the end of Paragraph 7.13.A:

If the Work includes excavation or trenches, CONTRACTOR shall keep at the Site at all times during the progress of the Work a competent person to comply with OSHA trenching and excavation requirements. The competent person shall be one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions that are unsanitary, hazardous or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

#### SC-7.18 Indemnification

Delete the word "negligent" from Paragraph 7.18.A.

Add the following to the end of Paragraph 7.18.A:

In addition, CONTRACTOR shall indemnify, hold harmless, and pay for the defense of OWNER and ENGINEER from and against claims, losses, or damages in regard to any act or failure to act by OWNER or ENGINEER in connection with general supervision, inspection and/or coordination of CONTRACTOR's operations.

CONTRACTOR shall, at its own expense, appear, defend, and pay all fees of attorneys and all costs and other expenses arising therefrom or incurred in connection therewith; and, if any judgments shall be rendered against any individual or entity indemnified hereunder in any such action, CONTRACTOR shall, at its own expense, satisfy and discharge same. CONTRACTOR expressly understands and agrees that any Letter of Credit or insurance protection required by the Contract, or otherwise provided by CONTRACTOR, shall in no way limit the responsibility to indemnify, hold harmless, and defend any individual or entity indemnified hereunder as herein provided.

Add the following new paragraph immediately after Paragraph 7.18.B:

C. For any matter for which OWNER and ENGINEER are indemnified under Paragraph 7.18.A, CONTRACTOR shall pay for OWNER's and ENGINEER's reasonable defense, 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 or awards until OWNER or ENGINEER are found negligent.

#### SC-7.19 Delegation of Professional Design Services

Add the following new paragraphs immediately after Paragraph 7.19.G:

H. The design professional providing the design calculations and design drawings shall be licensed in the State of the Project.

I. The design calculation and design drawings are not shop drawings, but shall be submitted to ENGINEER separately along with the required shop drawings for the system, material, or equipment specified. These calculations will be forwarded to OWNER for their records.

#### SC-10.03 Resident Project Representative

Add the following new paragraphs immediately after Paragraph 10.03.B:

C. The Resident Project Representative (RPR) will be ENGINEER's representative at the Site. RPR's dealings in matters pertaining to the Work in general will be with ENGINEER and CONTRACTOR. RPR's dealings with Subcontractors will only be through or with the full knowledge or approval of CONTRACTOR. The RPR will:

1. Conferences and Meetings: Attend meetings with CONTRACTOR, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings (but not including CONTRACTOR's safety meetings), and as appropriate prepare and circulate copies of minutes thereof.

2. Schedules: Review the progress schedule, schedule of Shop Drawing and Sample submittals, and Schedule of Values prepared by CONTRACTOR and consult with ENGINEER concerning acceptability.

3. Liaison:

a. Serve as ENGINEER's liaison with CONTRACTOR. Working principally through CONTRACTOR's authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.

b. Assist ENGINEER in serving as OWNER's liaison with CONTRACTOR when CONTRACTOR's operations affect OWNER's on-Site operations.

c. Assist in obtaining from OWNER additional details or information, when required for proper execution of the Work.

4. Interpretation of Contract Documents: Report to ENGINEER when clarifications and interpretations of the Contract Documents are needed and transmit to CONTRACTOR clarifications and interpretations as issued by ENGINEER.

5. Modifications: Consider and evaluate CONTRACTOR's suggestions for modifications in Drawings or Specifications and report such suggestions, together with RPR's recommendations, if any, to ENGINEER. Transmit to CONTRACTOR in writing decisions as issued by ENGINEER.

6. Review of Work and Rejection of Defective Work:

a. Conduct on-Site observations of CONTRACTOR's work in progress to assist ENGINEER in determining if the Work is in general proceeding in accordance with the Contract Documents.

b. Report to ENGINEER whenever RPR believes that any part of CONTRACTOR's work in progress is defective, will not produce a completed Project that conforms generally to the Contract Documents, or will imperil the integrity of the design concept of the completed Project as a functioning whole as indicated in the Contract

Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise ENGINEER of that part of work in progress that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.

7. Tests and System Start-ups:

a. Observe that tests, equipment, and systems start-ups and operating and maintenance training are conducted in the presence of appropriate OWNER's personnel, and that CONTRACTOR maintains adequate records thereof.

b. Observe, record, and report to ENGINEER appropriate details relative to the test procedures and systems start-ups.

8. Records:

a. Prepare a daily report or keep a diary or log book, and send periodic reports to ENGINEER.

9. Reports:

a. Furnish to ENGINEER periodic reports as required of progress of the Work and of CONTRACTOR's compliance with the Progress Schedule and schedule of Shop Drawing and Sample submittals.

b. Draft and recommend to ENGINEER proposed Change Orders, Work Change Directives, and Field Orders. Obtain backup material from CONTRACTOR.

c. Notify ENGINEER of the occurrence of any Site accidents, emergencies, acts of God endangering the Work, force majeure or delay events, damage to property by fire or other causes, or the discovery of any Constituent of Concern or Hazardous Environmental Condition.

10. Payment Requests: Review applications for payment with CONTRACTOR for compliance with the established procedure for their submission and forward with recommendations to ENGINEER, noting particularly the relationship of the payment requested to the Schedule of Values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.

11. Certificates, Operation and Maintenance Manuals: During the course of the Work, review materials and equipment certificates, operation and maintenance manuals and other data required by the Contract Documents to be assembled and furnished by CONTRACTOR are applicable to the items actually installed and in accordance with the Contract Documents, and have these documents delivered to ENGINEER for review and forwarding to OWNER prior to payment for that part of the Work.

12. Completion:

a. Participate in ENGINEER's visits regarding Substantial Completion.

b. Assist in the preparation of a punch list of items to be completed or corrected.

c. Participate in ENGINEER's visit to the Site in the company of OWNER and CONTRACTOR regarding completion of the Work, and prepare a final punch list of items to be completed or corrected by CONTRACTOR.

d. Observe whether items on the final punch list have been completed or corrected.

D. The RPR will not:

1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including "or-equal" items).

2. Exceed limitations of ENGINEER's authority as set forth in the Contract Documents.

3. Undertake any of the responsibilities of CONTRACTOR, Subcontractors, or Suppliers.

4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of construction.

5. Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of OWNER or CONTRACTOR.

6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by ENGINEER.

7. Authorize OWNER to occupy the Project in whole or in part.

#### SC-11.01 Amending and Supplementing the Contract

Delete the second sentence in Paragraph 11.01.C in its entirety.

#### SC-11.07 Change of Contract Price

Amend the phrase at the end of Paragraph 11.07.B.2 to read:

(which may include an allowance for overhead and profit in accordance with Paragraph 11.07.C.2. unless OWNER and CONTRACTOR agree that these allowances are not appropriate for the Work involved.)

#### SC-11.09.C Change Proposals

Delete Paragraph 11.09.C in its entirety and insert the following in its place:

"Not used."

#### SC-11.10 Notification to Surety

Add the following new paragraphs immediately after Paragraph 11.10.A:

B. CONTRACTOR shall be responsible for notifying the surety of any assignment, modification, or change of the Contract, change in the Work covered thereby, or extension of time for the completion of the project.

C. Failure to provide notice to the surety of any such change shall not exonerate the surety from its obligations under the bond.

#### SC-12.01.A Claims Process

Delete Paragraph 12.01.A.3 in its entirety and insert the following in its place:

“Not used.”

#### SC-14.02.A Tests and Inspections

Add the following to the beginning of Paragraph 14.02.A:

All Work is subject to testing to indicate compliance with Contract Document requirements. Copies of test results of all tests required shall be submitted to ENGINEER. Tests and inspection of work may be conducted by OWNER or an independent laboratory employed by OWNER. Tests may also be performed in the field by ENGINEER as a basis for acceptance of the Work.

Add the following to the end of Paragraph 14.02.A:

Samples required for testing shall be furnished by CONTRACTOR at no cost to OWNER. In the event that completed Work does not conform to Specification requirements during the initial test, the Work shall be corrected and retested for conformance. The entire cost of retesting completed Work shall be borne by CONTRACTOR. This shall include the extra cost for inspection to OWNER which will be deducted from the final amount due CONTRACTOR.

#### SC-15.01 Progress Payments

Add the following language at the end of Paragraph 15.01.B.1:

An updated Progress Schedule shall be submitted with each Application for Payment. Applications for Payment submitted without an acceptable updated Progress Schedule will be returned to CONTRACTOR without review. Progress Schedules that are submitted which do not reflect current project conditions, will not be considered acceptable.

In accordance with Wisconsin Statute sec. 779.14(1m)(d), CONTRACTOR shall pay all claims for labor and materials, CONTRACTOR shall maintain a list of all Subcontractors and Suppliers, and OWNER may make direct payment to a Subcontractor or pay CONTRACTOR with checks made payable to CONTRACTOR and to one or more Subcontractors.

#### SC-15.01.B Applications for Progress Payment

Delete Paragraph 15.01.B.3 in its entirety and renumber Paragraph 15.01.B.4 as 15.01.B.3.

Add the following language at the end of Paragraph 15.01.B.3:

No payments will be made that would deplete the retainage, place in escrow any funds that are required for retainage, or invest the retainage for the benefit of CONTRACTOR.

Add the following paragraphs immediately after Paragraph 15.01.B.3:

4. CONTRACTOR shall submit with each pay request CONTRACTOR's partial waiver of lien for the full amount of the requested payment. Beginning with the second pay

request, and with each succeeding pay request, CONTRACTOR shall submit partial waivers of lien for each Subcontractor and Supplier showing that the amount paid to date to each is at least equivalent to the total value of Subcontractor's or Supplier's work, less retainage, included on the previous pay request. CONTRACTOR shall submit with each pay request a signed Waiver of Lien Log clearly documenting the following:

- a. The names of all Subcontractors/Suppliers on the project.
  - b. Contract amounts for each Subcontractor/Supplier.
  - c. Amount paid to date to each Subcontractor/Supplier.
  - d. Lien waivers provided with current pay application for previous month's payments.
  - e. Amount to be paid to each Subcontractor/Supplier included in the pending pay request.
  - f. Remaining balance for each Subcontractor/Supplier.
5. No advanced payment for shop drawing preparation will be made. Shop drawing costs will be paid when equipment and materials are delivered and suitably stored on the site.
6. All stored equipment and materials for which payment is requested shall have invoices included with the pay request. Equipment shall be identified thoroughly on the invoices, including serial numbers.
7. Payment for the stored equipment and material which are on the site shall not exceed the invoiced amount for each item, less the Contract retainage. The overhead and profit for the stored items shall not be invoiced until the item is installed.
8. Payment for off-site storage is normally reserved for sensitive or very large pieces of equipment that in ENGINEER's opinion would not be practical to have stored on the site. Payment for off-site stored items shall be limited to 75% of the invoiced value of the item, less Contract retainage. CONTRACTOR shall reimburse OWNER the cost of inspecting off-site stored items. When off-site storage is approved, CONTRACTOR shall provide Insurance Certificates and Document of Ownership to OWNER.
9. Payment for PLC and SCADA programming shall be limited to 75% of the invoiced time spent, less Contract retainage.

To allow this payment value, programming must be completed by area and system. CONTRACTOR must provide the following:

- a. Signed certification by an officer of CONTRACTOR and electrical subcontractor that work has been completed.
- b. Ladder diagram or function block dump with complete descriptive narrative in PDF format.
- c. Database cross reference report for graphics (if applicable).
- d. I/O partition list.

- e. Smart I/O (DeviceNet, profibers, control net, Ethernet I/O, field bus, etc.) configuration report.
- f. Processor configuration report.
- g. Subroutine listing.

#### SC-15.02 CONTRACTOR's Warranty of Title

Amend Paragraph 15.02.A by striking out the following text: "no later than seven days after the time of payment by OWNER" and inserting "no later than the time of payment by OWNER."

#### SC-15.03 Substantial Completion

Add the following new subparagraph to Paragraph 15.03.B:

1. If some or all of the Work has been determined not to be at a point of Substantial Completion and will require re-inspection or re-testing by ENGINEER, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, will be paid by CONTRACTOR to OWNER. If CONTRACTOR does not pay, or the parties are unable to agree as to the amount owed, then OWNER may impose a reasonable set-off against payments due under this Article 15.

#### SC-15.08 Correction Period

Add the following new Paragraph 15.08.G:

G. If Substantial Completion for the entire work is never requested by CONTRACTOR, the correction period shall commence after final payment.

#### SC-16.02 OWNER May Terminate for Cause

Add the following new paragraphs immediately after Paragraph 16.02.B.2:

3. complete the Work as OWNER may deem expedient at the expense of CONTRACTOR and surety;
4. apply the amounts retained from partial payments to the completion of the Work;  
and
5. authorize the surety to complete the steps in Paragraphs 16.02.B.1 through 4.

#### SC-16.03 OWNER May Terminate for Convenience

Add the following paragraph after Paragraph 16.03.B:

C. CONTRACTOR shall require similar provisions contained in Paragraph 16.03 in each of its subcontracts to protect CONTRACTOR from claims by Subcontractors arising from OWNER's termination for convenience, or to minimize claims by such subcontractors. The remedy provided to CONTRACTOR under this Paragraph 16.03 shall be CONTRACTOR's sole remedy in the event of termination for convenience by OWNER.

END OF SECTION



# CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

**IMPORTANT:** If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

|                                         |                               |                |
|-----------------------------------------|-------------------------------|----------------|
| PRODUCER<br><br><b>Insurance Agency</b> | CONTACT NAME:                 |                |
|                                         | PHONE (A/C, No, Ext):         | FAX (A/C, No): |
| INSURED<br><br><b>Contractor</b>        | E-MAIL ADDRESS:               |                |
|                                         | PRODUCER CUSTOMER ID #:       |                |
|                                         | INSURER(S) AFFORDING COVERAGE |                |
|                                         | NAIC #                        |                |
|                                         | INSURER A : Insurance Company |                |
|                                         | INSURER B :                   |                |
|                                         | INSURER C :                   |                |
|                                         | INSURER D :                   |                |
| INSURER E :                             |                               |                |
| INSURER F :                             |                               |                |

**COVERAGES****CERTIFICATE NUMBER:****REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

| INSR LTR                            | TYPE OF INSURANCE                                                              | ADDL INSR                           | SUBR WVD    | POLICY NUMBER            | POLICY EFF (MM/DD/YYYY) | POLICY EXP (MM/DD/YYYY) | LIMITS                                                   |              |
|-------------------------------------|--------------------------------------------------------------------------------|-------------------------------------|-------------|--------------------------|-------------------------|-------------------------|----------------------------------------------------------|--------------|
| <input checked="" type="checkbox"/> | GENERAL LIABILITY                                                              | <b>X</b>                            |             |                          |                         |                         | EACH OCCURRENCE                                          | \$ 1,000,000 |
|                                     | <input checked="" type="checkbox"/> COMMERCIAL GENERAL LIABILITY               |                                     |             |                          |                         |                         | DAMAGE TO RENTED PREMISES (Ea occurrence)                | \$           |
|                                     | <input type="checkbox"/> CLAIMS-MADE <input checked="" type="checkbox"/> OCCUR |                                     |             |                          |                         |                         | MED EXP (Any one person)                                 | \$           |
|                                     |                                                                                |                                     |             |                          |                         |                         | PERSONAL & ADV INJURY                                    | \$ 1,000,000 |
|                                     |                                                                                |                                     |             |                          |                         |                         | GENERAL AGGREGATE                                        | \$ 2,000,000 |
|                                     |                                                                                |                                     |             |                          |                         |                         | PRODUCTS - COMP/OP AGG                                   | \$ 1,000,000 |
| GEN'L AGGREGATE LIMIT APPLIES PER:  |                                                                                |                                     |             |                          |                         |                         |                                                          |              |
| <input type="checkbox"/>            | POLICY                                                                         | <input checked="" type="checkbox"/> | PRO-JECT    | <input type="checkbox"/> | LOC                     |                         | \$                                                       |              |
| <input checked="" type="checkbox"/> | AUTOMOBILE LIABILITY                                                           | <b>X</b>                            |             |                          |                         |                         | COMBINED SINGLE LIMIT (Ea accident)                      | \$ 1,000,000 |
|                                     | <input checked="" type="checkbox"/> ANY AUTO                                   |                                     |             |                          |                         |                         | BODILY INJURY (Per person)                               | \$ 500,000   |
|                                     | <input type="checkbox"/> ALL OWNED AUTOS                                       |                                     |             |                          |                         |                         | BODILY INJURY (Per accident)                             | \$ 1,000,000 |
|                                     | <input type="checkbox"/> SCHEDULED AUTOS                                       |                                     |             |                          |                         |                         | PROPERTY DAMAGE (Per accident)                           | \$ 500,000   |
|                                     | <input type="checkbox"/> HIRED AUTOS                                           |                                     |             |                          |                         |                         |                                                          | \$           |
|                                     | <input type="checkbox"/> NON-OWNED AUTOS                                       |                                     |             |                          |                         |                         |                                                          | \$           |
| <input type="checkbox"/>            | UMBRELLA LIAB                                                                  | <input checked="" type="checkbox"/> | OCCUR       | <b>X</b>                 |                         |                         | EACH OCCURRENCE                                          | \$ 1,000,000 |
|                                     | EXCESS LIAB                                                                    | <input type="checkbox"/>            | CLAIMS-MADE |                          |                         |                         | AGGREGATE                                                | \$ 2,000,000 |
|                                     |                                                                                |                                     |             |                          |                         |                         | \$                                                       |              |
|                                     |                                                                                |                                     |             |                          |                         |                         | \$                                                       |              |
| <input type="checkbox"/>            | WORKERS COMPENSATION AND EMPLOYERS' LIABILITY                                  | <input type="checkbox"/>            | Y/N         | N/A                      |                         |                         | <input checked="" type="checkbox"/> WC STATU-TORY LIMITS | OTH-ER       |
|                                     | E.L. EACH ACCIDENT                                                             |                                     |             |                          |                         |                         | \$ 100,000                                               |              |
|                                     | E.L. DISEASE - EA EMPLOYEE                                                     |                                     |             |                          |                         |                         | \$ 100,000                                               |              |
|                                     | E.L. DISEASE - POLICY LIMIT                                                    |                                     |             |                          |                         |                         | \$ 100,000                                               |              |
| <input type="checkbox"/>            | BUILDER'S RISK POLLUTION LIABILITY                                             |                                     |             |                          |                         |                         | SEE SC-6.04                                              |              |
|                                     | EACH CLAIM                                                                     |                                     |             |                          |                         |                         | \$ 1,000,000                                             |              |
|                                     |                                                                                |                                     |             |                          |                         |                         | GENERAL AGGREGATE                                        | \$ 2,000,000 |

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

Well No. 6 Well Facility, Contract 4-2025, Waunakee Utilities, Wisconsin

Waunakee Utilities and Strand Associates, Inc. are additional insured with respect to General Liability, Automobile Liability, Pollution Liability, and Excess/Umbrella Liability. Waunakee Utilities is an insured with respect to Builder's Risk policy. In addition, see attached Additional Insured Endorsements for the General Liability and Automobile Liability policies.

**CERTIFICATE HOLDER****CANCELLATION**

|                                                                       |                                                                                                                                                                       |
|-----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Waunakee Utilities<br>322 Moravian Valley Road<br>Waunakee, WI 53597  | <b>SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.</b> |
| (Provide separate certificate to each party.)                         |                                                                                                                                                                       |
| Strand Associates, Inc.<br>910 West Wingra Drive<br>Madison, WI 53715 | AUTHORIZED REPRESENTATIVE                                                                                                                                             |

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## **SPECIFICATIONS**

## SECTION 01 11 00

### SUMMARY OF WORK

#### PART 1—GENERAL

##### 1.01 DIVISION ONE

- A. The requirements of Division 01 apply to all sections of the Contract.

##### 1.02 PROJECT SCOPE

- A. CONTRACTOR shall provide all items, articles, materials, operations or methods mentioned or scheduled on the Drawings or herein specified: including all labor, supervision, equipment, incidentals, taxes, and permits necessary to complete the Work as described within the Contract Documents. CONTRACTOR shall install all items provided by OWNER as mentioned or scheduled on the Drawings or herein specified.

##### 1.03 CONTRACT DOCUMENTS—INTENT AND USE

###### A. Intent of Documents:

1. Singular notations and specifications shall be considered plural where application is reasonably inferred.
2. Mention or indication of extent of work under any division or Specification section is done only for convenience of CONTRACTOR and shall not be construed as describing all work required under that division or section.
3. Some individual sections may contain a list of related sections. The list of related sections in individual sections is provided for the convenience of CONTRACTOR and is not necessarily all-inclusive. CONTRACTOR may not rely upon this listing for determination of scope of work. Other sections of the Specifications not referenced in individual sections shall apply as required for proper performance of the Work.
4. Command type sentences may be used in the Contract Documents. These sentences refer to and are directed to CONTRACTOR.
5. Symbols for various elements and systems are shown on the Drawings. Should there be any doubt regarding the meaning or intent of the symbols used, a written interpretation shall be obtained from ENGINEER.

###### B. Use of Documents:

1. CONTRACTOR shall examine all Specifications and Drawings for the Work, including those that may pertain to Work CONTRACTOR does not normally perform with its own forces.
2. CONTRACTOR shall use all of the Project Drawings and Specifications:
  - a. For a complete understanding of the Project.
  - b. To determine the type of construction and systems required.
  - c. For coordination with other contractors.
  - d. To determine what other work may be involved in various parts or phases.
  - e. To anticipate and notify others when work by others will be required.
  - f. And all other relevant matters related to the project.
3. CONTRACTOR is also bound by all requirements of the Contract Documents which are applicable to, pertain to, or affect its Work as may be shown or inferred by the entire set of Project Drawings and Specifications.

#### 1.04 CONTRACTOR USE OF SITE

##### A. General:

1. The "area of the site" referred to in these Specifications shall be as shown on the Drawings. If the "area of the site" is not shown, OWNER's property lines, the Project right-of-way and/or any easements obtained for the Project shall be considered the "area of the site."
2. Construction activities shall be confined within the "area of the site" limits.
3. From the start of work to completion CONTRACTOR is responsible for the care of the site and the premises which are affected by operations of Work of this Contract.
4. Except for permanent site improvements provided under the Contract, CONTRACTOR shall restore property disturbed during the Work, to the conditions which previously existed.
5. Work in occupied spaces shall be restricted to specified Work and essential activities, such as making necessary connections and extending services or constructing temporary access ways. Such work shall be scheduled in advance with OWNER.

##### B. Parking and Deliveries:

1. CONTRACTOR is responsible for control of traffic by vehicles and persons within the limits of its operations.
2. Parking for employees, subcontractors, and agents of CONTRACTOR shall be in areas subject to approval of OWNER.
3. Access to the site for delivery of construction material or equipment shall be subject to approval of OWNER.

#### 1.05 EXISTING SERVICES, OVERHEAD UTILITIES, AND UNDERGROUND FACILITIES INCLUDING STRUCTURES

- A. Interruption of existing services and systems including heating, ventilating, air conditioning, water, sanitary, lighting and power, signal and security systems, and similar work shall be kept to an absolute minimum and shall be limited to times approved by OWNER.
- B. If deemed necessary by OWNER, such work shall be accomplished after OWNER's normal office hours.
- C. Work shall not commence until all labor, materials, and equipment are available so Work can continue without interruption or delay.
- D. Should uncharted or incorrectly charted services or Underground Facilities be encountered during installation, notify OWNER and consult with utility owner immediately.
- E. Cooperate with OWNER and utility companies in keeping respective services and Underground Facilities in operation and repair any damage.
- F. CONTRACTOR shall not interrupt existing services and Underground Facilities occupied and used by OWNER or others, except when permitted in writing by OWNER.
- G. Any accidental interruption of services and Underground Facilities shall be repaired immediately, including provision of temporary facilities until permanent repairs can be made.
- H. Wisconsin Statute 182.0175(2) requires, among other provisions, that before excavation or demolition begins, reasonable advance notice not less than three working days prior to the

start of the excavation or demolition of the intent to excavate or demolish and the commencement date be provided to the owners of the Underground Facilities in and near the construction area whose facilities may be affected by the excavation or demolition. As part of this notification requirement, CONTRACTOR shall contact Digger's Hotline (811 or 1-800-242-8511). CONTRACTOR shall be aware that not all owners participate in the Digger's Hotline program. A call to this agency shall not absolve CONTRACTOR of the requirements of this statute. CONTRACTOR shall comply with all other provisions of the statute though not enumerated herein.

- I. Locations and elevations of services and Underground Facilities as shown on the Drawings are approximate. It shall be CONTRACTOR's responsibility to determine their exact location when in their vicinity. To this end, CONTRACTOR shall proceed with caution in the excavation and preparation of the Site so the exact location of services and Underground Facilities can be determined. CONTRACTOR shall include in the Contract Price any costs for temporary or permanent relocations of such services and Underground Facilities required to complete the Work unless specifically indicated otherwise in the Specifications.
- J. Where potential grade conflicts might occur with existing services and Underground Facilities, CONTRACTOR shall uncover such services and Underground Facilities sufficiently in advance of construction so that elevations may be determined to allow any necessary adjustments to be made.
- K. CONTRACTOR shall coordinate with overhead utility companies prior to the Work. CONTRACTOR shall provide all necessary temporary and permanent support relocation or temporary and permanent restraint to maintain overhead utilities in service.
- L. CONTRACTOR shall keep an accurate and complete record of all such services and Underground Facilities encountered and shall provide OWNER a copy of this record. The record shall include a description of the item encountered, opinion as to conditions, and adequate measurements and depths so that the item can be located in the future.
- M. CONTRACTOR shall inspect all services and Underground Facilities for condition and soundness. Unsound conditions shall be reported to OWNER immediately after exposing. CONTRACTOR shall not proceed with the Work until the service or facility owner has been notified. Service or facility owner shall then be given time to inspect and correct, if required, the service or Underground Facility. CONTRACTOR may make claim under the provisions of Articles 11 and 12 of the General Conditions should CONTRACTOR feel a price or time adjustment is justified.
- N. Any additional costs incurred because of failure of CONTRACTOR to report the condition of any and all existing services and Underground Facility encountered shall be paid for by CONTRACTOR.
- O. Whenever ENGINEER feels it is necessary to explore and excavate to determine the location of existing services and Underground Facilities, CONTRACTOR shall make explorations and excavations for such purposes. If CONTRACTOR is required to perform additional Work in making the explorations and excavations, extra compensation will be allowed as provided for in the General Conditions.

## 1.06 PROTECTION OF WORK AND IMPROVEMENTS

- A. CONTRACTOR shall protect the property of OWNER, existing improvements, and the Work installed by CONTRACTOR and others from abuse, damage, dust, debris, and other objectionable materials resulting from construction activities.
- B. CONTRACTOR shall provide suitable covers, partitions, or other dust and fume containment devices to suit construction operations.
- C. CONTRACTOR shall keep property, existing improvements, and the Work including structures, mains, fittings, and accessories free from dirt and foreign matter at all times.
- D. CONTRACTOR shall provide temporary plugging of openings, holes, and pipe ends that are existing or that CONTRACTOR has installed.
- E. Property, improvements, and Work damaged by CONTRACTOR shall be repaired or replaced by CONTRACTOR to the satisfaction of OWNER.
- F. CONTRACTOR is cautioned that existing public and private streets, alleyways, and roads may not hold up to typical construction traffic or activities. CONTRACTOR shall repair or replace streets, alleyways, roads, and shoulders damaged by its construction activities to their original condition at CONTRACTOR's expense.

## 1.07 AVAILABILITY OF LANDS

- A. Easements were not obtained for this Project. CONTRACTOR shall confine its operations, equipment and storage areas to the lands and rights-of-way in which the Project is to be located. CONTRACTOR may enter into written agreements with property owners for use of other lands during construction. Copies of such agreements shall be provided to OWNER.

## PART 2-PRODUCTS

NOT APPLICABLE

## PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01 29 00

### CONTRACT CONSIDERATIONS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Cash Allowances.
  - 2. Measurement and Payment—Lump Sum.

##### 1.02 CASH ALLOWANCES

- A. See Paragraph 13.02 of the General Conditions for costs to be included in allowances.
- B. Refer to sections of the Specifications identified in the Bid Form for specific information on use of cash allowances.
- C. The Bid shall include the amount equal to the specified quantity times the unit price.

##### 1.03 MEASUREMENT AND PAYMENT—LUMP SUM

- A. Payment for Lump Sum projects will be based on the accepted schedule of values for the project.
- B. An acceptable schedule of values will include the following features:
  - 1. Schedule shall list the installed value of the component parts of the work in sufficient detail to serve as a basis for computing values for progress payments during construction. Schedule shall be subdivided as necessary by specification section and work area.
  - 2. Identify each line item with the number and title of the respective Specification Section.
  - 3. For each major line item list sub-values of major products or operations under the item.
  - 4. For the various portions of the work:
    - a. Each item shall include a directly proportional amount of CONTRACTOR's overhead and profit.
    - b. For items on which progress payments will be requested for stored materials, break down the value into:
      - (1) The cost of the materials, delivered and unloaded, with taxes paid. Paid invoices are required for materials upon request by ENGINEER.
      - (2) The total installed value.
  - 5. The sum of all values listed in the schedule shall equal the total Contract Sum.
  - 6. Schedule shall include a separate listing of general items such as bonds, insurance, mobilization, demobilization, field supervision, record documents, and cash allowances.
- C. Once a schedule of values is accepted, it shall not be revised, except for changes associated with subsequently executed change orders.
- D. No separate measurement for payment will be performed for Lump Sum Work.

- E. CONTRACTOR shall estimate percentage of Work completed. ENGINEER will review CONTRACTOR's estimate of quantity of Work completed.
- F. Payment will be made based on the percentage of the Contract completed less retainage and/or liquidated damages.
- G. Unless noted otherwise, all Work described in the Specifications and/or shown on the Drawings shall be included in the Lump Sum Bid.
- H. Some technical specification sections may include payment provisions. These provisions are in addition to the provisions of this section which apply to all of the Work.

## PART 2-PRODUCTS

NOT APPLICABLE

## PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01 31 00

### COORDINATION, FIELD ENGINEERING, AND MEETINGS

#### PART 1-GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Coordination.
  - 2. Field Engineering.
  - 3. Progress Meetings.
  - 4. Preinstallation Videoconference.

##### 1.02 COORDINATION

- A. CONTRACTOR shall coordinate scheduling, submittals, and work of the various sections of the work to provide an efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. CONTRACTOR shall verify utility requirements and characteristics of operating equipment are compatible with building utilities and coordinate Work of various sections having interdependent responsibilities for installing, connecting to, and placing in service such equipment.
- C. CONTRACTOR shall coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on the Drawings and shall follow routing shown for pipes, ducts, and conduit as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. In finished areas, except as otherwise indicated, CONTRACTOR shall conceal pipes, ducts, and wiring within the construction and coordinate locations of fixtures and outlets with finish elements.
- E. CONTRACTOR shall coordinate completion and cleanup of Work of separate sections in preparation for substantial completion and for portions of Work designated for OWNER's occupancy.
- F. After OWNER occupancy of premises, CONTRACTOR shall coordinate access to Site for correction of defective Work and Work not in accordance with Contract Documents to minimize disruption of OWNER's activities.

##### 1.03 FIELD ENGINEERING

- A. CONTRACTOR shall locate and protect property stakes, legal survey monuments, benchmarks, and survey control and reference points. CONTRACTOR shall pay for replacement of disturbed property stakes and legal survey monuments by a Registered Land Surveyor acceptable to OWNER and for replacement of benchmarks and survey control and reference points provided by ENGINEER.



- B. CONTRACTOR shall provide field engineering services as required to establish elevations, lines, and levels utilizing recognized engineering survey practices.
- C. CONTRACTOR shall furnish all required plummets and graduated poles to check all Work.
- D. If stakes and boards have to be reset because of negligence of CONTRACTOR, CONTRACTOR shall bear the cost of such work.
- E. If laser beam is used, CONTRACTOR shall check its Work against intermediate grade stakes provided between manholes. Prior to initial use of the laser, CONTRACTOR shall set up laser on ground surface and check line and gradient controls. Lasers not functioning properly shall be immediately removed.
- F. CONTRACTOR shall be responsible for all lines, elevations, and measurements of buildings, structures, piping, utilities, and other work executed by CONTRACTOR under the Contract. CONTRACTOR must exercise proper precaution to verify figures before laying out the Work and will be held responsible for any error resulting from its failure to exercise such precaution.

#### 1.04 PROGRESS MEETINGS

- A. Progress meetings will be held throughout progress of the Work at intervals agreed to by OWNER, ENGINEER, and CONTRACTOR. Interval will generally be monthly.
- B. CONTRACTOR's project manager, job superintendent, major subcontractors, and suppliers shall attend as appropriate to address agenda topics for each meeting. CONTRACTOR's representatives shall have authority to bind CONTRACTOR to decisions at the meetings.
- C. The project schedule shall be updated monthly and shall be reviewed at each progress meeting.
- D. CONTRACTOR shall also provide the following information in written form at each meeting.
  - 1. Construction progress, including:
    - a. Activities completed this reporting period.
    - b. Activities in progress this reporting period.
    - c. Activities scheduled to commence this reporting period.
  - 2. Description of problem areas.
  - 3. Current and anticipated delays.
    - a. Cause of the delay.
    - b. Corrective action and schedule adjustments to correct the delay.
    - c. Impact of the delay on other activities, on milestones, and on completion dates.
  - 4. Changes in construction sequence.
- E. ENGINEER will prepare and distribute minutes to all attending parties.

#### 1.05 PREINSTALLATION VIDEOCONFERENCE

- A. When required in Section 26 09 00—Controls and Instrumentation, CONTRACTOR shall convene a preinstallation videoconference prior to the on-site functional acceptance testing.
- B. CONTRACTOR shall require attendance of CONTRACTOR, System Supplier, Division 26 contractor, OWNER, ENGINEER, and all other parties responsible for the equipment and controls schedules for on-site functional acceptance testing.

- C. CONTRACTOR shall arrange videoconference two months prior to the anticipated on-site functional acceptance testing. CONTRACTOR shall arrange an additional videoconference one month prior to the date for on-site functional acceptance testing of each group of equipment.
- D. Additional requirements for the videoconference can be found in Section 26 09 00—Controls and Instrumentation.

#### PART 2—PRODUCTS

NOT APPLICABLE

#### PART 3—EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01 33 00

### SUBMITTALS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Whenever possible throughout the Contract Documents, the minimum acceptable quality of workmanship and materials has been defined either by manufacturer's name and catalog number or by reference to recognized industry standards.
  - 2. To facilitate CONTRACTOR's understanding of the design intent, procedures have been established for advance submittal of design data and for its review or rejection by ENGINEER.
  - 3. The type of submittal requirements specified in this section include construction progress schedule, submittal schedule, shop drawings, product data, samples, maintenance manuals, and other miscellaneous work-related submittals.
- B. Related work described elsewhere: More detailed requirements for submittals are described in other sections of these Specifications for some materials and equipment. They are to be considered additional requirements to supplement the requirements specified in this section. Submittals shall conform to Article 7 of the General Conditions.
- C. Definitions: "Electronic Submittal" is defined as any submittal transmitted electronically to ENGINEER for review.

##### 1.02 IDENTIFICATION OF SUBMITTALS

- A. CONTRACTOR shall completely identify each submittal and resubmittal by showing at least the following information:
  - 1. Name and address of submitter, plus name and telephone number of the individual who may be contacted for further information.
  - 2. Name and location of project and identification number.
  - 3. Drawing number and Specifications section number to which the submittal applies.
  - 4. Include the date of each submittal or resubmittal.

##### 1.03 GROUPING OF SUBMITTALS

- A. Unless otherwise specifically permitted by ENGINEER, CONTRACTOR shall make all submittals in groups containing all associated items so that information is available for checking each item when it is received.
- B. Partial submittals may be rejected as not complying with the provisions of the Contract Documents.

##### 1.04 TIMING OF SUBMITTALS

- A. CONTRACTOR shall make all submittals far enough in advance of scheduled dates of installation to provide required time for reviews, for securing necessary approval, for possible revision and resubmittal, and for placing orders and securing delivery.

- B. The review period for submittals that are received after 3 P.M. shall commence on the following business day.

#### 1.05 CONSTRUCTION PROGRESS AND SUBMITTAL SCHEDULES

- A. Submit preliminary schedules within 10 days of the Effective Date of the Contract.
- B. Revise schedules incorporating any comments provided at the schedule review conference required in GC-2.05 and resubmit.
- C. As a minimum, the construction progress schedule shall consist of a horizontal bar chart with a separate line for each major portion of Work or operation, identifying first workday of each week.
- D. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration for each activity. Identify activities that are on the critical path.
- E. Include line items for milestones (if any), Substantial, and Final Completion.
- F. Submit updated schedules with each Application for Payment, identifying changes since previous version.
- G. Indicate estimated percentage of completion for each item of Work at each submission.
- H. Indicate submittal dates required for shop drawings, product data, samples, and product delivery dates.

#### 1.06 SHOP DRAWINGS

- A. Shop drawings shall include specially prepared technical data for this project including drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements, and similar information not in standard printed form for general application to a range of similar projects. Shop drawings shall be submitted for all manufactured or fabricated items. See individual technical sections for special requirements.
- B. CONTRACTOR shall make all shop drawings accurately to scale and sufficiently large to show all pertinent aspects of the item and its method of connection to the work.
- C. Shop drawings shall be checked, approved, and stamped by CONTRACTOR in accordance with the General Conditions before transmittal to ENGINEER for review and approval.
- D. Complete shop drawings and descriptive data shall be submitted on all manufactured or fabricated items prior to 50% completion of the Work. Applications for payment beyond 50% of the Contract amount will not be recommended for payment until all shop drawings are submitted, including color hard copies if requested by OWNER, or a revised schedule for any remaining submittals is agreed to by OWNER and ENGINEER.
- E. CONTRACTOR shall submit shop drawings following the electronic submittal procedure described below.

- F. Shop drawings submitted to ENGINEER will be reviewed and stamped "Approved," "Approved as Noted," "Approved as Noted-Resubmit," or "Not Approved." CONTRACTOR shall resubmit shop drawings stamped "Approved as Noted-Resubmit" and "Not Approved," and will continue this process until shop drawings are stamped "Approved" or "Approved as Noted." If Drawings are stamped "Approved as Noted-Resubmit," fabrication may proceed in accordance with the marked-up shop drawings. Installation shall not proceed until shop drawings have been resubmitted and stamped "Approved" or "Approved as Noted."
- G. If shop drawings are stamped "Approved as Noted" or "Approved as Noted-Resubmit" and CONTRACTOR does not agree with revisions or cannot conform with revisions, fabrication shall not proceed and shop drawings shall be resubmitted with explanation of CONTRACTOR's position.
- H. All shop drawings used for construction site activities shall bear the "Approved" or "Approved as Noted" stamp of ENGINEER.
- I. Electronic Submittal Procedures:
  - 1. Summary:
    - a. Shop drawing and product data submittals shall be transmitted to ENGINEER in electronic (PDF) format using Submittal Exchange, or equal, a website service designed specifically for transmitting submittals between construction team members, or equal.
    - b. The intent of electronic submittals is to expedite the construction process by reducing paperwork, improving information flow, and decreasing turnaround time.
    - c. The electronic submittal process is not intended for color samples, color charts, or physical material samples.
  - 2. Procedures:
    - a. CONTRACTOR shall review and apply electronic stamp certifying that the submittal complies with the requirements of the Contract Documents including verification of manufacturer/product, dimensions and coordination of information with other parts of the work.
    - b. CONTRACTOR shall transmit each submittal to ENGINEER using the approved website service.
    - c. ENGINEER review comments will be made available on the approved website for downloading. CONTRACTOR will receive email notice of completed review.
    - d. Distribution of reviewed submittals to subcontractors and suppliers is the responsibility of CONTRACTOR.
    - e. Electronically submitted shop drawings shall follow the following format:
      - (1) Filenames for the shop drawing submittals shall follow a XX XX XX.YYY-Z. Description convention where XX XX XX is the Specification section number, YYY is the submittal number, Z is the resubmittal number, and description is a short description of what the submittal includes. Submittals shall be consecutively numbered in direct sequence of submittal. Resubmittals shall be consecutively numbered with the first submittal numbered with a -0 and the first resubmittal numbered with a -1. Example file name: 03 20 00.016-1. Structure 10 Concrete Reinforcement. This would be the first revision of the sixteenth submittal and contain information on concrete reinforcement.
      - (2) All files shall be delivered in PDF format with a minimum resolution of 300 dpi unless otherwise requested by ENGINEER. Scanned in material shall be scanned in color and any markings by CONTRACTOR shall be made in red. Pages shall be rotated to the appropriate position for easy reading on a computer monitor such that the majority of text is vertical.

- (3) Files shall be delivered without security features activated.
- (4) Shop Drawings shall be uploaded as individual files. Files combined into a zip drive are not acceptable. All pages of one submittal should be contained in one file.
- (5) The file shall open to a cover page containing, at a minimum, the following information:
  - (a) CONTRACTOR's stamp.
  - (b) Name, e-mail, and telephone number of the individual who may be contacted for further information.
  - (c) Project number.
  - (d) Submittal number.
  - (e) Submission date, if resubmittal, all previous submission dates.
  - (f) Index detailing contents and the total number of pages in the submittal.
- f. Once a shop drawing has been "Approved" or "Approved as Noted," CONTRACTOR shall provide three hard color copies of the "Approved" or "Approved as Noted" shop drawings to ENGINEER. CONTRACTOR is responsible for the hard copy color replication of ENGINEER's "Approved" or "Approved as Noted" shop drawings for use by CONTRACTOR. Hard copy shop drawings shall be submitted in 3-ring binders or 3-tab report covers.
- 3. Costs:
  - a. CONTRACTOR shall include the full cost of approved website service project subscription in the Contract amount.
  - b. Internet Service and Equipment Requirements:
    - (1) Email address and Internet access at CONTRACTOR's main office.
    - (2) Adobe Acrobat ([www.adobe.com](http://www.adobe.com)), Bluebeam PDF Revu ([www.bluebeam.com](http://www.bluebeam.com)), or other similar PDF review software for applying electronic stamps and comments.
- J. CONTRACTOR is fully responsible for obtaining any and all copyright permission associated with conversion of shop drawing information to electronic format.
- K. Shop drawings shall include verification that the item meets applicable codes and standards.

#### 1.07 COLORS AND PATTERNS

- A. Unless the precise color and pattern is specifically described in the Contract Documents, whenever a choice of color or pattern is available in a specified product, CONTRACTOR shall submit accurate color charts and pattern charts to ENGINEER for OWNER's review and selection.
- B. Unless all available colors and patterns have identical wearing capabilities and are identically suited for the installation, CONTRACTOR shall completely describe the relative capabilities of each.

#### 1.08 SAMPLES AND FIELD MOCKUPS

- A. CONTRACTOR shall provide samples and field mockups where noted or specified.
- B. Samples are physical examples which illustrate materials, equipment, or workmanship and establish standards by which the work will be judged.

- C. Samples shall be of sufficient size and quantity to clearly illustrate the functional characteristics of the product and full range of color, texture, and pattern.
- D. Samples shall have labels firmly attached, bearing the following information:
  - 1. Name of project.
  - 2. Description of product and finish.
  - 3. Name of CONTRACTOR.
  - 4. Trade name and number of product.
  - 5. Standards met by the product.
- E. Approval of samples must be obtained prior to proceeding with any work affected by material requiring sample approval.
- F. Samples, unless otherwise noted, become the property of OWNER.
- G. In situations specifically approved by ENGINEER, the retained sample may be used in the construction as one of the installed items.
- H. Field Mockups:
  - 1. CONTRACTOR shall erect field mockups at the project site in a location acceptable to ENGINEER and OWNER.
  - 2. When accepted by ENGINEER, the mockup will become the basis for comparison of the actual work.
  - 3. Remove mockup at conclusion of the work if it was not incorporated into the work.

#### 1.09 PRODUCT DATA

- A. CONTRACTOR shall provide product data as required to supplement shop drawings.
- B. Product data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by CONTRACTOR to illustrate a material, product, or system for some portion of the work.
- C. CONTRACTOR shall collect required product data into one submittal for each unit of work or system.
- D. CONTRACTOR shall include manufacturer's standard printed recommendations for application and use, compliance with standards, performance characteristics, wiring and piping diagrams and controls, component parts, finishes, dimensions, required clearances, and other special coordination requirements.
- E. CONTRACTOR shall mark each copy of standard printed data to identify pertinent products, models, options, and other data.
- F. CONTRACTOR shall supplement manufacturer's standard data to provide information unique to the work.

#### 1.10 RESUBMISSION REQUIREMENTS

- A. Make any corrections or changes in the submittals required by ENGINEER.
- B. Shop Drawings and Product Data:
  - 1. Revise initial drawings or data and resubmit as specified for initial submittal.

2. Itemize in a cover letter any changes which have been made other than those requested by ENGINEER.

#### 1.11 MANUFACTURER'S DIRECTIONS

- A. Manufactured articles, materials, and equipment shall be stored, commissioned, operated, applied, installed, connected, erected, used, cleaned, and conditioned as directed by the manufacturer, unless specified to the contrary.
- B. Wherever Specifications call for work to be performed or materials to be installed in accordance with the manufacturer's printed instructions or directions, CONTRACTOR shall furnish copies as required for shop drawings of those instructions or directions to ENGINEER before installing the material or performing the work.

#### 1.12 MAINTENANCE MANUAL

- A. Prior to 75% completion of the Contract or at a minimum of 45 days prior to the scheduled start-up date of any individual item of equipment, whichever is earlier, CONTRACTOR shall furnish to ENGINEER two complete color hard copies of a maintenance manual for all equipment furnished. Applications for payment beyond 75% of the contract amount will not be recommended for payment until all maintenance manuals are submitted or a revised schedule for remaining maintenance manuals is agreed to by OWNER and ENGINEER.
- B. The manuals shall include manufacturer's instructions for maintenance and operation for each item of mechanical and electrical equipment. Manuals shall be specific for the equipment as installed; provide project specific inserts as required. Manuals shall contain: operation instructions, lubrication schedules, types and quantities, preventative maintenance program, spare parts list, parts lists, I.D. No. and exploded views, assembly instructions, parts supplier location, trouble shooting and startup procedures and, where applicable, test data and curves.
- C. All sheets shall have reduced dimensions as described for shop drawings. Only one copy shall be submitted in a 3-ring binder or 3-tab report cover, and the remaining copies shall be furnished in 3-tab report covers, binder clips, or large envelopes.
- D. CONTRACTOR is responsible for producing an electronic version of the Equipment Operations and Maintenance (O&M) Manuals Manual. The Electronic Equipment O&M Manual shall be delivered in Portable Document Format (PDF). The entire manual may be converted to PDF via scanning or other method of conversion. Drawings or other graphics must be converted to PDF format and made part of the PDF document. CONTRACTOR shall provide all Equipment O&M Manuals in the electronic format as defined below.
- E. The filename for the Equipment O&M Manual submittal will be provided with the request for final Equipment O&M Manuals. Filenames use the "eight dot three" convention (XX XX XX\_YY.PDF) where XX XX XX is the Specification section number and YY is an ID number. No one file shall be larger than 10 MB. If technical problems require that the submittal be divided into more than one file, a letter extension shall be added to the end of each filename.
- F. The number of files shall be kept to a minimum. Equipment O&M Manuals that span more than one file shall have the final Bookmark "Return to Table of Contents" which shall take the User to the first file on the Equipment O&M Manual.



- G. All text (word processed), spreadsheets, and electronic graphics shall be delivered in portable document format (\*.PDF). The resolution of all scanned images shall be a minimum of 300 dpi unless otherwise requested by ENGINEER. Scanned images shall be processed with the "original image with hidden text" option (Adobe Acrobat 6 or higher). This results in a clear image and provides for optical character recognition (OCR) and word search functionality. Graphical files shall be fully searchable. All submittals must be indexed with the Adobe Catalog feature. Placement and structure of index files shall be in accordance with Adobe's recommendations to minimize problems when transferring files. Successful searches for words or strings in the PDF document shall demonstrate proof of OCR.
- H. Rotate pages viewed in landscape to the appropriate position for easy reading on a computer monitor.
- I. Bookmarks shall be created in the navigation frame for each entry in the Table of Contents. Three levels deep is usually enough (i.e., "Chapter," "Section," "Subsection"); however, complex submittals like instrumentation and electrical may be required at the discretion of ENGINEER. When setting bookmarks for Chapter level heading, the page shall be displayed at Full Page. Section and Subsection level heading pages shall be displayed as a magnified view. Bookmarks shall be displayed as subordinate to other bookmarks in their hierarchy set so that only the Chapter level headings are displayed.
- J. Thumbnails shall be generated and embedded in each PDF file.
- K. Files shall be delivered without Security features activated. Password protected files will be unacceptable.
- L. The opening view for PDF files shall be set as follows:
  - 1. Initial View: Bookmarks and Page
  - 2. Magnification: Fit In Window
  - 3. Page Layout: Single Page
- M. The file shall open to the cover page of the Equipment O&M Manual with bookmarks to the left. The first bookmark shall be the name of Equipment O&M Manual.
- N. O&M Manual PDFs shall be delivered electronically.
- O. CONTRACTOR shall reprocess any portion of the document that does not view or print to OWNER's satisfaction.
- P. CONTRACTOR is fully responsible for obtaining any and all copyright permissions associated with conversion of this information to electronic format.
- Q. Each maintenance manual shall include a completed equipment maintenance summary form for each type and size of equipment being furnished that requires power, lubrication, or maintenance. Equipment Summary forms are located at the end of this section.

## PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## EQUIPMENT MAINTENANCE SUMMARY FORM<sup>(1)</sup>

|                               |                       |            |                   |
|-------------------------------|-----------------------|------------|-------------------|
| Equipment                     | No.:                  |            |                   |
| _____                         | _____                 |            |                   |
| _____                         | _____                 |            |                   |
| _____                         | _____                 |            |                   |
| Specification Section: _____  |                       |            |                   |
| Equipment Name: _____         |                       |            |                   |
| Building Name: _____          | Room No.: _____       |            |                   |
| Plant Location: _____         |                       |            |                   |
| Manufacturer: _____           |                       |            |                   |
| Address: _____                |                       |            |                   |
| Phone: _____                  |                       |            |                   |
| Service Representative: _____ |                       |            |                   |
| Address: _____                |                       |            |                   |
| Phone: _____                  | Fax: _____            |            |                   |
| Make: _____                   | Model: _____          |            |                   |
| Serial No.: _____             | Type: _____           |            |                   |
| Size: _____                   | _____                 |            |                   |
| Equipment Speed: _____        |                       |            |                   |
| Capacity: _____               |                       |            |                   |
| Operating Range: _____        |                       |            |                   |
| Material: _____               |                       |            |                   |
| Alarms: _____                 |                       |            |                   |
| _____                         |                       |            |                   |
| _____                         |                       |            |                   |
| Drive Ratio: _____            |                       |            |                   |
| Motor Speed: _____            | Service Factor: _____ |            |                   |
| Volts: _____                  | Phase: _____          | hp: _____  | Efficiency: _____ |
| Motor Type: _____             |                       |            |                   |
| Motor Sensors: _____          |                       |            |                   |
| Motor Manufacturer: _____     |                       |            |                   |
| Model: _____                  | Motor Frame: _____    |            |                   |
| Insulation Class: _____       |                       |            |                   |
| FLA: _____                    |                       | LRA: _____ |                   |

(1) Complete as applicable; attach supplementary pages as necessary.

Maintenance Requirements

(Use additional sheets if more space is needed.)

LUBRICATION

| <u>Item</u> | <u>Generic Type<br/>of Lubricant</u> | <u>Supplier</u> | <u>Estimated<br/>Frequency</u> | <u>Annual<br/>Quantity</u> |
|-------------|--------------------------------------|-----------------|--------------------------------|----------------------------|
|-------------|--------------------------------------|-----------------|--------------------------------|----------------------------|

PREVENTIVE MAINTENANCE

| <u>Item</u> | <u>Action</u> | <u>Frequency</u> | <u>Reference</u> |
|-------------|---------------|------------------|------------------|
|-------------|---------------|------------------|------------------|

SUGGESTED MINIMUM SPARE PARTS LIST

| <u>Manufacturer</u> | <u>Part No.</u> | <u>Quantity Unit</u> | <u>Description</u> |
|---------------------|-----------------|----------------------|--------------------|
|---------------------|-----------------|----------------------|--------------------|

The following information is included in O&M Manual:

Check or mark N/A

- |    |                                                                                                         |       |
|----|---------------------------------------------------------------------------------------------------------|-------|
| 1. | Recommended installation, adjustment, calibration, and troubleshooting.                                 | _____ |
| 2. | Complete internal and connection wiring diagrams.                                                       | _____ |
| 3. | Complete parts lists, by generic title and identification number, with exploded views of each assembly. | _____ |
| 4. | Disassembly, overhaul, and reassembly instructions.                                                     | _____ |
| 5. | Recommended prestart checks.                                                                            | _____ |
| 6. | Recommended start procedure.                                                                            | _____ |
| 7. | Recommended shutdown procedure for both short and long term.                                            | _____ |
| 8. | Recommended operating precautions that include safety for personnel and equipment.                      | _____ |
| 9. | Recommended standing maintenance procedure.                                                             | _____ |

END OF SECTION

SECTION 01 41 00  
REGULATORY REQUIREMENTS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. OSHA Requirements.
  - 2. Roadway Limits.
  - 3. Permits.
  - 4. Wage Rates.

1.02 OSHA REQUIREMENTS

- A. All work including site safety, equipment, materials, and fabricated items provided under the Contract shall comply with the provisions of the "Occupational Safety and Health Act."

1.03 ROADWAY LIMITS

- A. CONTRACTOR shall comply with roadway weight restrictions including seasonal weight restrictions.

1.04 PERMITS

- A. The following permits will be or were obtained by OWNER:
  - 1. Wisconsin Department of Natural Resources (WDNR) Construction Permit.
  - 2. Public Service Commission of Wisconsin Construction (PSCW) Authorization.
- B. The PSCW permit is included as an attachment to this division and the WDNR permit will be provided before work begins. CONTRACTOR shall comply with all provisions of these permits and shall be responsible for notifications as required by these permits. CONTRACTOR shall obtain all other permits required for the Work. Where the requirements of any permit is more restrictive than the Drawings or the Specifications, the permit requirements shall govern.
- C. A building permit will be required from OWNER. However, OWNER will waive fees associated with the permit.
- D. Any permits required for dewatering operations shall be obtained and paid for by CONTRACTOR.
- E. For dewatering operations, if dewatering wells singly or in aggregate produce 70 or more gallons per minute, CONTRACTOR shall obtain from the Wisconsin Department of Natural Resources, in accordance with NR 812.09(4), a permit for high capacity wells. All wells shall be drilled and closed in accordance with DNR requirements for installing and abandoning wells.
- F. CONTRACTOR shall comply with the provisions of Chapter 283, Wisconsin Statutes, regulating the discharge of effluent from construction pit trench dewatering. These provisions

provide for the removal of suspended solids from dewatering effluent prior to the direct discharge to surface waters or wetlands. CONTRACTOR shall apply as necessary to the Department of Natural Resources for a permit to discharge effluent from construction pit or trench dewatering. This discharge may be covered by an existing state general permit for discharging contaminated stormwater runoff/or construction pit dewatering.

#### 1.05 WAGE RATES

- A. A wage rate determination is not a requirement of this Project.

#### PART 2-PRODUCTS

NOT APPLICABLE

#### PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01 42 00

### REFERENCE STANDARDS AND DEFINITIONS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Reference Standards:
    - a. Throughout the Contract Documents, reference is made to codes and standards which establish qualities and types of workmanship and materials, and which establish methods for workmanship and materials, and which establish methods for testing and reporting on the pertinent characteristics.
    - b. Where materials or workmanship are required by these Contract Documents to meet or exceed the specifically named code or standard, it is CONTRACTOR's responsibility to provide materials and workmanship which meet or exceed that specifically named code or standard.
    - c. It is also CONTRACTOR's responsibility, when so required by the Contract Documents, to deliver to ENGINEER all required proof that the material or workmanship, or both, meet or exceed the requirements of the specifically named code or standard.
  - 2. Definitions:
    - a. A substantial amount of specification language constitutes definitions for terms found in other Contract Documents, including the Drawings which must be recognized as diagrammatic in nature and not completely descriptive of requirements indicated thereon.
    - b. Certain terms used in the Contract Documents are defined generally in this section to supplement definitions of the Agreement, General Conditions, Supplementary Conditions, and other general contract documents.
    - c. Definitions and explanations of this section are not necessarily either complete or exclusive, but are general for the Work.
- B. Related Work Described Elsewhere: The specific naming of codes or standards occurs on the Drawings and in other sections of these Specifications.

##### 1.02 QUALITY ASSURANCE

- A. Familiarity with Pertinent Codes and Standards:
  - 1. It is CONTRACTOR's responsibility to verify the requirements of the specifically named codes and standards and to verify that the items procured for use in this Work meet or exceed the specified requirements.
  - 2. When required by individual sections of these Specifications, CONTRACTOR shall obtain a copy of each pertinent code or standard and maintain the copies at the job site during submittals, planning, and progress of the Work until Substantial Completion of the Work is attained.
- B. Overlapping or Conflicting Requirements:
  - 1. Where compliance with two or more industry standards or sets of requirements are specified, and the overlapping of those standards or requirements establishes different or conflicting minimums or levels of quality, the most stringent requirement (which is



generally recognized to be also most costly) is intended and will be enforced, unless more detailed language written directly into Contract Documents clearly indicates that a less stringent requirement is acceptable.

2. Refer all uncertainties to ENGINEER for decision before proceeding.

### 1.03 REFERENCE STANDARDS

- A. Applicable standards of the construction industry are made a part of the Contract Documents by reference as if copied directly into the Contract Documents, or as if published copies were bound herewith. See Article 3.02 of the General Conditions for additional provisions regarding references.
- B. Standards referenced directly in the Contract Documents or by governing regulation, have precedence over nonreferenced standards which are recognized in industry for applicability to the Work.
- C. Nonreference standards are hereby defined to have no particular applicability to the Work except as a general measurement of whether the Work complies with standards recognized in the construction industry.
- D. Reference standards and codes listed in these Specifications may include, but are not necessarily limited to, standards or codes published by the following agencies and organizations:

1. AA                      Aluminum Association  
1525 Wilson Boulevard, Arlington, VA 22209
2. AAMA                  American Architectural Manufacturer's Association  
1827 Walden Office Square Suite 550, Schaumburg, IL 60173-4268
3. AASHTO              American Association of State Highway & Transportation Officials  
444 North Capitol Street NW Suite 249, Washington, DC 20001
4. ACI                     American Concrete Institute  
38800 Country Club Drive, Farmington Hills, MI 48331-3439
5. AI                        Asphalt Institute  
2696 Research Park Drive, Lexington, KY 40511-8480
6. AISC                   American Institute of Steel Construction  
One East Wacker Drive Suite 700, Chicago, IL 60601-1802
7. AISI                    American Iron and Steel Institute  
25 Massachusetts Avenue NW Suite 800, Washington, DC 20001
8. ANSI                   American National Standards Institute  
25 West 43rd Street, New York, NY 10036
9. APA                    American Plywood Association  
7011 South 19th, Tacoma, WA 98466-5333

10. API American Petroleum Institute  
1220 L Street NW, Washington, DC 20005-4070
11. ARI Air-Conditioning & Refrigeration Institute  
4100 North Fairfax Drive Suite 200, Arlington, VA 22203
12. ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers  
1791 Tullie Circle NE, Atlanta, GA 30329
13. ASME American Society of Mechanical Engineers  
Two Park Avenue, New York, NY 10016-5990
14. ASSE American Society of Sanitary Engineering  
901 Canterbury Suite A, Westlake, OH 44145
15. ASTM ASTM International  
100 Barr Harbor Drive, West Conshohocken, PA 19428-2959
16. AWI Architectural Woodwork Institute  
46179 Westlake Drive Suite 120, Potomac Falls, VA 20165-5874
17. AWPA American Wood Protection Association  
P.O. Box 361784, Birmingham, AL 35236-1784
18. AWS American Welding Society  
8669 Doral Boulevard Suite 130, Doral, FL 33166
19. AWWA American Water Works Association  
6666 West Quincy Avenue, Denver, CO 80235
20. BHMA Builder's Hardware Manufacturers Association  
355 Lexington Avenue 15th floor, New York, NY 10017
21. BIA Brick Industry Association  
1850 Centennial Park Drive Suite 301, Reston, VA 20191
22. CRSI Concrete Reinforcing Steel Institute  
9333 North Plum Grove Road, Schaumburg, IL 60173
23. DOT U.S. Department of Transportation  
1200 New Jersey Avenue, SE, Washington, DC 20590
24. EJMA Expansion Joint Manufacturers Association  
25 North Broadway, Tarrytown, NY 10591
25. FM FM Global  
FM Global Corporate Offices, 270 Central Avenue, Johnston, RI 02919

- 26. FTI                      Facing Tile Institute  
Box 8880, Canton, OH 44711
  
- 27. GA                        Gypsum Association  
6525 Belcrest Road Suite 480, Hyattsville, MD 20782
  
- 28. GANA                    Glass Association of North America  
800 SW Jackson Street Suite 1500, Topeka, KS 66612-1200
  
- 29. ICC                      International Code Council  
500 New Jersey Avenue NW 6th Floor, Washington, DC 20001
  
- 30. IES                        Illuminating Engineering Society  
120 Wall Street, Floor 17, New York, NY 10005-4001
  
- 31. MIL                      Military Specifications  
Naval Publications and Forms Center  
5801 Tabor Avenue, Philadelphia, PA 19120
  
- 32. NAAMM                National Association of Architectural Metal Manufacturers  
800 Roosevelt Road Building C Suite 312, Glen Ellyn, IL 60137
  
- 33. NCMA                    National Concrete Masonry Association  
13750 Sunrise Valley Drive, Herndon, VA 20171-4662
  
- 34. NECA                    NECA  
National Electrical Contractors Association  
3 Bethesda Metro Center Suite 1100, Bethesda, MD 20814
  
- 35. NEMA                    National Electrical Manufacturers Association  
1300 North 17th Street Suite 1752, Rosslyn, VA 22209
  
- 36. NFPA                    National Fire Protection Association  
1 Batterymarch Park, Quincy, MA 02169-7471
  
- 37. NIST                     National Institute of Standards and Technology  
(U.S. Department of Commerce), 100 Bureau Drive, Stop 1070  
Gaithersburg, MD 20899-1070
  
- 38. NRCA                    National Roofing Contractors Association  
10255 West Higgins Road Suite 600, Rosemont, IL 60018-5607
  
- 39. NSF                      National Sanitation Foundation International  
P.O. Box 130140, 789 North Dixboro Road, Ann Arbor, MI 48113-0140
  
- 40. OSHA                    Occupational Safety & Health Administration  
200 Constitution Avenue NW, Washington, DC 20210
  
- 41. PCA                      Portland Cement Association  
5420 Old Orchard Road, Skokie, IL 60077

- |            |                                                                                                                                |
|------------|--------------------------------------------------------------------------------------------------------------------------------|
| 42. PCI    | Prestressed Concrete Institute<br>200 West Adams Street Suite 2100, Chicago, IL 60606                                          |
| 43. SAE    | Society of Automotive Engineers<br>SAE World Headquarters<br>400 Commonwealth Drive, Warrendale, PA 15096-0001                 |
| 44. SDI    | Steel Deck Institute<br>P.O. Box 25, Fox River Grove, IL 60021                                                                 |
| 45. SDI    | Steel Door Institute<br>30200 Detroit Road, Westlake, OH 44145-1987                                                            |
| 46. SIGMA  | Sealed Insulating Glass Manufacturers Assoc.<br>401 North Michigan Avenue Suite 2400, Chicago, IL 60611                        |
| 47. SJI    | Steel Joist Institute<br>234 Cheves Street, Florence, SC 29501                                                                 |
| 48. SMACNA | Sheet Metal and Air Conditioning<br>Contractor's National Association<br>4201 Lafayette Center Drive, Chantilly, VA 20151-1219 |
| 49. SSPC   | Society for Protective Coatings<br>40 24th Street 6th Floor, Pittsburgh, PA 15222-4656                                         |
| 50. TCA    | Tile Council of America<br>100 Clemson Research Boulevard, Anderson, SC 29625                                                  |
| 51. UL     | Underwriters Laboratories<br>333 Pfingston Road; Northbrook, IL 60062                                                          |

#### 1.04 SUBMITTALS

- A. For OWNER's records, CONTRACTOR shall submit copies of permits, licenses, certifications, inspection reports, and similar documents, correspondence and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

#### 1.05 DEFINITIONS

- A. Indicated:
  - 1. The term "indicated" is a cross-reference to details, notes, or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in the Contract Documents.
  - 2. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated," it is for the purpose of helping the reader locate cross-reference, and no limitation is intended except as specifically noted.
- B. Approve (or Words of Similar Nature):
  - 1. Where used in conjunction with ENGINEER's response to submittals, requests,

applications, inquiries, reports, and claims by CONTRACTOR, the meaning of the term "approve" will be held to the limitation of ENGINEER's responsibilities and duties as specified in Paragraph 1.02.B of the General Conditions.

2. In no case will "approval" by ENGINEER be interpreted as a release of CONTRACTOR from responsibility to fulfill requirements of the Contract Documents.

C. Minimum Requirements:

1. Indicated requirements are for a specific minimum acceptable level of quality or quantity, as recognized in the industry.
2. Actual work must comply with (or within specified tolerances) or exceed minimums.
3. CONTRACTOR shall refer uncertainties to ENGINEER before proceeding.

- D. Abbreviations: Abbreviations, where not defined in the Contract Documents, will be interpreted to mean the normal construction industry terminology.

PART 2-PRODUCTS

NOT APPLICABLE

PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01 45 00

### QUALITY CONTROL

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Includes:
  - 1. Quality Assurance—Control of Installation.
  - 2. Tolerances.
  - 3. Manufacturers' Field Services and Reports.

##### 1.02 QUALITY ASSURANCE—CONTROL OF INSTALLATION

- A. CONTRACTOR shall monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship to produce Work of specified quality.
- B. CONTRACTOR shall comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, CONTRACTOR shall request clarification from ENGINEER before proceeding.
- D. CONTRACTOR shall comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Work shall be performed by persons qualified to produce workmanship of specified quality.
- F. CONTRACTOR shall secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

##### 1.03 TOLERANCES

- A. CONTRACTOR shall monitor tolerance control of installed products to produce acceptable work and shall not permit tolerances to accumulate.
- B. CONTRACTOR shall comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, CONTRACTOR shall request clarification from ENGINEER before proceeding.
- C. CONTRACTOR shall adjust products to appropriate dimensions; position before securing products in place.

##### 1.04 MANUFACTURERS' FIELD SERVICES AND REPORTS

- A. When specified in individual specification sections or when requested by ENGINEER, CONTRACTOR shall require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, and quality of workmanship.

- B. CONTRACTOR shall submit qualifications of observer to ENGINEER 30 days in advance of required observations.
- C. CONTRACTOR shall report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. CONTRACTOR shall submit report in duplicate within 30 days of observation to ENGINEER for information.

#### PART 2-PRODUCTS

NOT APPLICABLE

#### PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01 50 00

### TEMPORARY FACILITIES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Temporary Utilities.
  - 2. Temporary Stairs and Access.
  - 3. Temporary Support Facilities.
  - 4. Removal of Temporary Facilities.
- B. CONTRACTOR shall arrange for and provide temporary facilities as required for proper and expeditious prosecution of the Work.
- C. CONTRACTOR shall pay all costs, except as otherwise specified, until final acceptance of the Work unless OWNER makes arrangements for use of completed portions of the Work after substantial completion in accordance with the provisions of the General Conditions.
- D. CONTRACTOR shall make all temporary connections to utilities and services in locations acceptable to OWNER and local authorities having appropriate jurisdiction.
  - 1. Furnish all necessary labor and materials.
  - 2. Make all installations in a manner subject to the acceptance of such authorities and OWNER.
  - 3. Maintain such connections.
  - 4. Remove temporary installation and connection when no longer required.
  - 5. Restore services and sources of supply to proper operating conditions.

##### 1.02 TEMPORARY UTILITIES

- A. Temporary Toilets: CONTRACTOR shall provide and maintain sanitary temporary chemical toilets located where approved by OWNER and in sufficient number required for the work force employed by CONTRACTOR.
- B. Temporary Electrical Services:
  - 1. CONTRACTOR shall make all necessary arrangements, furnish, install, and maintain necessary temporary electrical services at the Site. CONTRACTOR shall remove all temporary services when Project is complete.
  - 2. All utility charges for installation of the temporary services shall be paid for by CONTRACTOR. All metering installation charges and all energy charges for electric current used for temporary lighting and power are to be paid by CONTRACTOR.
  - 3. No permanent electrical equipment or wiring shall be used without express written permission of OWNER. Such approval, if given, shall not affect guarantee period. If OWNER authorizes use of permanent service facilities, CONTRACTOR shall pay all metering costs until acceptance or occupancy (whichever occurs first) of building by OWNER.
- C. Weather Protection and Temporary Heat:
  - 1. CONTRACTOR shall provide weather protection to protect the Work from damage because of freezing, rain, snow, and other inclement weather.



2. CONTRACTOR shall provide temporary heat within buildings, without cost to OWNER, from the time the buildings or portions thereof are enclosed until the Project is accepted or occupied by OWNER, whichever occurs first. The building work is to be heated during construction so a minimum temperature of 50°F is maintained at all times. Temporary heating equipment shall be properly vented.
  3. Tanks that are constructed and existing tanks taken out of service as part of the Work shall be protected by CONTRACTOR from damage because of frost by insulating, enclosure, heating, or a combination of methods as required.
  4. No permanent heating equipment shall be used on a temporary basis without express written permission by OWNER. Such approval, if given, shall not affect the guarantee period. If OWNER authorizes use of permanent heating equipment, CONTRACTOR shall pay all related energy costs until acceptance or occupancy (whichever occurs first) of the building by OWNER.
- D. Temporary Water: CONTRACTOR shall supply its own water during construction. CONTRACTOR shall also provide its own piping, valves, and appurtenances for its requirements. Connection to the existing water system shall be coordinated with OWNER and shall meet all code requirements including disinfection and backflow prevention.
- E. Temporary Fire Protection: CONTRACTOR and Subcontractor(s) who maintain or provide an enclosed shed or trailer shall provide and maintain in operating order in each shed or trailer a minimum of one fire extinguisher. More extinguishers shall be provided as necessary. Fire extinguishers shall be minimum dry chemical, nonfreezing-type, UL rating 2A-30BC, with 10-pound capacity for Class A, B, and C fires.
- F. CONTRACTOR's and Subcontractor(s)' personnel shall refrain from smoking during excavation, laying pipe, backfilling, and other work at the Site which may involve potential contact with explosive vapors or gasoline products.

#### 1.03 TEMPORARY STAIRS AND ACCESS

- A. CONTRACTOR shall provide and maintain all equipment such as temporary stairs, ladders, ramps, runways, chutes, and so on as required for proper execution of the Work. CONTRACTOR shall be responsible for providing its own scaffolds, hoists, etc.
- B. All such apparatus, equipment, and construction shall meet all requirements of OSHA, the labor laws, and other applicable State and local laws. Provide stairs with handrails. As soon as possible and where applicable, permanent stairs shall be installed.
- C. As soon as permanent stairs are created, provide temporary protective treads, handrails, and shaft protection.
- D. Provide barricades at hazardous locations, complete with signs, temporary general lighting, warning lights, and similar devices as required.

#### 1.04 TEMPORARY SUPPORT FACILITIES

- A. CONTRACTOR shall provide whatever facilities and services which may be needed to properly support primary construction process and meet compliance requirements and governing regulations.
- B. CONTRACTOR shall not use permanent facilities except as otherwise indicated, unless authorized by OWNER.

## 1.05 REMOVAL OF TEMPORARY FACILITIES

- A. Remove temporary materials, equipment, services, and construction as soon as practicable but no later than just prior to substantial completion inspection.
- B. Clean and repair damage caused by installation or use of temporary facilities and restore existing facilities used during construction to specified, or to original, condition.

### PART 2–PRODUCTS

NOT APPLICABLE

### PART 3–EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 52 13  
FIELD OFFICES AND SHEDS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. Materials, Equipment, and Furnishings.
  - 2. Construction.
  - 3. Environmental Control.
  - 4. Storage Areas and Sheds.
  - 5. Preparation.
  - 6. Maintenance and Cleaning.
  - 7. Removal.

PART 2–PRODUCTS

2.01 MATERIALS, EQUIPMENT, AND FURNISHINGS

- A. Materials, equipment, and furnishings shall be serviceable, new or used, and adequate for required purpose.

2.02 CONSTRUCTION

- A. Portable or mobile buildings or buildings shall be constructed with floors raised above ground, securely fixed to foundations, with steps and landings at entrance doors.
- B. CONTRACTOR shall provide structurally sound, secure, weathertight enclosures for office and storage spaces.
- C. Temperature transmission resistance of floors, walls, and ceilings shall be compatible with occupancy and storage requirements.
- D. Exterior materials shall be weather resistant.
- E. Interior materials in offices shall consist of sheet type materials for walls and ceilings, prefinished or painted; resilient floors and bases.
- F. Lighting for offices shall be 50 footcandles minimum at desk top height, with exterior lighting at entrance doors.
- G. Provide appropriate type fire extinguisher at each office and each storage area.
- H. Interior materials in storage sheds shall be as required to provide specified conditions for storage of products.

## 2.03 ENVIRONMENTAL CONTROL

- A. Heating, cooling, and ventilating for offices shall consist of automatic equipment to maintain comfort conditions; 70°F heating and 78°F cooling.
- B. Heating and ventilation for storage spaces shall be as needed to maintain products in accordance with Contract Documents and to provide adequate lighting for maintenance and observation of products.

## 2.04 STORAGE AREAS AND SHEDS

- A. Provide storage areas and sheds of size to meet storage requirements for products of individual sections, allowing for access and orderly provision for maintenance and for observation of products to meet requirements of Section 01 60 00—Materials and Equipment.

# PART 3—EXECUTION

## 3.01 PREPARATION

- A. CONTRACTOR shall fill and grade sites for temporary structures to provide drainage away from buildings.

## 3.02 MAINTENANCE AND CLEANING

- A. CONTRACTOR shall maintain approach walks free of mud, water, and snow.

## 3.03 REMOVAL

- A. Upon final acceptance and completion of the Work, CONTRACTOR shall remove field offices, foundations, utility services, and debris and shall restore areas.

END OF SECTION

## SECTION 01 57 00

### TEMPORARY CONTROLS

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Dust Control.
  - 2. Water, Erosion, and Sediment Control.
  - 3. Noise Control.
  - 4. Traffic Control.
  - 5. Site Security.
  - 6. Daily Cleanup.

#### PART 2–PRODUCTS

NOT APPLICABLE

#### PART 3–EXECUTION

##### 3.01 DUST CONTROL

- A. CONTRACTOR shall execute the Work by methods to minimize raising dust from construction operations.
- B. CONTRACTOR shall provide positive means to prevent airborne dust from dispersing into atmosphere.
- C. CONTRACTOR shall provide partitions, enclosures, etc., within buildings as necessary to confine dust and protect adjacent areas.

##### 3.02 WATER, EROSION, AND SEDIMENT CONTROL

- A. CONTRACTOR shall grade site to drain and shall maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. CONTRACTOR shall protect Site from puddling or running water.
- C. CONTRACTOR shall provide erosion control measures as necessary to control discharge of sediment laden water to surface waters and wetlands.
- D. Except as provided for in the document, overland discharge of water from dewatering operations shall not be allowed. Depending on water quality, such water shall either be piped directly to the surface water or shall be directed to sedimentation basins or other such structures or features prior to discharge to surface waters so as not to cause damage to existing ground and improvements, erosion, or deposition in the discharge area.

- E. CONTRACTOR shall use jute or synthetic netting, silt fences, straw bales, dikes, channels, and other applicable measures to prevent erosion of soils disturbed by its construction operation.
- F. Restoration of the Site shall proceed concurrently with the construction operation. See Drawings and Specifications for erosion control measures in addition to that which may be required above.
- G. Erosion control measures shall comply with DNR Conservation Practice Standards-Construction Site Erosion and Sediment Controls.

### 3.03 NOISE CONTROL

- A. Provide methods, means, and facilities to minimize noise produced by construction operations.

### 3.04 TRAFFIC CONTROL

- A. CONTRACTOR shall be responsible for providing all signs, barricades, flagmen, and other traffic control devices in the construction zone.
- B. All traffic control measures shall meet the requirements of Part 6 of the Manual on Uniform Traffic Control Devices of the State of Wisconsin.
- C. Do not close or obstruct roadways without approval of OWNER.
- D. Conduct operations with minimum interference to roadways.
- E. Maintain two-way traffic on streets at all times.

### 3.05 SITE SECURITY

- A. CONTRACTOR shall have the sole responsibility of safeguarding the Site perimeter to prevent unauthorized entry to the Site throughout the duration of the Project. CONTRACTOR shall at all times provide such permanent and temporary fencing or barricades or other measures as may be necessary to restrict unauthorized entry to its construction area including construction in public rights-of-way or easements. Site security measures shall include safeguards against attractive nuisance hazards as a result of construction activity.
- B. CONTRACTOR shall at all times be responsible for the security of the Work including materials and equipment. OWNER will not take any responsibility for missing or damaged equipment, tools, or personal belongings. CONTRACTOR shall have the sole responsibility of safeguarding the Work and the Site throughout the duration of the Project.

### 3.06 DAILY CLEANUP

- A. CONTRACTOR shall clean up the Site and remove all rubbish on a daily basis.
- B. CONTRACTOR shall clean up public streets and highways and remove any dirt, mud, or other materials due to project traffic on daily basis and shall comply with all local and state ordinances and permit requirements.

END OF SECTION

## SECTION 01 60 00

### MATERIALS AND EQUIPMENT

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: CONTRACTOR shall be responsible for the delivery, handling, storage and protection of all material and equipment required to complete the Work as specified herein.
- B. Related Sections and Divisions: Specific requirements for the handling and storage of material and equipment are described in other sections of these Specifications.

##### 1.02 PRODUCTS

- A. Components required to be supplied in quantity within a Specification section shall be the same, and shall be interchangeable.
- B. CONTRACTOR shall not use materials and equipment removed from existing construction, except as specifically required, or allowed, by the Contract Documents.
- C. When any construction deviations from the Drawings and/or Specifications necessary to accommodate equipment supplied by CONTRACTOR, result in additional costs to CONTRACTOR or other contractors, such additional costs shall be borne by CONTRACTOR. CONTRACTOR shall also pay any additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.
- D. Each major component of equipment shall bear a nameplate giving the name and address of the manufacturer and the catalogue number or designation.

##### 1.03 TRANSPORTATION AND HANDLING

- A. Materials, products and equipment shall be properly containerized, packaged, boxed, and protected to prevent damage during transportation and handling.
- B. CONTRACTOR shall not overload any portion of the structure in the transporting or storage of materials.
- C. CONTRACTOR shall not damage other construction by careless transportation, handling, spillage, staining or impact of materials.
- D. CONTRACTOR shall provide equipment and personnel to handle products, including those provided by OWNER, by methods to prevent soiling and damage.
- E. CONTRACTOR shall provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.
- F. CONTRACTOR shall handle product by methods to avoid bending or overstressing. Lift large and heavy components only at designated lift points.

#### 1.04 DELIVERY AND RECEIVING

- A. CONTRACTOR shall arrange deliveries of products in accordance with the Progress Schedule, allowing time for observation prior to installation.
- B. CONTRACTOR shall coordinate deliveries to avoid conflict with the Work and conditions at the Site; work activities of other contractors or OWNER; limitations on storage space; availability of personnel and handling equipment and OWNER's use of premises.
- C. CONTRACTOR shall deliver products in undamaged, dry condition, in original unopened containers or packaging with identifying labels intact and legible.
- D. CONTRACTOR shall clearly mark partial deliveries of component parts of equipment to identify equipment and contents to permit easy accumulation of parts and to facilitate assembly.
- E. Immediately on delivery, CONTRACTOR shall inspect shipment to review that:
  - 1. Product complies with requirements of Contract Documents and reviewed submittals.
  - 2. Quantities are correct.
  - 3. Accessories and installation hardware are correct.
  - 4. Containers and packages are intact and labels legible.
  - 5. Products are protected and undamaged.

#### 1.05 STORAGE AND PROTECTION

- A. General:
  - 1. CONTRACTOR shall store products, immediately on delivery, in accordance with manufacturer's instructions, with all seals and labels intact and legible.
  - 2. Any additional off-site space required shall be arranged by CONTRACTOR.
  - 3. CONTRACTOR shall allocate the available storage areas and coordinate their use by the trades on the job.
  - 4. CONTRACTOR shall arrange storage in a manner to provide access for maintenance of stored items and for observation.
- B. In enclosed storage, CONTRACTOR shall:
  - 1. Provide suitable temporary weather tight storage facilities as may be required for materials that will be damaged by storage in the open.
  - 2. Maintain temperature and humidity within ranges stated in manufacturer's instructions.
  - 3. Provide ventilation for sensitive products as required by manufacturer's instructions.
  - 4. Store unpacked and loose products on shelves, in bins, or in neat groups of like items.
  - 5. Store solid materials such as insulation, tile, mechanical and electrical equipment, fittings, and fixtures under shelter, in original packages, away from dampness and other hazards.
  - 6. Store liquid materials away from fire or intense heat and protect from freezing.
- C. At exterior storage, CONTRACTOR shall:
  - 1. Store unit materials such as concrete block, brick, steel, pipe, conduit, door frames, and lumber off ground, out of reach of dirt, water, mud and splashing.
  - 2. Store tools or equipment that carry dirt outside.
  - 3. Store large equipment so as not to damage the Work or present a fire hazard.
  - 4. Cover products subject to discoloration or deterioration from exposure to the elements, with impervious sheet material and provide ventilation to avoid condensation.



5. Completely cover and protect any equipment or material which is prime coated or finish painted with secured plastic or cloth tarps. Store out of reach of dirt, water, mud and splashing.
6. Store loose granular materials on clean, solid surfaces such as pavement, or on rigid sheet materials, to prevent mixing with foreign matter.
7. Provide surface drainage to prevent erosion and ponding of water.
8. Prevent mixing of refuse or chemically injurious materials or liquids.
9. Cover aggregates such as sand and gravel in cold wet weather.
10. Remove all traces of piled bulk materials at completion of work and return site to original or indicated condition.

#### 1.06 MAINTENANCE OF STORAGE

- A. CONTRACTOR shall periodically inspect stored products on a scheduled basis.
- B. CONTRACTOR shall verify that storage facilities comply with manufacturer's product storage requirements, and verify that manufacturer required environmental conditions are maintained continually.
- C. CONTRACTOR shall verify that surfaces of products exposed to the elements are not adversely affected and that any weathering of finishes is acceptable under requirements of Contract Documents.
- D. CONTRACTOR shall perform scheduled maintenance of equipment in storage as recommended by the manufacturer. A record of the maintenance shall be kept and turned over to ENGINEER when the equipment is installed.

#### 1.07 INSTALLATION REQUIREMENTS

- A. Manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned as directed by the respective manufacturers, unless otherwise specified.
- B. After installation, CONTRACTOR shall protect all materials and equipment against weather, dust, moisture, and mechanical damage.
- C. CONTRACTOR shall be responsible for all damages that occur in connection with the care and protection of all materials and equipment until completion and final acceptance of the Work by OWNER. Damaged material and equipment shall be immediately removed from the Site.

#### 1.08 EQUIPMENT WARRANTIES

- A. Warranties shall be nonprorated, include all parts and labor, and be in written form. Warranties shall specifically exclude buyer's indemnification language. Warranty language shall not eliminate manufacturer's responsibility for sizing of the equipment. During warranty period, manufacturer shall be responsible for any travel expenses, outside contractor fees, and rental equipment fees associated with providing warranty service. Manufacturer shall pay expenses incurred for repairs and parts replacement not made by manufacturer if manufacturer's response is not within 72 hours of notification by OWNER. Warranty language shall be provided with the shop drawings.

## 1.09 CONCRETE EQUIPMENT BASE

- A. Cast-in-place concrete equipment bases shall be provided for all new and relocated equipment including electrical control panels, motor control centers, switchgear, etc. Concrete equipment bases shall be provided by CONTRACTOR except where specifically noted to be provided by others. Bases shall be 3 1/2-inch minimum height and shall be a minimum of 3 inches larger than equipment being supported. Grouting of equipment bases shall be as recommended by equipment manufacturer.
- B. Concrete and grout shall meet applicable sections of the Specifications.
- C. Provide all anchor bolts, metal shapes and templates to be cast in concrete or used to form concrete for support of equipment.

### PART 2-PRODUCTS

NOT APPLICABLE

### PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

## SECTION 01 77 00

### CONTRACT CLOSEOUT

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Closeout Procedures.
  - 2. Final Cleaning.
  - 3. Adjusting.
  - 4. Project Record Documents.
  - 5. Warranties.

##### 1.02 CLOSEOUT PROCEDURES

- A. CONTRACTOR shall provide submittals to ENGINEER that are required by governing or other authorities.
- B. CONTRACTOR shall comply with General Conditions and Supplementary Conditions and complete the following before requesting ENGINEER's observation of the Work or designated portion thereof for substantial completion.
  - 1. Submit executed warranties, workmanship bonds, maintenance agreements, inspection certificates, and similar required documentation for specific units of Work, enabling OWNER's unrestricted occupancy and use.
  - 2. Submit record documentation, maintenance manuals, tools, spare parts, keys, and similar operational items.
  - 3. Submit consent of surety (if surety required in Contract).
  - 4. Complete final cleaning, touch-up work of marred surfaces, and remove temporary facilities and tools.

##### 1.03 FINAL CLEANING

- A. It is CONTRACTOR's responsibility to completely clean up the inside and outside of all buildings and the construction site at the completion of the Work.
- B. CONTRACTOR shall clean areas of the building in which painting and finishing work is to be performed just prior to the start of this work and maintain these areas in satisfactory condition for painting and finishing. This cleaning includes:
  - 1. Removal of trash and rubbish from these areas.
  - 2. Broom cleaning of floors.
  - 3. Removal of any plaster, mortar, dust, and other extraneous materials from finish surfaces, including but not limited to exposed structural steel, miscellaneous metal, masonry, concrete, mechanical equipment, piping, and electrical equipment.
- C. In addition to the cleaning specified above and the more specific cleaning that may be required in various technical sections of the Specifications, CONTRACTOR shall prepare the Project for occupancy by a thorough cleaning throughout, which shall include the following:

1. Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
2. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
3. Replace filters of operating equipment.
4. Clean debris from roofs, gutters, downspouts, and drainage systems.
5. Clean site; sweep paved areas, rake clean landscaped surfaces.
6. Remove waste and surplus materials, rubbish, and construction facilities from the Site.

#### 1.04 ADJUSTING

- A. CONTRACTOR shall adjust operating products and equipment to provide smooth and unhindered operation.

#### 1.05 PROJECT RECORD DOCUMENTS

- A. CONTRACTOR shall maintain on Site one set of the following record documents to record actual revisions to the Work:
  1. Drawings.
  2. Specifications.
  3. Addenda.
  4. Change orders and other modifications to the Contract.
  5. Reviewed shop drawings, product data, and samples.
  6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. CONTRACTOR shall make entries that are complete and accurate, enabling future reference by OWNER.
- C. CONTRACTOR shall store record documents separate from documents used for construction.
- D. CONTRACTOR shall record information concurrent with construction progress.
- E. Specifications: CONTRACTOR shall legibly mark and record at each Product section description of actual products installed, including the following:
  1. Manufacturer's name and product model and number.
  2. Product substitutions or alternates utilized.
  3. Changes made by addenda and modifications.
- F. Record Drawings: CONTRACTOR shall legibly mark each item to record actual construction including:
  1. Measured depths of foundations in relation to finish floor datum.
  2. Measured horizontal and vertical locations of underground utilities and appurtenances referenced to permanent surface improvements.
  3. Measured locations of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of the Work.
  4. Field changes of dimension and detail.
  5. Details not on original Contract Drawings.

## 1.06 WARRANTIES

- A. CONTRACTOR shall provide warranties beyond project one-year warranty as required by technical sections.
- B. Submit warranty information as follows:
  - 1. Provide original copies bearing authorized signatures.
  - 2. Execute and assemble transferable warranty documents from Subcontractors, suppliers, and manufacturers, and provide Table of Contents and assemble in three-ring binder with durable cover.
  - 3. Submit with request for certificate of Substantial Completion.
  - 4. For items of work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance listing date of acceptance as start of warranty period.

### PART 2-PRODUCTS

NOT APPLICABLE

### PART 3-EXECUTION

NOT APPLICABLE

END OF SECTION

SECTION 01 91 00  
STARTING OF SYSTEMS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. General.
  - 2. Equipment and System Installation.
  - 3. Starting Equipment and Systems.
  - 4. Demonstration, Instructions, and Operator Training.
  - 5. Start-Up and Testing.
  - 6. Equipment Systems Requiring Certification of Proper Installation.
  - 7. Equipment Systems Requiring Additional Documentation.
- B. CONTRACTOR shall perform the Work described in the following subsections.

1.02 GENERAL

- A. The number of days for manufacturer's services stated in the Specifications shall be considered as the minimum number of days. Should additional time be required for services because of equipment malfunction or other problem, such time shall be at the expense of CONTRACTOR, with no change in Contract Price.
- B. "Days" specified shall consist of 8-hour days on-site, excluding travel time.
- C. CONTRACTOR shall designate and provide one person to be responsible for scheduling, coordinating, and expediting the specified services. Scheduling the services shall be done in cooperation with, and with the prior approval of ENGINEER and OWNER. Such schedule shall be arranged with the appropriate subcontractors, manufacturers, and suppliers with sufficient time to allow their compliance with the service requirements.
- D. CONTRACTOR shall manage equipment checkout such that checkout has been completed and deficiencies addressed prior to demonstration and training. Scheduling training prior to checkout may result in cancellation when checkout cannot be completed prior to training.

1.03 EQUIPMENT AND SYSTEM INSTALLATION

- A. Competent and experienced technical personnel shall represent the manufacturers of all equipment and systems for as many days as may be necessary to provide proper installation and to resolve assembly or installation problems at the site that are attributable to, or associated with, the equipment furnished. This requirement applies to manufacturers for all equipment furnished, whether or not specifically set forth in the Specifications.
- B. Where a Certificate of Proper Installation is called for in this Specification Section, the manufacturer's representative shall provide the attached Certificate of Proper Installation stating that the equipment or system has been installed in accordance with the manufacturer's instructions and has been inspected by a manufacturer's authorized representative, that it has been serviced with the proper initial lubricants, that applicable

safety equipment has been properly installed, that the proper electrical and mechanical connections have been made, and that any other manufacturer requirements have been met. This certification shall be provided to ENGINEER and OWNER prior to the start-up. This certificate is in addition to the manufacturer's standard startup reports, checklists, and other pertinent information.

- C. Functional (or run) testing is required for all equipment and systems. The manufacturer's representative shall supervise the functional test, which shall include checking for proper rotation, alignment, speed, excessive vibration, and noisy operation. The Manufacturer's Certificate of Proper Installation shall state that proper adjustments have been made and that the equipment or system is ready for start-up.
- D. Manufacturer shall demonstrate, using laser alignment equipment, if appropriate, that the installed equipment has been aligned properly. Final acceptance of equipment will not be granted until manufacturer has demonstrated to ENGINEER that acceptable alignment to tolerances have been achieved. For pumps with motors 7.5 hp and larger, the acceptable shaft alignment tolerances shall be as recommended in the pump manufacturer's written instructions and shall include parallel offset and angular gap measurements.

#### 1.04 STARTING EQUIPMENT AND SYSTEMS

- A. Where field testing and start-up services are called for in the Specifications, or when technical assistance is necessary as a result of any malfunction of the equipment or system furnished, the manufacturer's representative shall provide such services.
- B. Manufacturer's representative shall also conduct and/or assist with performance testing, as required by the Specifications. These services shall continue until such times as the applicable equipment or system has been successfully tested for performance and has been accepted by OWNER for full-time operation.
- C. Coordinate schedule for start-up of various equipment and systems. Coordination includes, but is not limited to, communication with subcontractors, suppliers, OWNER, and ENGINEER. CONTRACTOR shall confirm that all necessary work is complete and that the equipment and systems can be operated in conjunction with all associated processes.
- D. Notify ENGINEER and OWNER a minimum of 7 days prior to start-up of each item using the attached Equipment Startup and O&M Training Scheduling form. CONTRACTOR shall submit form to ENGINEER.
- E. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or for other conditions that may cause damage.
- F. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- G. Verify wiring and support components for equipment are complete and tested.
- H. Execute start-up under supervision of applicable manufacturer's representative and CONTRACTOR's personnel in accordance with manufacturers' instructions.
- I. Require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up and to supervise

placing equipment or system in operation. Authorized representative shall provide approval for starting of systems in writing where specified.

- J. Equipment manufacturer shall provide a written report covering checkout, testing, inspections, and start-up and shall identify any deficiencies noted. Report shall be submitted to ENGINEER. CONTRACTOR shall be responsible for correcting all deficiencies noted in report. In addition, CONTRACTOR shall submit a fully executed Certificate of Proper Installation form if required in Paragraph 3.01 of this section.

#### 1.05 DEMONSTRATION, INSTRUCTIONS, AND OPERATOR TRAINING

- A. For all mechanical equipment and systems and where called for in the Specifications, provide a qualified technical representative to provide detailed instructions to OWNER's personnel for operation and maintenance of equipment and associated instrumentation. Training services shall include pre-start-up classroom instruction and start-up on-site instruction, as stated in the Specifications.
- B. Refer to the Specifications for additional training requirements.
- C. CONTRACTOR shall coordinate the pre-start-up training periods with OWNER's operating personnel and manufacturers' representatives.
  - 1. Schedule training dates and times with OWNER, that are acceptable to the OWNER, using equipment, startup, and O&M training form. Normal hours available for training are between 7:30 A.M. to 3 P.M., Monday through Friday, except for holidays.
  - 2. Submit outline and presentation to ENGINEER at least 7 days in advance of training.
  - 3. Provide name, contact information, and brief synopsis of qualifications of the trainer.
  - 4. If materials above are not provided at least 7 days in advance, training may be canceled.
  - 5. Failure of supplier's or manufacturer's representative to appear for scheduled training, failure to notify OWNER 24 hours in advance of need to cancel scheduled training or failure to arrive within 30 minutes of start of scheduled training shall result in reimbursement to OWNER for time lost by OWNER's personnel in waiting for arrival of manufacturer's representative. Except in case of failure to arrive on time, time will not exceed 1 hour for each employee scheduled to receive training. Failure to arrive on time will be reimbursed by actual time late, up to 1 hour, after 1 hour, training will be rescheduled. CONTRACTOR shall reimburse OWNER via a change order.
  - 6. During the training, instructor will dedicate its time solely to training and not start-up services.
  - 7. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with OWNER's personnel in detail to explain all aspects of operation and maintenance.
  - 8. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment.
  - 9. Prepare and insert additional data in operation and maintenance manuals when need for additional data becomes apparent during instruction.
  - 10. OWNER may videorecord the training for future internal use. Provide to OWNER paper and electronic copies of any media used as part of training.
  - 11. Provide training handouts for each of OWNER's personnel present.



- D. CONTRACTOR shall provide attached Certificate of Operator Training cosigned by OWNER and supplier's representative verifying training was accomplished to satisfaction of all parties.
- E. Operation and maintenance manual submitted in accordance with Section 01 33 00–Submittals shall be provided prior to operator training.
- F. For equipment or systems requiring seasonal operation, perform demonstration for dormant season at start of dormant season.
- G. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to OWNER's satisfaction.
- H. Where items of equipment are placed into service at different times or sequence, manufacturer's services for start-up, field testing, and supervision shall be provided for each time or sequence. Training shall be provided prior to or at the time the first similar item of equipment is placed in service.

#### 1.06 START-UP AND TESTING

- A. Prior to acceptance of any portion of the Work, start-up and testing of all equipment and testing of all materials furnished on the Project by CONTRACTOR shall have been conducted in the presence of representatives of CONTRACTOR, OWNER, and ENGINEER and also manufacturer if requested by OWNER or ENGINEER.
- B. CONTRACTOR shall provide whatever temporary installations and conditions are necessary in order to perform start-up and testing operations on all equipment and materials furnished under the Contract. Temporary connections and equipment necessary during start-up and testing operations shall include, but not be limited to, temporary piping and electrical power and control equipment and devices, temporary connection from various parts of the systems and any other labor, materials, fuel, devices, or items that may be required for start-up and testing operations. Temporary conditions shall include filling with water, if necessary, to check equipment and materials.
- C. All temporary installations and conditions shall be removed by CONTRACTOR upon completion of start-up and testing.

#### PART 2–PRODUCTS

NOT APPLICABLE

#### PART 3–EXECUTION

##### 3.01 EQUIPMENT SYSTEMS REQUIRING CERTIFICATION OF PROPER INSTALLATION

- A. All space and process related heating, cooling, and ventilation equipment and systems specified in Division 23.
- B. Section 26 32 13–Standby Power System.
- C. Section 33 11 34–Deep Well Turbine Pump.

D. All equipment specified in Division 46.

### 3.02 EQUIPMENT SYSTEMS REQUIRING ADDITIONAL DOCUMENTATION

- A. Section 26 09 00—Controls and Instrumentation: Documented date(s) of CONTRACTOR written request for Factory Acceptance Test.
- B. Section 26 09 00—Controls and Instrumentation: Documented date(s) of CONTRACTOR written request for On-Site Acceptance Test.
- C. Section 28 46 00—Fire Alarm System: Documented dates of manufacturer representative visits and site start-up and functional checkout report.

END OF SECTION

TS No. \_\_\_\_\_

EQUIPMENT START-UP AND O&M TRAINING SCHEDULING FORM  
STRAND ASSOCIATES, INC.®

PROJECT \_\_\_\_\_ CLIENT \_\_\_\_\_

CONTRACT \_\_\_\_\_

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

The following equipment is scheduled for start-up on \_\_\_\_\_

EQUIPMENT NAME: \_\_\_\_\_ SPECIFICATION SECTION: \_\_\_\_\_

MANUFACTURER: \_\_\_\_\_ MINIMUM HOURS OF TRAINING: \_\_\_\_\_

DATE O&M MANUALS SUBMITTED: \_\_\_\_\_

Specification Section 01 91 00 requires that start-up and operation and training be conducted by a qualified manufacturer's representative prior to placing equipment in operation. Review Specification Sections 01 33 00 and 01 45 00 and the individual equipment sections for start-up and training requirements. OWNER may find it necessary to propose alternate dates for training based on conflicts with other training and staff availability. The Operation and Maintenance Manuals must be submitted prior to training.

After the equipment or system has been properly installed and is functioning correctly, submit a written report in accordance with Specification Section 01 45 00.

Submit the completed form to ENGINEER and OWNER at least 7 days prior to start-up and training.

Proposed Training Date: \_\_\_\_\_ Time of Training: \_\_\_\_\_

Factory-trained representative giving training:

Name(s): \_\_\_\_\_

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

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

Phone: \_\_\_\_\_

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

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

## CERTIFICATE OF PROPER INSTALLATION

Project\_\_\_\_\_

Equipment\_\_\_\_\_

Specification Section\_\_\_\_\_

Contract\_\_\_\_\_

I hereby certify the equipment supplier/manufacturer has inspected this equipment and that it has been properly installed, adjusted, and calibrated. I further certify this equipment may now be operated for test purposes and/or normal use.

### MANUFACTURER'S REPRESENTATIVE

Signature\_\_\_\_\_Date\_\_\_\_\_

Name (print)\_\_\_\_\_

Title\_\_\_\_\_

Representing\_\_\_\_\_

### CONTRACTOR

Signature\_\_\_\_\_Date\_\_\_\_\_

Name (print)\_\_\_\_\_

Title\_\_\_\_\_

This form shall be completed and submitted to ENGINEER prior to OWNER training.

## CERTIFICATE OF OPERATOR TRAINING

Project\_\_\_\_\_

Equipment\_\_\_\_\_

Specification Section\_\_\_\_\_

Contract\_\_\_\_\_

I hereby certify the equipment supplier/manufacture has instructed OWNER's personnel in the start-up operation and maintenance of this equipment as required in the Specifications.

### MANUFACTURER'S REPRESENTATIVE

Signature\_\_\_\_\_Date\_\_\_\_\_

Name (print)\_\_\_\_\_

Title\_\_\_\_\_

Representing\_\_\_\_\_

### CONTRACTOR

Signature\_\_\_\_\_Date\_\_\_\_\_

Name (print)\_\_\_\_\_

Title\_\_\_\_\_

### OWNER

I hereby state that my operating personnel received instruction for start-up, operation, and maintenance of this equipment.

Signature\_\_\_\_\_Date\_\_\_\_\_

Name (print)\_\_\_\_\_

Title\_\_\_\_\_

END SECTION

Section 01 91 00-8

1602.175/4-2025

## PERMITS

**PUBLIC SERVICE COMMISSION OF WISCONSIN**

Application of the Village of Waunakee, as a Water Public Utility, for Authority to Construct Replacement Well No. 6, Elevated Storage Tank and Well House, in the Village of Waunakee, Dane County, Wisconsin

6260-CW-107

Public Service Commission of Wisconsin  
RECEIVED: 2/19/2025 2:25:00 PM

**FINAL DECISION**

**Introduction**

On October 8, 2024, the Commission received an application from the Village of Waunakee, as a water public utility (applicant), pursuant to Wis. Stat. § 196.49 and Wis. Admin. Code ch. PSC 184. The applicant seeks authority to construct replacement Well No. 6, an elevated storage tank, and a well house, in the Village of Waunakee, at an estimated total cost of \$6,000,000. The Commission found the application in this docket to be complete on December 10, 2024. The Commission issued a Notice of Investigation on December 19, 2024. No hearing was required nor held. No major concerns were brought to the attention of Commission staff.

The application is GRANTED, subject to conditions.

**Findings of Fact**

1. The applicant is a public utility as defined under Wis. Stat. § 196.01(5)(a) and provides water service to approximately 4,964 customers in Dane County.
2. The proposed project consists of constructing replacement Well No. 6, an elevated storage tank, and a well house, at an estimated total cost of \$6,000,000.
3. The type of project proposed and the estimated cost of the project require Commission review and approval under Wis. Stat. § 196.49 and Wis. Admin Code ch. PSC 184.
4. No person requested a hearing in this investigation.
5. The applicant reported total operating revenues of \$2,736,455 in 2023.

6. Based on the applicant's PSC Annual Report, between 2019 and 2023, water sales increased by 36 percent, and average gallons per Residential customer increased by 12 percent.

7. The proposed project is necessary to provide adequate and reliable service for present and future customers.

8. Completion of the proposed project would not substantially impair the efficiency of the service provided by the applicant.

9. Completion of the proposed project would not provide facilities unreasonably in excess of the applicant's probable future requirements.

10. The additional cost-of-service of the proposed project would be proportionate to the increase in value or available quantity of service.

11. No significant environmental consequences are associated with the proposed project.

12. No significant risk of flooding is associated with the proposed project.

13. Authorization of the proposed project is in the public interest.

### **Conclusions of Law**

1. The Commission has authority under Wis. Stat. §§ 1.11, 44.40, 196.02, 196.025, 196.395, and 196.49, and Wis. Admin. Code chs. PSC 4 and 184 to issue a Final Decision and Certificate authorizing the applicant to construct the proposed facilities at an estimated total cost of \$6,000,000.

2. The Commission has authority under Wis. Stat. § 15.02(4) to delegate to the Administrator of the Division of Water Utility Regulation and Analysis those functions vested by law as enumerated above. It has delegated the authority to the Administrator of the Division of



Water Utility Regulation and Analysis to issue a Final Decision and Certificate for the proposed project.

3. The estimated gross cost of this project exceeds the minimum threshold of applicant projects requiring Commission review and approval under Wis. Stat. § 196.49 and Wis. Admin. Code ch. 184.

4. The Commission may impose any term, condition, or requirement necessary to protect the public interest pursuant to Wis. Stat. §§ 196.02, 196.395, and 196.49.

5. The application is a Type III action under Wis. Admin. Code § PSC 4.10(3) and requires neither an environmental impact statement nor an environmental assessment.

### **Opinion**

#### **Project Description and Purpose**

The applicant provides water service to its customers in the Village of Waunakee in Dane County. The applicant's existing water system consists of five wells, one ground storage tank, four elevated storage tanks, and 76.5 miles of water main. The applicant proposes to construct Well No. 6, associated storage, and a well house to replace the existing Well No. 2, which is out of service due to tetrachloroethylene (PCE) contamination.

The proposed project includes the following activities:

- Drilling and construction of a 1,000-1,200 gallons per minute (gpm) Well No. 6 and associated pumping equipment.
- Construction of a 500,000-gallon elevated tank.

- Construction of a 1,300-square-foot Well House No. 6 that includes generator room, fluoride room, chlorine room, pump room, and restroom. ([PSC REF#: 520625](#), page 20.)
- Installation of associate supervisory control and data acquisition (SCADA) equipment and an electrical generator to connect and operate the proposed Well No. 6 to the existing water system.

The proposed well, well house, and elevated storage tank will be located in lot 15 of the Kilkenny West Farms Development Plan, placed adjacent to the intersection between Woodland Drive and County Road Q. The applicant estimated the proposed project will cost \$6,000,000.

### **Project Need**

The applicant owns five wells: Well Nos. 1 to 5. The capacities of Well Nos. 1 to No. 5 are 640 gpm, 900 gpm, 1,300 gpm, 1,280 gpm and 1,200 gpm, respectively. ([PSC REF#: 520615](#), page 31 of 181.) The applicant constructed Well Nos. 1 to 5 between 1927 and 2010. Well Nos. 1 to 5 provide water for 5,358 customers. The applicant operates Well Nos. 1 to 5 on a daily basis for its current potable supply. The applicant treats the water from Well Nos. 1 to 5 with chlorine for disinfection and fluoride for dental protection.

In April 2024, the applicant and its consultant, Ayres Associates, Inc., prepared the “Limited Hydrogeologic Study on Waunakee Wells No. 1 and No. 2 Report” and concluded that the PCE contamination plume was traveling towards Well No. 2, increasing PCE contamination in the well above the current maximum contaminant level (MCL) for PCE according to Wisconsin Department of Natural Resources (DNR). ([PSC REF#: 520615](#), page 30 of 181.) Due to the identified contamination above the existing 5 micrograms per liter ( $\frac{\mu\text{gr}}{\text{L}}$ ) MCL, the

applicant removed Well No. 2 from service in April 2024, losing 900 gpm of water production capacity and decreasing the existing total well capacity (TWC) of the applicant's system from 5,320 gpm to 4,420 gpm.

Furthermore, the applicant's existing firm well capacity (FWC), including Well No. 2, is 4,020 gpm, which meets the current maximum day demand (MDD) of 2,440 gpm. However, without Well No. 2 in service, the FWC is reduced to 3,120 gpm, which still meets the current MDD but results in a shortage of 760 gpm for the projected 2030 MDD of 3,800 gpm. Therefore, the applicant proposes to drill a new Well No. 6 with an approximate water production capacity between 1,000-1,200 gpm to replace the existing contaminated water source and increase the applicant's FWC to be between 4,120-4,220 gpm and its TWC to be between 5,420-5,620 gpm. Along with the new well, the applicant proposes to construct a new well house with associated SCADA control and water treatment.

Additionally, in 2018, the applicant and its consultant, Strand Associates, developed a Report called "2018 Water Study", and found that the applicant will have a 235,800 gallon storage deficit in 2030. According to the Wisconsin Department of Administration projections, the applicant will experience a 21 percent population increase from 2020 to 2030, increasing the number of habitants from 14,879 to 17,996. ([PSC REF#: 520615](#), page 177 of 181.) Thus, the applicant proposes to construct a new 500,000-gallon water storage tank along with the new proposed Well No. 6 to meet water demand and water storage needs by 2030 and provide enough water service to its customers over the next 10 years. ([PSC REF#: 520278](#), page 32 of 44.)

## **Alternatives**

The applicant evaluated three alternatives. The first and selected option involved the construction of a new well, well house, and associated elevated storage tank. The applicant selected this option because it addresses the required water source replacement of Well No. 2, increases the storage capacity of the system to meet water demand until 2030, and it will recover the TWC and FWC of the applicant's water system. Additionally, this project has a smaller upfront cost, and it does not require additional land purchase or installation of a long water main connection as other alternatives need. The applicant estimated the project will cost \$6,000,000.

The second alternative involved the installation of a granular activated carbon (GAC) treatment facility on the existing Well No. 2 and the construction of a new storage tank on separated land. Even though this option would solve the PCE contamination problem from Well No. 2, the applicant did not select this alternative because the installation of a new GAC treatment train, well house, and water storage would require the purchase of new land and the installation of two miles of water main transmission located between Well Nos. 2 and 3. The need to purchase new land and install new water main would raise the cost of the project to be higher than all the other analyzed alternatives. The applicant estimated that this alternative would cost \$8,000,000.

The third alternative involved the reconstruction of Well No. 2. The applicant did not select this alternative because of the uncertainty of its effectiveness in reducing the PCE contamination. Although this option has the lowest cost of all the analyzed alternatives, the applicant considered drilling a deeper Well No. 2 and installing a liner to be too risky based on the uncertainty of the current and future location of the PCE plume within the aquifer. The

reconstruction of Well No. 2 was also considered risky as the well is 60 years old and was constructed in 1964. ([PSC REF#: 520615](#), page 35 of 181.) The applicant estimated that this alternative would cost \$3,500,000.

### **Environmental Review**

Commission and DNR staff reviewed the proposed project for impacts to environmental resources, including historic resources, wetlands, waterways and any sensitive habitat, endangered resources, and community resources. No significant environmental consequences are associated with the proposed project.

The applicant provided an Endangered Resources Preliminary Assessment which stated that the proposed project is covered under the Broad Incidental Take Permit/Authorization for No/Low Impact Activities with no further actions necessary for the project. The proposed construction is not anticipated to impact any threatened or endangered species under Wis. Stat. § 29.604.

Commission authorization of the proposed project is not expected to have any effects on historic properties. A portion of Wisconsin Historic Preservation Database property DA-0375 (Schunk and Eugel Site) would be in the direct Area of Potential Effect of the proposed project but does not likely retain sufficient integrity or information potential to be considered a historic property. ([PSC REF#: 524084](#) at point 7.) The applicant included an Inadvertent Discovery Protocol that should be followed if the project is constructed.

The applicant provided a conservative desktop review of the DNR's Surface Water Data Viewer that found no wetlands or waterways present within or in proximity to the proposed location for construction activities.

This is a Type III action under Wis. Admin Code § PSC 4.10(3). No unusual circumstances suggesting the likelihood of significant environmental effects on the human environment have come to the Commission's attention. Neither an environmental impact statement under Wis. Stat. § 1.11 nor an environmental assessment is required.

### **Project Cost, Construction Schedule, Rate Impact**

The total estimated cost of this project is \$6,000,000. The applicant plans to fund this project with \$6,000,000 from Safe Drinking Water Loan Program funds. The applicant plans to construct the proposed project from March 2025 to June 2027. Commission staff estimates that implementation of this project will result in the need to increase customer water rates by 31 percent. The Commission provides the estimated rate impact for general information. The actual amount of any rate increase would be determined at the time the applicant submits an application for a rate increase. The amount of any increase would depend on several factors including, but not limited to, project financing, growth in customer demand, inflation, actual project costs, and the rate of return authorized.

### **Conclusion**

The project, as conditioned herein, complies with Wis. Stat. § 196.49(3)(b). The project will not substantially impair the efficiency of the applicant's service. The proposed project will replace an old, contaminated water source that currently is not serving the applicant's customers. The proposed project will enhance the efficiency of the applicant's water service by installing new, more efficient pumping equipment under automatic operation that will save energy and manual labor costs. Furthermore, the proposed water storage will increase the resiliency of the

applicant's water system to respond to future water demand. No interruptions of the water service are expected due to the proposed project.

Completion of this project will not provide facilities unreasonably in excess of the applicant's probable future requirements. The applicant designed the proposed well and elevated storage tank to meet projected water demand according to the applicant's estimated population increase. The increase in storage will meet water storage needs up to 2030, and the proposed well will recover the FWC to meet current MDD and 2030 MDD.

When placed in service, the project will increase the value of available quantity of service in proportion to the addition to the applicant's cost of service. The increase in water storage and a new well will ensure the resilience of the applicant's water service and provide adequate volume and storage for future demand, while increasing the reliability of the water system to provide service to the applicant's customers.

### **Certificate**

The Village of Waunakee, as a water public utility, is authorized to construct the facilities proposed in its October 8, 2024 application, at a total cost of \$6,000,000, subject to the conditions in this Final Decision.

### **Order**

1. The applicant's application for authority to construct facilities in Dane County, at an estimated total cost of \$6,000,000, is granted.
2. The Commission, consistent with its past practice, shall review in a future rate proceeding the recoverability of costs associated with the project. If it is discovered or identified that the project cost, including *force majeure* costs, may exceed the estimated cost by more than

10 percent, the applicant shall, within 30 days of when it becomes aware of the possible change or cost increase, notify the Commission of the accounts or categories where costs deviate from those authorized and shall itemize and segregate those costs by major accounts and provide sufficient documentation to support and explain the reasons for such deviations.

3. The applicant shall notify and obtain approval from the Commission before proceeding with any substantial change in the scope, design, size, or location of the approved project.

4. The applicant shall obtain all necessary federal, state, and local permits prior to commencement of construction.

5. If the applicant does not begin on-site physical construction within two years of the effective date of this Final Decision, the certificate authorizing the project shall become void unless the applicant: (a) files a written request for an extension of time with the Commission before the date on which the certificate becomes void; and (b) is granted an extension by the Commission.

6. If the applicant has not begun on-site physical construction and has not filed a written request for an extension before the date the certificate becomes void, the applicant shall inform the Commission of those facts in writing within 20 working days after the date on which the certificate becomes void.

7. The applicant shall submit to the Commission the final actual costs segregated by the Commission's uniform system of accounts within one year after the in-service date. For those accounts where actual costs deviate significantly from those authorized, the final cost report shall itemize and explain the reasons for any such deviations.



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8. This Final Decision takes effect one day after the date of service.

9. Jurisdiction is retained.

Dated at Madison, Wisconsin, this 19<sup>th</sup> day of February, 2025.

For the Commission:

A handwritten signature in black ink, appearing to read 'A.P. Galvin', followed by a horizontal line extending to the right.

Andrew P. Galvin

Administrator

Division of Water Utility Regulation and Analysis

APG:GAU:rgs DL:02056408

Attachment: Notice of Rights

PUBLIC SERVICE COMMISSION OF WISCONSIN  
4822 Madison Yards Way  
P.O. Box 7854  
Madison, Wisconsin 53707-7854

**NOTICE OF RIGHTS FOR REHEARING OR JUDICIAL REVIEW, THE  
TIMES ALLOWED FOR EACH, AND THE IDENTIFICATION OF THE  
PARTY TO BE NAMED AS RESPONDENT**

The following notice is served on you as part of the Commission's written decision. This general notice is for the purpose of ensuring compliance with Wis. Stat. § 227.48(2), and does not constitute a conclusion or admission that any particular party or person is necessarily aggrieved or that any particular decision or order is final or judicially reviewable.

*PETITION FOR REHEARING*

If this decision is an order following a contested case proceeding as defined in Wis. Stat. § 227.01(3), a person aggrieved by the decision has a right to petition the Commission for rehearing within 20 days of the date of service of this decision, as provided in Wis. Stat. § 227.49. The date of service is shown on the first page. If there is no date on the first page, the date of service is shown immediately above the signature line. The petition for rehearing must be filed with the Public Service Commission of Wisconsin and served on the parties. An appeal of this decision may also be taken directly to circuit court through the filing of a petition for judicial review. It is not necessary to first petition for rehearing.

*PETITION FOR JUDICIAL REVIEW*

A person aggrieved by this decision has a right to petition for judicial review as provided in Wis. Stat. § 227.53. In a contested case, the petition must be filed in circuit court and served upon the Public Service Commission of Wisconsin within 30 days of the date of service of this decision if there has been no petition for rehearing. If a timely petition for rehearing has been filed, the petition for judicial review must be filed within 30 days of the date of service of the order finally disposing of the petition for rehearing, or within 30 days after the final disposition of the petition for rehearing by operation of law pursuant to Wis. Stat. § 227.49(5), whichever is sooner. If an *untimely* petition for rehearing is filed, the 30-day period to petition for judicial review commences the date the Commission serves its original decision.<sup>1</sup> The Public Service Commission of Wisconsin must be named as respondent in the petition for judicial review.

If this decision is an order denying rehearing, a person aggrieved who wishes to appeal must seek judicial review rather than rehearing. A second petition for rehearing is not permitted.

Revised: March 27, 2013

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<sup>1</sup> See *Currier v. Wisconsin Dep't of Revenue*, 2006 WI App 12, 288 Wis. 2d 693, 709 N.W.2d 520.

SECTION 03 11 00  
CONCRETE FORMWORK

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. Forms for Cast-In-Place Concrete.
  - 2. Form Accessories.
  - 3. Openings For Other Work.
  - 4. Form Stripping.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ACI 117–Tolerances for Concrete Construction.
- B. ACI 301–Structural Concrete for Buildings.
- C. ACI 318–Building Code Requirements for Reinforced Concrete.
- D. ACI 347–Recommended Practice for Concrete Formwork.
- E. PS1–Construction and Industrial Plywood.
- F. NSF/ANSI 61–Drinking Water System Components.

1.03 DESIGN

- A. All formwork shall comply with ACI 347 and ACI 301.
- B. CONTRACTOR shall assume the responsibility for the complete design and construction of the formwork.

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01 33 00–Submittals for form ties, form coatings, and any other form accessories.

PART 2–PRODUCTS

2.01 FORMS

- A. Forms shall be of wood, plywood, steel, fiberboard lined, or other approved materials which will produce concrete which meets the specified requirements. The type, size, quality, and shape of all materials of which the forms are made are subject to the review of ENGINEER.

- B. Caution shall be exercised in the use of wood or composition forms or form liner to be certain that no chemical reaction will take place which causes a damaging effect on the concrete surface.

## 2.02 FORM TIES–NONREMOVABLE

- A. Internal wall ties shall contain positive stops at the required wall thickness. The exterior clamp portions of the tie shall be adjustable in length. Ties shall provide a positive disconnection on both ends 1 to 1 1/2 inches inside the finished face of the concrete.
- B. The use of wood spacers and wire ties will not be approved.

## 2.03 FORM COATINGS

- A. Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.

## 2.04 CHAMFER STRIPS

- A. Provide 3/4-inch by 3/4-inch wood or plastic chamfer strips at all exposed corners, except as noted.

## 2.05 KEYWAYS

- A. Keyways shall be formed with wood inserts.

# PART 3–EXECUTION

## 3.01 CONSTRUCTION

- A. Forms shall conform to the shape, line, grade, and dimensions as shown on the Drawings. They shall be mortar-tight and sufficiently rigid to prevent displacement or sagging between supports and shall support the loads and pressures without deflection from the prescribed lines. They shall be properly braced or tied together so as to maintain position and shape. Spacing of ties shall be recommended by the tie manufacturer.
- B. Formwork and finished concrete construction shall meet the tolerances specified in ACI 117.
- C. Architectural surfaces and surfaces to be fitted with equipment shall be formed to match the shape intended. Where indicated on the Drawings, the form shall be lined with minimum 3/8-inch masonite and shimmed as required.
- D. When forms are placed for successive concrete placement, thoroughly clean concrete surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets.
- E. At the request of ENGINEER, temporary openings shall be provided at the base of column forms and wall forms and at other points where necessary to facilitate cleaning and observation immediately before depositing concrete.

- F. Provide inserts and provide openings in concrete form work to accommodate work of other trades. Verify size and location of openings, recesses, and chases with the trade requiring such items. Securely support items to be built into forms.
- G. Bevel wood inserts for forming keyways (except in expansion joints where inserts shall have square edges), reglets, recesses, and the like to allow for ease of removal. Inserts shall be securely held in place prior to concrete placement. Unless otherwise shown, chamfer strips shall be placed in the angles of the forms to provide 3/4-inch bevels at exterior edges and corners of all exposed concrete.
- H. The forms shall be oiled with a field-applied commercial form oil or a factory-applied nonabsorptive liner. Oil shall not stain or impede the wetting of surfaces to be cured with water or curing compounds. The forms shall be coated prior to placing reinforcing steel. Oil on reinforcement will not be permitted.
- I. All form surfaces shall be thoroughly cleaned, patched, and repaired before reusing and are subject to review of ENGINEER.

### 3.02 FORM REMOVAL

- A. Supporting forms and shoring shall not be removed until the member has acquired sufficient strength to support its own weight and the construction live loads on it.
- B. All form removal shall be accomplished in such a manner that will prevent injury to the concrete.
- C. Forms shall not be removed before the expiration of the minimum times or until the concrete has attained its minimum 28-day design strength as confirmed by concrete cylinder tests, unless specifically authorized by ENGINEER. Wall and Vertical Faces: 24 hours.

END OF SECTION

SECTION 03 20 00  
CONCRETE REINFORCEMENT

PART 1—GENERAL

1.01 SUMMARY

- A. Work includes providing complete, in-place, all steel and fibers required for reinforcement of cast-in-place concrete as shown on the Drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. Applicable standards listed in this section include, but are not necessarily limited to the following:
  - 1. ACI 315—Manual of Standard Practice for Detailing Reinforced Concrete Structures.
  - 2. ACI 318—Building Code Requirements for Reinforced Concrete.
  - 3. ASTM A615—Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
  - 4. ASTM A996—Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcing.
  - 5. ASTM C1116—Standard Specification for Fiber-Reinforced Concrete.
  - 6. CRSI—Manual of Standard Practice.

1.03 SUBMITTALS

- A. Comply with pertinent provisions of Section 01 33 00—Submittals.
- B. Provide complete shop drawings of all material to be furnished and installed under this section:
  - 1. Before fabrication of the reinforcement is begun, CONTRACTOR shall obtain the approval of ENGINEER on reinforcing bar lists and placing drawings.
  - 2. These drawings and lists shall show in detail the number, size, length, bending, and arrangement of the reinforcing. Reinforcing supports shall also be located on the shop drawings.
  - 3. Shop drawings shall be in accordance with ACI 315.

1.04 PRODUCT HANDLING

- A. Delivery:
  - 1. Deliver reinforcement to the job site bundled, tagged, and marked.
  - 2. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.
- B. Storage: Store reinforcement at the job site on blocks and in a manner to prevent damage and accumulation of dirt and excessive rust.

## PART 2-PRODUCTS

### 2.01 MATERIALS

- A. Reinforcing bars shall comply with ASTM A615 or A996 Type R, Grade 60. Reinforcing bars required to be welded shall be ASTM A706 low alloy.
- B. Reinforcement supports, including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place shall be:
  - 1. Wire bar-type supports complying with CRSI recommendations, unless otherwise indicated.
  - 2. For slabs on grade, supports with sand plates, or horizontal runners where base material will not support chair legs.
  - 3. For exposed-to-view concrete surfaces or where the concrete surface will be exposed to weather or moisture, where legs of supports are in contact with forms, supports with either hot-dipped galvanized or plastic protected legs.
  - 4. When supports bear directly on the ground and it is not practical to use steel bar supports, precast concrete blocks may be used to support only the bottom lift of reinforcement. The precast blocks must be solid, be of an equal or higher strength than the concrete being placed, must provide adequate support to the reinforcement, and be of proper height to provide specified reinforcing cover. The use of face bricks, hollow concrete blocks, rocks, wood blocks, or other unapproved objects will not be permitted.
- C. Fibrous Reinforcing:
  - 1. Fibrous concrete reinforcement shall be Fibermesh 300, manufactured by Propex Concrete Systems, or equal.
  - 2. Reinforcement shall be 100% virgin polypropylene fibrillated, multi-length graded fiber containing no reprocessed olefin materials and specifically manufactured for use as concrete secondary reinforcement.
  - 3. Physical Characteristics:
    - a. Specific Gravity: 0.91.
    - b. Fiber Length: Multidesign gradation.
- D. Mechanical Splices and Threaded Couplers:
  - 1. Mechanical splices shall be Zap Screwlok by Bar Splice Products, Inc., or equal.
  - 2. Threaded couplers and dowel bar replacements shall be Dowel Bar Splicer System by Dayton/Richmond, or equal.
  - 3. Mechanical splices and couplers shall be capable of developing at least 125% of the yield strength of the reinforcing bar.

### 2.02 FABRICATION

- A. General:
  - 1. Fabricate reinforcing bars to conform to required shapes and dimensions with fabrication tolerances which comply with CRSI Manual.
  - 2. In case of fabricating errors, do not rebend or straighten reinforcement in a manner that will injure or weaken the material.
  - 3. Unless otherwise shown on the Drawings, all end hook dimensions shall conform with "ACI Standard Hooks."
- B. Reinforcement with any of the following defects shall be deemed unacceptable and will not be permitted in the work:

1. Bar lengths, depths, and bends exceeding specified fabrication tolerances.
2. Bend or kinks not indicated on Drawings or final shop drawings.
3. Bar with reduced cross section because of excessive rusting or other cause.

## PART 3-EXECUTION

### 3.01 INSPECTION

- A. Examine the substrate, formwork, and the conditions under which concrete reinforcement is to be placed.
- B. Correct conditions detrimental to the proper and timely completion of the work.
- C. Do not proceed until unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. General:
  1. Comply with the specified standards for details and methods of placing reinforcement and supports.
  2. Clean reinforcement to remove loose rust, mill scale, earth, and other materials that reduce or destroy bond with concrete.
- B. Placing Reinforcement:
  1. All reinforcing shall be placed in accordance with Contract Drawings and with shop drawings stamped and approved by ENGINEER.
  2. Position, support, and secure reinforcing against displacement by formwork, construction, or concrete placement operations.
  3. Support reinforcing by metal chairs, runners, bolsters, spacers, and hangers as needed.
  4. Unless otherwise shown on the Drawings, the reinforcement is to be so detailed and placed as to allow the following concrete protection:
    - a. Three inches of cover where the concrete is placed directly against ground.
    - b. Two inches of cover where the concrete is placed in forms but is to be exposed to weather, liquid, or the ground.
    - c. One-inch cover in slabs and walls not exposed to weather, liquid, or the ground.
    - d. One and one-half-inch cover in beams, girders, and columns not exposed to weather, liquid, or the ground. This cover applies to beam stirrups and column ties where applicable.
  5. Reinforcement shall be positioned within  $\pm 3/8$  inch for members with depth to tension reinforcing from compression face less than or equal to 8 inches. Tolerance shall be  $\pm 1/2$  inch for members with depth to tension reinforcing from compression face greater than 8 inches. Tolerance on dimension between adjacent bars in slab and wall reinforcing mats shall be 1 inch. Secure against displacement by anchoring at the supports and bar intersections with wire or clips.
  6. Bars shall be securely tied at all intersections, except where spacing is less than 1 foot in each direction when alternate intersections shall be tied. To avoid interference with embedded items, bar spacing may be varied slightly if acceptable to ENGINEER. Tack welding of reinforcing will not be permitted.
  7. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.
  8. If reinforcing must be cut because of openings or embedded items in the concrete, additional reinforcing must be provided adjacent to the opening at least equal in cross



- sectional area to that reinforcing which was cut, and it shall extend a minimum of 36 bars diameters beyond the opening on each side or as shown on the Drawings. At sumps or depressions in slabs, bars shall be bent and/or extended under sumps or depressions.
9. Wall reinforcing mats shall be secured in a vertical plane by providing clearance from forms with bar supports and by using Z-shaped bars at  $\pm 4$  feet on center wired between two mats of steel, spacing and staying both of them. Nails shall not be driven into the forms to support reinforcement and neither shall wire for this purpose come in contact with the forms. Alternate top transverse bars in slab shall be supported by individual bar chairs at approximately 3 foot 0-inch centers. Bottom longitudinal bars shall be supported by continuous bar chairs at approximately 4 foot 0-inch centers.
  10. If carrier bars are to be used, CONTRACTOR shall provide reinforcing bars for this purpose in addition to the reinforcing called for by the Drawings and Specifications.
- C. Reinforcement Supports:
1. Strength and number of supports shall be sufficient to carry reinforcement.
  2. Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support.
  3. Do not use supports as bases for runways for concrete-conveying equipment and similar construction loads.
- D. Splices:
1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying.
  2. Lap splices in reinforcing shall be provided as shown on the Drawings. Where lap splice lengths are not shown on the Drawings, provide Class B, Category 1 lap splices in accordance with ACI 318.
  3. Adjacent splices of tangential bars in circular slabs and horizontal bars in circular walls shall be staggered a minimum of one full lap splice length or 3 feet, whichever is greater, unless otherwise shown. Stagger dimension shall be measured from center to center of lap splices.
  4. For circular walls, horizontal bar lap splices shall not coincide in vertical arrays more frequently than every third bar.
  5. Mechanical splices and threaded dowel bar inserts may be used where acceptable to ENGINEER.
- E. Embedded Items:
1. Allow other trades to install embedded items as necessary.
  2. Particularly after bottom layer of reinforcing is placed in slabs, allow electrical contractors to install conduit scheduled for encasement in slabs prior to placing upper layer of reinforcing.
- F. Fibrous Reinforcing:
1. Fibrous concrete reinforcing shall be used in all building interior slab-on-grade concrete and all precast concrete topping, and where shown on the Drawings.
  2. Add fibers at a minimum rate of 1.5 pounds per cubic yard.
  3. Mix concrete in strict accordance with reinforcement manufacturer's recommendations.

END OF SECTION

## SECTION 03 30 00

### CAST-IN-PLACE CONCRETE

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. All cast-in-place concrete as shown except as noted otherwise.
  - 2. Expansion joint fillers, bonding agents, patching mortars, curing compounds, nonshrink grout, grout topping, floor sealer, and other related items and accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ACI 211.1—Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- B. ACI 301—Specifications for Structural Concrete.
- C. ACI 304R—Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- D. ACI 305R—Guide to Hot Weather Concreting.
- E. ACI 306R—Guide to Cold Weather Concreting.
- F. ACI 308—Specification for Curing Concrete.
- G. ACI 309—Guide for Consolidation of Concrete.
- H. ACI 318—Building Code Requirements for Structural Concrete and Commentary.
- I. ASTM C31—Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- J. ASTM C33—Standard Specification for Concrete Aggregates.
- K. ASTM C39—Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- L. ASTM C40—Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
- M. ASTM C88—Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
- N. ASTM C94—Standard Specification for Ready-Mixed Concrete.
- O. ASTM C143—Standard Test Method for Slump of Hydraulic-Cement Concrete.
- P. ASTM C150—Standard Specification for Portland Cement.

- Q. ASTM C156—Standard Test Method for Water Loss (from a Mortar Specimen) Through Liquid Membrane-Forming Curing Compounds for Concrete.
- R. ASTM C172—Standard Practice for Sampling Freshly Mixed Concrete.
- S. ASTM C231—Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- T. ASTM C260—Standard Specification for Air-Entraining Admixtures for Concrete.
- U. ASTM C309—Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- V. ASTM C494—Standard Specification for Chemical Admixtures for Concrete.
- W. ASTM C595—Standard Specification for Blended Hydraulic Cements.
- X. ASTM C618—Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- Y. ASTM C652—Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale).
- Z. ASTM D994—Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- AA. ASTM D1752—Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

### 1.03 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01 33 00—Submittals.
- B. Submit the following information:
  - 1. Gradation of fine and coarse aggregate—ASTM C33.
  - 2. Specific gravity and dry rodded density of each aggregate.
  - 3. Test of deleterious substances in fine and coarse aggregate—ASTM C33.
  - 4. Design mix of each individual concrete mix to be used.
  - 5. Previous test results or trial batch results with 7- and 28-day compressive strengths for each concrete mix proposed.
  - 6. Certified mill test results for cement identifying brand, type, and chemistry of cement to be used.
  - 7. Brand, type, principal ingredient, and amount of each admixture to be used.
- C. It is important that the above data be submitted to ENGINEER well in advance of anticipated concreting operations to avoid any delay in construction.

## PART 2—PRODUCTS

### 2.01 CEMENT

- A. Cement shall be Portland cement Type I/II conforming to ASTM C150 or Portland limestone cement Type IL conforming to ASTM C595. All cement shall be the product of one reputable manufacturer and mill.

- B. Cement shall be stored in a dry, weathertight, properly ventilated structure with the floor raised not less than 1 foot above the ground.

## 2.02 FLY ASH

- A. All fly ash used as an admixture in Portland cement or Portland limestone cement concrete shall be Class C or F conforming to the requirements of ASTM C618.

## 2.03 AGGREGATE

- A. All aggregates shall be washed and shall consist of natural sand, gravel, or crushed rock and shall have clean, hard, durable, uncoated grains of strong minerals. The amounts of deleterious substances present in the fine and coarse aggregate expressed in percentages by weight shall not exceed the following:

| Deleterious Substance            | Aggregate |        |
|----------------------------------|-----------|--------|
|                                  | Fine      | Coarse |
| Clay Lumps and Friable Particles | 3.0       | 3.0    |
| Coal and Lignite                 | 0.5       | 0.5    |
| Mineral finer than No. 200 sieve | 3.0       |        |
| Soft Fragments                   | 3.0       | 3.0    |
| Chert*                           | ---       | 5.0    |
| Sum of Chert and Clay Lumps      |           | 5.0    |

\* Material classified as chert and having a bulk specific gravity of less than 2.45. The percentage of chert shall be determined on the basis of the weight of chert in the sample retained on a 3/8-inch sieve divided by the weight of the total sample.

- B. The combined amount of all deleterious substances in an aggregate shall not exceed 5% of the weight of the aggregate.
- C. If requested by ENGINEER, sodium sulfate soundness tests (ASTM C88) shall be performed on the aggregate. When the aggregate is subjected to 5 cycles, the weight loss shall not exceed 12%. Samples of proposed aggregates shall be submitted to an independent laboratory for testing in advance of concrete work. All testing shall be performed in accordance with ASTM C33. Certified test results shall be submitted to ENGINEER confirming that aggregate complies with all stated specifications. Report shall identify source of aggregate and absorbed water.
- D. Fine aggregate shall be well-graded from coarse to fine and shall conform to the following requirements:

| Percentage by Weight   |        |
|------------------------|--------|
| Passing 3/8-inch sieve | 100    |
| Passing No. 4 sieve    | 95-100 |
| Passing No. 8 sieve    | 80-100 |
| Passing No. 16 sieve   | 50-85  |
| Passing No. 30 sieve   | 25-60  |
| Passing No. 50 sieve   | 5-30   |
| Passing No. 100 sieve  | 0-10   |

- E. Gradation of fine aggregate shall be reasonably uniform and not subject to the extreme percentages of gradation specified above. The fineness modulus shall be not less than 2.3 or more than 3.1, nor shall the fineness modulus of any sample vary by more than +0.20 from the fineness modulus of the representative sample used in proportioning the concrete.
- F. If requested by ENGINEER, fine aggregate shall be subjected to the color-metric test for organic impurities (ASTM C40) and shall not produce a color darker than Figure 1, unless they pass the mortar strength test. Aggregate producing color darker than Figure 2 shall not be used in any event.
- G. Coarse aggregate shall be well-graded from coarse to fine, and when tested by laboratory sieves having square openings, shall conform to the following requirements:

|                          | Percentage by Weight<br>Aggregate |
|--------------------------|-----------------------------------|
|                          | 3/4-Inch Stone                    |
| Passing 2-inch sieve     | ---                               |
| Passing 1 1/2-inch sieve | ---                               |
| Passing 1-inch sieve     | 100                               |
| Passing 3/4-inch sieve   | 90-100                            |
| Passing 3/8-inch sieve   | 20-55                             |
| Passing No. 4 sieve      | 0-10                              |
| Passing No. 8 sieve      | 0-5                               |

- H. Aggregates must be allowed to drain for at least 12 hours before being used. The ground upon which aggregates are stored must be hard, firm, well-drained, and free from all vegetable matter. Various sizes of aggregates must be stored separately, and if they have become contaminated or merged with each other, they shall not be used.

## 2.04 WATER

- A. Water used in mixing concrete shall be clean and free from injurious amounts of oil, alkali, organic matter, or other deleterious substances.

## 2.05 ADMIXTURES

- A. Water Reducing Admixture shall be Master Pozzolith® 200 by Master Builders Solutions, Daracem 19 by Grace, or equal. Water reducing admixture shall conform to ASTM C494, Type A and Type F. Water reducing admixture shall not reduce durability, shall increase strength 10%, and shall not affect bleeding characteristics over reference mix.
- B. Air-Entraining Admixture shall be equal to MasterAir® AE 90 by Master Builders Solutions, Darex by Grace Construction Products, or equal. Air-entraining admixture shall conform to ASTM C260.
- C. No other admixture will be allowed without written approval of ENGINEER. All admixture shall be compatible with cement, aggregate, and water used.

## 2.06 PROPORTIONING

- A. The proportions of aggregate to cement shall be such as to produce a workable mixture that can be thoroughly compacted and that will work readily in the forms and around reinforcement without permitting materials to segregate or excess water to collect on the surfaces. The combined aggregates shall be such that when separated on the No. 4 sieve, the weight passing the sieve shall not be less than 30% nor greater than 50%.
- B. Concrete of various classes shall have the following maximum water/cement or water/(cement + fly ash) ratio minimum compressive strengths at 28 days and minimum cement and fly ash contents:

| Class | Maximum Water/<br>Cement or Water/<br>(Cement+Fly Ash) | Minimum 28 Day<br>Strength-Pounds<br>per Square Inch | Cement<br>Content-Pounds<br>per Cubic Yard | Fly Ash-<br>Pounds per<br>Cubic Yard |        |
|-------|--------------------------------------------------------|------------------------------------------------------|--------------------------------------------|--------------------------------------|--------|
|       |                                                        |                                                      |                                            | Type C                               | Type F |
| A     | 0.45                                                   | 4,000                                                | 564                                        | ---                                  | ---    |
| A-FA  | 0.45                                                   | 4,000                                                | 480                                        | 110                                  | 125    |
| X     | ---                                                    | 2,000                                                | 376                                        | ---                                  | ---    |

- C. Unless noted otherwise on the Drawings or in the Specifications, all other concrete shall be Class A or Class A-FA concrete.
- D. All concrete mixes shall be designed for a strength of 15% above that specified to allow for job variations. All mixes shall be designed in accordance with ACI 211.1 by a qualified concrete engineer or qualified laboratory technician. Required materials test data shall be submitted with design mixes for review and approval by ENGINEER. Mix computations shall be submitted if requested by ENGINEER.
- E. The slump for all concrete shall be 3 inches and concrete with a slump within the range of 2 to 3 1/2 inches will be acceptable, unless otherwise stated.
- F. A water-reducing admixture shall be used in all concrete. A qualified representative of the manufacturer shall be available to assist in proportioning the concrete, advise on the proper addition of the admixture to the concrete, and advise on adjustments of concrete proportions to suit job conditions.
- G. An air-entraining admixture shall be used in all concrete except as noted. Air content shall be tested by the pressure method as outlined in ASTM C231 and shall be between 4% to 7% by volume. An air-entraining admixture is not required for concrete patching and for concrete floors, equipment pads, and supports in interior heated buildings where the concrete will be protected from freezing during and after construction.
- H. CONTRACTOR shall submit to ENGINEER concrete cylinder compressive strength results from previous projects for the same concrete mixes proposed on the current project. If this information is not available, one cubic yard trial batches of each individual mix proposed for use shall be made prior to use in the work. Four test cylinders shall be made for each trial batch, two to be tested at 7 days and two at 28 days. The trial batches shall be made preceding actual placement operations so that the results of the 7-day tests can be obtained. All costs for material, equipment, and labor incurred during design of concrete mixes shall be borne by CONTRACTOR.

- I. All aggregates shall be measured by weight. The concrete mixer is to be equipped with an automatic water-measuring device that can be adjusted to deliver the desired amount of water.

## 2.07 JOINT FILLER

- A. Expansion joints shall have standard 1/2-inch-thick cork expansion joint filler, W. R. Meadows, or equal, meeting ASTM D1752–Type II. Exceptions to this are expansion joints in exterior concrete walks and between concrete walks and other structures which shall be asphalt expansion joint filler, 1/2-inch-thick, Grace, W.R. Meadows, or equal, meeting ASTM D994.

## 2.08 BONDING AGENT

- A. Bonding agent for bonding new concrete to existing concrete at construction joints and for bonding concrete overlays to existing concrete shall be a liquid latex product meeting ASTM C1059, Type II. Acceptable products include Euroweld 2.0 by Euclid Chemical, Acrylic Bonding Agent J40 by Dayton Superior, or equal.

## 2.09 PATCHING ADDITIVE

- A. Acceptable manufacturers include MasterEmaco® A 660 by Master Builders Solutions, Sonocrete by Sonneborn Contech Co., or equal.

## 2.10 NONSHRINK GROUT

- A. Acceptable manufacturers include Dayton Superior, Master Builders Solutions, or equal. Grout shall be nonshrink, nonmetallic and shall achieve a strength of 7,500 psi in 28 days.

## 2.11 CURE–SEAL HARDENER

- A. Penetrating sealer for interior building floors shall be Ashford Formula by Curecrete Chemical Company, Inc., or equal. See finish schedule for locations to be used.

# PART 3–EXECUTION

## 3.01 MIXING

- A. Ready-mixed concrete shall be batched, mixed, and delivered in accordance with ASTM C94 and ACI 304R. In general, concrete shall be mixed 50 revolutions at plant, 20 upon arrival at site, and 20 each time water is added; maximum of 110 revolutions at mixing speed. Concrete shall be delivered and discharged within 1 1/2 hours or before the drum has revolved 300 times after introduction of water to the cement and aggregates or the cement to the aggregates. Truck mixers shall be equipped with drum revolution counters. In no event shall concrete which has taken its initial set be allowed to be used. Retempering of concrete is not permitted.
- B. A representative of ENGINEER may be at the batching plant periodically to observe the batching and mixing.
- C. No water shall be added on the job unless required by CONTRACTOR and with the knowledge of ENGINEER; the amount of water, if added, shall be recorded on all copies of

the delivery tickets. If water is added, CONTRACTOR shall verify that the required water-cement ratio is not exceeded.

- D. Concrete shall have a temperature not less than 60°F nor more than 80°F as delivered to the jobsite.
- E. With each load of concrete, CONTRACTOR shall obtain delivery tickets and shall make these tickets available for review by ENGINEER. Delivery tickets shall provide the following information:
  - 1. Date.
  - 2. Name of ready-mix concrete plant, job location, and CONTRACTOR.
  - 3. Type of cement and admixtures, if any.
  - 4. Specified cement content in sacks per cubic yard of concrete and approved concrete mix number or designation.
  - 5. Amount of concrete in load, in cubic yards.
  - 6. Water-cement ratio.
  - 7. Water added at job, if any.
  - 8. Truck number and time dispatched.
  - 9. Number of mixing drum revolutions.
- F. For job-mixed concrete, all concrete materials shall be mixed in a machine batch mixer for at least 1 1/2 minutes after all ingredients are in the mixer and shall continue until there is a uniform distribution of the materials and the mass is uniform in color and homogeneous. The mixer shall not be loaded beyond the capacity given by the manufacturer and shall be rotated at the speed recommended by the manufacturer. The mixer is to be provided with positive timing device that will positively prevent discharging the mixture until the specified mixing time has elapsed.

### 3.02 JOINTS

- A. CONTRACTOR shall place all joints as shown on the Drawings or specified herein. If acceptable to ENGINEER, CONTRACTOR may, at its own expense, place construction joints in addition to and at places other than those shown on the Drawings. Unless otherwise shown, all joints shall be straight, truly vertical or horizontal, and proper methods shall be employed to obtain this result.
- B. Where construction joints are not shown on the Drawings or specified elsewhere, CONTRACTOR shall provide construction joints in walls as follows:
  - 1. Vertical construction joints at 60 feet on center maximum but not more than 15 feet from corners or intersections.
  - 2. Horizontal construction joints at 18 feet on center maximum for walls 12 inches or more in thickness.
  - 3. Horizontal construction joints of 8 feet on center maximum for walls 10 inches or less in thickness.
- C. Immediately after completion of the first pour at a joint, the concrete surface, reinforcement, and waterstop projecting beyond the joint shall be thoroughly cleaned and laitance removed. The waterstops shall not be disturbed after the concrete in the first pour at a joint has set. Concrete around waterstops shall be thoroughly compacted by hand spading and vibrating. Immediately before the second pour, all extraneous matter shall be removed from the joint, the waterstop and steel cleaned, and the surface thoroughly wetted.
- D. Concrete at all joints shall have been in place at least 48 hours before abutting concrete is placed. At least two hours must elapse after depositing concrete in columns or walls before depositing in beams, girders, or slab supported thereon. Beams, girders, brackets, column



capital, and haunches shall be considered as part of the floor system and shall be placed integrally therewith.

### 3.03 BONDING TO EXISTING CONCRETE

- A. When placing new concrete adjacent to existing concrete, the existing concrete shall be thoroughly roughened, cleaned, and saturated with water 24 hours before pouring new concrete. Existing concrete is defined as concrete more than six months old. At time of new pour, remove any standing water and apply bonding agent. Bonding agent shall be applied in accordance with manufacturer's recommendations.

### 3.04 PATCHING EXISTING CONCRETE

- A. When patching existing concrete, remove poor concrete until firm hard concrete is exposed; roughen and clean surface of the existing concrete, clean any exposed reinforcing bars, and pour new concrete. Concrete finish shall match existing concrete. New concrete shall be 4,000 psi 28-day strength mixed with patching additive, mixed according to manufacturer's instructions. Concrete shall not be air-entrained.

### 3.05 EMBEDDED ITEMS IN CONCRETE

- A. All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting.
- B. All contractors whose work is related to the concrete or must be supported by it shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.
- C. Embedded items shall be positioned accurately and supported against displacement. Reinforcing bars shall clear embedded items a minimum of 2 inches.

### 3.06 PLACING CONCRETE

- A. Before placing concrete, all equipment, forms, ground, reinforcements, and other surfaces with which the concrete will come in contact are to be thoroughly cleaned of all debris, ice, and water. Ground shall be wetted prior to placement of concrete on it.
- B. After reinforcement is placed and before concrete is placed over it, ENGINEER shall be allowed sufficient time to observe the reinforcing.
- C. Unless otherwise authorized by ENGINEER, all concrete shall be placed in the presence of ENGINEER.
- D. Concrete shall be conveyed from the mixer to the place of final deposit as rapidly as practicable by methods that will prevent the segregation or loss of materials. Chuting for conveying purposes must be accomplished in such a manner as to prevent segregation or loss of materials. Receiving hoppers shall be installed at the chute discharge and at no point in its travel from the mixer to place of final deposit shall the concrete pass through a free vertical drop of more than 3 feet. Elephant trunks or tremies shall be used in all wall pours to prevent coating of forms and reinforcing bars.
- E. Care shall be taken to avoid an excess of water on the concrete surface. Excess water shall be drained or otherwise removed from the surface. Dry cement or a mixture of cement and sand shall not be sprinkled directly on the surface to absorb water.

- F. Concrete in wall and beam pours shall be deposited in approximately horizontal layers not to exceed 18 inches in thickness. Each layer shall be well worked into the preceding layer while both layers are still soft.
- G. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation from rehandling or flowing. The maximum allowable lateral movement of the concrete after being deposited is 3 feet. Once concreting is started, it shall be carried on as a continuous operation until the placing of the section or panel is completed.
- H. All concrete shall be placed with the aid of mechanical vibrating equipment in accordance with ACI 309. In congested areas, vibration shall be supplemented by hand spading adjacent to the forms. Vibration should secure the desired results within 5 to 15 seconds at intervals of 18 inches apart maximum. The vibrator shall penetrate the preceding layer of concrete. Vibrators shall have a frequency of not less than 10,000 impulses per minute when in operation submerged in concrete.
- I. A sufficient number of spare vibrators shall be kept in ready reserve to provide adequate vibration in case of breakdown of those in use.
- J. In placing concrete in beams where it is intended to be continuous and monolithic with the slab above, a delay to provide for settlement of the deep concrete shall be scheduled before placing the upper concrete in the slab. The length of delay shall be as long as possible and still permit the revibration of the deep concrete.
- K. Concrete is not to be placed under water. A suitable means shall be provided for lowering the water level below surfaces upon which concrete is to be placed. This may require excavating approximately 12 inches below the bottom of the concrete surface and refilling with gravel and compacting. The groundwater shall not be allowed to rise to the bottom of the concrete until 24 hours after the concrete pour has been completed. Water shall not be allowed to fall upon or run across the concrete during this period.
- L. No extra payment will be allowed for dewatering, undercutting, and gravel fill.

### 3.07 MOIST CURING

- A. All concrete shall be maintained in a moist condition for at least 7 days after being deposited except that for high-early strength concrete, a 3-day period will be sufficient. Moist curing shall be accomplished by one of the following methods:
  - 1. Wood forms left in place and kept wet at all times. If wood forms are not going to be kept wet or if metal forms are used, they shall be removed as soon as practicable and other methods of moist curing shall be started without delay.
  - 2. Use of a curing compound conforming to ASTM C309, Type I as approved by ENGINEER. Curing compound shall be applied at a uniform rate as indicated by the manufacturer sufficient to comply with the requirements of the test water retention of ASTM C156. Curing compound applied to vertical concrete surfaces after forms are removed shall be specially adapted to provide required coverage on the vertical surface. On nonformed surfaces, the curing compound shall be applied immediately after the disappearance of the water sheen after finishing of the concrete. Curing compound shall not be used on concrete surfaces that are to be painted, receive ceramic tile or resilient flooring, or be waterproofed. The curing compound for potable water structures shall be certified per NSF/ANSI-61. Care shall be taken not to get curing compound on construction joints, reinforcing steel, and other surfaces against which new concrete will be poured.
  - 3. Use of plastic film. Plastic film shall have a minimum thickness of 4 mils. It shall be placed over the wet surface of the fresh concrete as soon as possible without marring

the surface and shall be weighted so that it remains in contact with all exposed surfaces of the concrete. All joints and edges shall be lapped and weighted. Any tears in the film shall be immediately repaired.

4. Application of wet coverings weighing 9 ounces per square yard such as burlap, cotton mats, or other moisture-retaining fabrics. The covering system shall include two layers and shall be kept continuously moist so that a film of water remains on the concrete surface throughout the curing period.
5. Use of an approved waterproof curing paper. Edges of adjacent sheets shall be overlapped several inches and tightly sealed.
6. Ponding of water or continuous sprinkling of water is permitted. Sprinkling at intervals will not be permitted.
7. Construction joints shall be moist cured by one of the methods listed above except by Method "2."

- B. The use of moist earth, sand, hay, or another method that may discolor hardened concrete will not be permitted.

### 3.08 HOT WEATHER CONCRETING

- A. When the atmospheric temperature exceeds 80°F during concrete placement, this section and ACI 305 shall apply in addition to all other sections of the specifications.
- B. The temperature of the delivered concrete shall not exceed 85°F.
- C. Care shall be exercised to keep mixing time and elapsed time between mixing and placement at a minimum. Ready-mix trucks shall be dispatched so as to avoid delay in concrete placement, and the work shall be organized to use the concrete promptly after arrival at the jobsite.
- D. The subgrade, forms, and reinforcing shall be sprinkled with cool water just prior to placement of concrete. Prior to placing concrete, there shall be no standing water or puddles on the subgrade.
- E. If approved by ENGINEER, an admixture for retarding the setting of the concrete may be used.
- F. Exposed concrete surfaces shall be carefully protected from drying. Continuous water curing is preferred. Curing compounds shall be white pigmented.

### 3.09 COLD WEATHER CONCRETING

- A. Conditions of this section shall apply, in addition to all other sections of the specifications, when placing concrete in cold weather. Cold weather is defined as a period when, for more than three successive days, the average daily temperature drops below 40°F. When temperatures above 50°F occur during more than half of any 24-hour period, the period will no longer be regarded as cold weather. The average daily temperature is the average of the highest and lowest temperature during the period from midnight to midnight. Cold weather concreting shall conform to all requirements of ACI 306.1, except as modified by the requirements of these specifications.
- B. Detailed procedures for the production, placement, protection, curing, and temperature monitoring of concrete during cold weather shall be submitted to ENGINEER. Cold weather concreting shall not begin until these procedures have been reviewed for conformance with ACI 306.1.

- C. All concrete materials, forms, ground, mixing equipment, and other surfaces with which the concrete is to come in contact shall be free from frost, and the temperature of contact surfaces shall be 35°F or above. Ground upon which concrete is to be placed shall not be frozen at any depth.
- D. The mixing water and aggregates shall be heated and when entering the mixer shall have temperatures not exceeding 175°F and 80°F, respectively. Concrete temperature as mixed shall not exceed 80°F and shall typically be between 55°F and 70°F. Concrete, when placed in the forms, shall have a temperature of not less than 50°F.
- E. Freshly placed concrete shall be protected by adequate covering, insulating, or housing and heating. If heating is used, ambient temperature inside the housing shall be maintained at a minimum of 70°F for 3 days or 50°F for 5 days. The maximum ambient temperature during curing shall not exceed 80°F. If insulating methods are used, recommendations contained in ACI 306R shall be followed. Surface temperature shall be maintained at 50°F for 7 days. After the curing period, the temperature of the concrete shall be reduced uniformly at a rate not to exceed 40°F per 24 hours until outside air temperature is reached. Heating of enclosure shall continue if it is anticipated that the outside air temperature will drop more than 20°F in the next 24 hours. The concrete temperature shall be obtained by attaching a thermometer provided by CONTRACTOR to the concrete surface. Concrete shall be kept moist.
- F. If heating is used, the housing shall be constructed weathertight and shall be constructed in a manner that will provide uniform air circulation and air temperatures over the complete concrete area that is being cured. Special attention shall be given to the edges and ends of a concrete pour with the housing extending at least 5 feet beyond any concrete surface being protected. The housing shall be in place and heat applied within 2 hours after concrete placement.
- G. Heating may be by steam or hot air. Heaters shall be vented to outside of the housing. Open burning salamanders will not be permitted. Heating devices shall not be placed so close to the concrete as to cause rapid drying or discoloration from smoke.
- H. If heating is used, CONTRACTOR shall provide sufficient 24-hour inspection of the heaters to provide compliance with the above-specified temperature requirements during the curing period. CONTRACTOR shall provide maximum-minimum thermometers for ENGINEER's use.
- I. The use of calcium chloride, salts, or other chemical admixtures for the prevention of freezing is prohibited.
- J. Salts or other deleterious materials shall not be used on temporary or permanent structures above concrete surfaces that are being placed, finished, or cured.

### 3.10 FINISHING

- A. Flat Work:
  - 1. Floated Finish: Place, consolidate, strike off, and level concrete eliminating high spots and low spots. Do not work concrete further until it is ready for floating. Begin floating with a hand float, a bladed power float equipped with float shoes, or a powered disk float when the bleed water sheen has disappeared and the surface has stiffened sufficiently to permit the operation. Immediately refloat the slab to a uniform texture.
  - 2. Light Troweled Finish: Float concrete surface, then power trowel the surface. Hand trowel the surface smooth and free of trowel marks.

3. Hard Troweled Finish: Float concrete surface, then power trowel the surface. Hand trowel the surface smooth and free of trowel marks. Continue hand troweling until a ringing sound is produced as the floor is troweled.
  4. Tolerance for concrete floors shall be 1/4 inch within 10 feet in any direction. Straight edge shall be furnished by CONTRACTOR.
  5. Broom or Belt Finish: Immediately after concrete has received a floated finish, give the concrete surface a coarse transverse scored texture by drawing a broom or burlap belt across the surface.
  6. The above finishes shall be used in the following locations:
    - a. Float Finish: Surface to receive roofing, waterproofing, or sand bed terrazzo.
    - b. Light Troweled Finish: Submerged tank slabs.
    - c. Hard Troweled Finish: Building floors.
    - d. Broom or Belt Finish: Exterior slabs, sidewalks, tops of walls, and tank slabs to receive grout topping.
- B. Formed Surfaces:
1. Within 2 days after removing forms and prior to application of a curing compound, all concrete surfaces shall be observed and any poor joints, voids, stone pockets, or other defective areas shall be patched at once before the concrete is thoroughly dry. Defective areas shall be chipped away to remove all loose and partially bonded aggregate. The area shall be thoroughly wetted and filled with as dry as practical mortar mix placed to slightly overfill the recess. Mortar shall include a bonding agent. After partial set has taken place, the excess mortar shall be removed flush with the surface on the concrete using a wood float. All patching shall be cured, protected, and covered as specified for concrete. All cracks, leaks, or moist spots that appear shall be repaired. No extra compensation will be allowed CONTRACTOR for such work.
  2. The exterior or removal portion of nonremovable ties shall be removed with the use of a special tool designed for this purpose. Cutting or chipping of concrete to permit removal of exterior portion will not be permitted.
  3. For nonremovable ties, tie rod holes left by the removal of the exterior portion of the tie and cone shall be thoroughly wetted and filled by ramming with as dry as practical mortar mix in such a manner such that it completely fills the hole. Mortar shall include a bonding agent. All patching shall be cured, protected, and covered as specified for concrete. The holes are to be filled immediately after removal of the exterior portion of the tie.
  4. Holes left by removable ties shall be filled by installing a neoprene plug near the center of the wall. The balance of the hole shall be filled with mortar as specified above to within 1 inch of the face of the wall. The remainder of the hole shall be filled with a waterproofing compound.
  5. All finished or formed surfaces shall conform accurately to the shape, alignment, grades, and sections as shown or prescribed by ENGINEER. All surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness. All sharp angles, where required, shall be rounded or beveled. Any formed surface to be painted shall be free of any material that will be detrimental to the paint. The surface of the concrete shall be given one of the following finishes immediately after form stripping:
    - a. Finish A shall be referred to as a sack finish. Surfaces shall be free of contaminants prior to sacking. After wetting the surface, a grout shall be rubbed in using a rubber float or burlap. After the grout hardens sufficiently, it shall be scraped from the surface with the edge of a steel trowel without disturbing the grout in the air holes. After further drying, the surface shall be rubbed with burlap to remove all surface grout. The entire surface shall be finished to secure a continuous, hard, dust-free uniform texture surface free from pinholes and other minor imperfections. Finish A will be required for all unpainted surfaces (See Section 09 91 00–Painting for painted surfaces), interior surfaces of equipment rooms, operation areas, and permanently exposed vertical surfaces. Where steel-faced forms are used to form walls, the

- portion of wall to receive the sack finish shall first be roughened by brush blasting or other acceptable method to achieve a texture similar to 40 to 60 grit sandpaper.
- b. Finish B shall be the same as Finish A, except that the final burlap rubbing may be omitted, providing the steel trowel scraping removes the loose buildup from the surface. Finish B shall be provided for waterproof- and moistureproof-coated surfaces.
  - c. Finish C shall be referred to as a finish that has surface imperfections less than 3/8 inch in any dimension. Surface imperfections greater than 3/8 inch shall be repaired or removed and the affected areas neatly patched. Finish C or smoother shall be provided for interior surfaces of wet wells, tanks, and channels from 1 foot below minimum water surfaces and down and otherwise unfinished interior surfaces.
  - d. Finish D shall be the finish for surfaces that may be left as they come from the forms, except that tie holes shall be plugged and defects greater than 1/2 inch in any dimension shall be repaired. Finish D shall be provided for surfaces to be buried or covered by other construction such as masonry veneer.
- C. All precautions shall be taken to protect the concrete from stains or abrasions, and any such damage shall be removed or repaired under this Contract.

### 3.11 LOADING OF CONCRETE STRUCTURES

- A. No concrete structure or portion thereof shall be loaded with its design load until the concrete has obtained its specified 28-day compressive strength. This shall include but not be limited to vertical live load, equipment loading, water loading, groundwater loading, and backfill load. Concrete strength at time of loading shall be determined by testing field-cured concrete cylinders.
- B. Extreme care shall be taken so that construction loads do not exceed design loading of the structure.

### 3.12 NONSHRINK GROUT

- A. Nonshrink, nonmetallic grout shall be used for filling recesses and pockets left for equipment installation and for setting of base plates. The material used shall be approved by ENGINEER. Store, mix, and place the nonshrinking compound as recommended by the manufacturer. The minimum compressive strength shall be 5,000 psi at age 7 days and 7,500 psi at age 28 days.

### 3.13 TESTING AND SAMPLING

- A. The following tests of fresh concrete shall be performed by CONTRACTOR. CONTRACTOR shall prepare, protect, transport, and have tested all cylinders at its expense.
  - 1. Sampling of concrete for slump tests, air tests, temperature tests, and for making concrete test cylinders shall be performed in accordance with ASTM C172.
  - 2. Cylinders:
    - a. Three test cylinders shall be made for each pour less than 25 cubic yards, four test cylinders shall be made for each pour between 25 and 100 cubic yards, and eight test cylinders shall be made for each pour in excess of 100 cubic yards. Each concrete mix shall be represented by at least four cylinders for the entire job. Concrete for cylinders shall be collected near the middle of the load and/or as requested by ENGINEER.
    - b. Cylinders shall be made and tested in accordance with ASTM C31 and ASTM C39, respectively. The cylinders must be kept moist and at temperatures between 60°F and 80°F and shall remain undisturbed and stored in a location free from vibration.

In hot weather, the cylinders shall be covered with wet burlap and stored in a shaded area. It is CONTRACTOR's responsibility to provide a suitable protected location for storing cylinders on the jobsite.

- c. After 24 hours, the cylinders shall be transferred to an independent testing laboratory acceptable to OWNER. The cylinders shall be packed in sawdust or other cushioning material for transit to avoid any bumping or jarring of the cylinders.
  - d. Cylinders shall be broken at 7 and 28 days or as requested by ENGINEER. Test results shall be transmitted immediately and directly to ENGINEER and OWNER. Test data shall include date and location of pour and concrete mix used.
3. Slump Test: CONTRACTOR shall make one slump test near the beginning of all pours with two tests being made for all pours in excess of 25 yards or as requested by ENGINEER. Slump tests shall conform to ASTM C143.
  4. Air Test:
    - a. When air-entrained concrete is used, the air content shall be checked by CONTRACTOR near the beginning of all pours with at least two checks being made for all pours in excess of 25 cubic yards, or as requested by ENGINEER.
    - b. The air contents shall be checked using the pressure method in accordance with ASTM C231. The pocket-sized alcohol air indicator shall not be used unless it is first used in conjunction with the pressure method test.
- B. All costs of additional testing and sampling of fresh or hardened concrete needed because of suspected or actual violation of the specifications shall be borne by CONTRACTOR.

#### 3.14 RECORDS

- A. A record is to be kept of all concrete work. The record shall include the date, location of pour, concrete mix, slump, air content, test cylinder identification, concrete temperature, and ambient air temperature. In addition, for cold weather concreting the record shall include the daily maximum-minimum thermometer readings of all thermometers during the entire curing period for all concrete pours. The Resident Project Representative will keep this record, and CONTRACTOR shall assist in obtaining needed information.

#### 3.15 SIDEWALKS AND EXTERIOR SLABS

- A. Sidewalks shall be constructed where shown on the Drawings. They shall be a minimum of 5 inches thick and shall slope away from buildings or structures at a rate of 1/4 inch per foot. Concrete shall be as previously specified. Sidewalks shall be constructed on 3 inches of compacted granular fill. They shall have tooled joints of 1 inch minimum depth at approximately 5-foot centers with 1/2 inch preformed expansion joint filler at approximately 25-foot centers with one at all corners and located anywhere sidewalks abut structures and buildings.

#### 3.16 CONCRETE REMOVAL AND PATCHING

- A. All areas disturbed as a result of concrete removal or repair shall be patched as specified in Bonding to Existing Concrete.

#### 3.17 CURING AND SEALING INTERIOR BUILDING FLOORS

- A. Install cure-seal hardener product in accordance with manufacturer's instructions. Apply only to those floors noted to be sealed in the finish schedule.
- B. Where product will be used for moist curing, sealing and hardening, apply to new concrete as soon as the concrete is firm enough to walk on after troweling. Where product will be used for sealing and hardening only, surface must be free of dust, dirt, laitance, curing

compounds, and any material that would inhibit the penetration of the product. In some instances, the floor may need to be stripped and neutralized before application.

- C. Spray on at rate of 200 square feet per gallon.
- D. Keep surfaces wet with cure-seal hardener for minimum soak-in period of 30 minutes, without allowing drying out or becoming slippery. In hot weather, slipperiness may appear before the 30-minute time period has elapsed. If that occurs, apply more cure-seal hardener as required to keep entire surface in a nonslippery state for the first 15 minutes. For the remaining 15 minutes, mist the surface as needed with water to keep the material in a nonslippery state.
- E. After this period, when treated surface becomes slippery, lightly mist with water until slipperiness disappears.
- F. Wait for surface to become slippery again and then flush entire surface with water removing all residue of cure-seal hardener.
- G. Squeegee surface completely dry, flushing any remaining slippery areas until no residue remains.
- H. Wet vacuum or scrubbing machines may be used to remove residue, provided manufacturer's instructions are followed.
- I. Protect installed floors until chemical reaction process is complete; at least 3 months.
- J. Clean up spills immediately and spot-treat stains with good degreaser or oil emulsifier.
- K. Protection and cleaning of floors are the responsibility of CONTRACTOR until final completion. Replace concrete that becomes stained because of improper precautions or lack of cleaning.

END OF SECTION



## SECTION 03 41 13

### PRECAST CONCRETE HOLLOW CORE PLANKS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Precast Concrete Hollow Core Planks.
  - 2. Connection Plates and Hangers.
  - 3. Grouting Plank Joint Keys.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ACI 318-Building Code Requirements for Reinforced Concrete.
- B. ASTM C150-Portland Cement.
- C. AWS D1.1-Structural Welding Code.
- D. AWS D1.4-Structural Welding Code-Reinforcing Steel.
- E. PCI-Manual For The Design of Hollow Core Slabs.
- F. PCI MNL-116—Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.
- G. PCI MNL-120—Design Handbook—Precast and Prestressed Concrete.
- H. PCI MNL-123—Manual on Design of Connections for Precast Prestressed Concrete.
- I. PCI-Design Handbook-Precast and Prestressed Concrete.
- J. PCI-Tolerances for Precast and Prestressed Concrete.

##### 1.03 DESIGN REQUIREMENTS

- A. Size components to withstand design loads in an unrestrained condition as follows.  
Roof Assembly: All dead loads plus live loads plus concentrated loads shown on the Drawings. At pitched roof structures, the loads will be transmitted to the panels through the roof trusses or attic stud walls. Increased loading due to snow drifting at obstructions and changes in roof elevation shall be included in the design.
- B. Plank shall be designed in accordance with the PCI-Manual For The Design of Hollow Core Slabs and PCI-Design Handbook.

- C. Plank shall be capable of resisting shear forces as a diaphragm. Diaphragm chords will be the masonry bond beams.

#### 1.04 SUBMITTALS

- A. Professional Engineer: All plank designs shall bear the name and seal of a State of Wisconsin licensed professional engineer. CONTRACTOR shall be responsible for submitting the required additional copies of plank drawings with original stamp and signature for submittal to the State of Wisconsin. These materials must be submitted prior to installation.
- B. Shop Drawings: Indicate plank locations, unit identification marks, connection details, edge conditions, bearing requirements, support conditions, dimensions, openings, openings intended to be field cut, and relationship to adjacent materials.
- C. Product Data: Indicate standard component configuration, design loads, deflections, and cambers.

#### 1.05 QUALIFICATIONS

- A. Fabricator: Company specializing in manufacturing the work of this section with 3 years experience. Maintain plant records and quality control program during production of precast planks. Make records available upon request.
- B. Erector: Company specializing in erecting the work of this Section approved by fabricator.
- C. Design precast concrete members in accordance with PCI Manual For The Design of Hollow Core Slabs under direct supervision of a professional engineer experienced in design of this work and licensed in the State of Wisconsin.
- D. Welder: Qualified within previous 12 months in accordance with AWS D1.1.

#### 1.06 REGULATORY REQUIREMENTS

- A. Conform to ACI 318 and the 2015 International Building Code for design load and on-site construction requirements.
- B. CONTRACTOR shall submit additional copies of shop drawings for submittal to the 2015 International Building Code by ENGINEER.

#### 1.07 PREINSTALLATION CONFERENCE

- A. Convene minimum one week prior to commencing work of this section under provisions of Section 01 31 00—Coordination, Field Engineering, and Meetings.
- B. Discuss anchor and weld plate locations, sleeve locations, and cautions regarding cutting or core drilling.

#### 1.08 DELIVERY, STORAGE, AND HANDLING

- A. Lifting or handling devices shall be capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.

- B. Mark each member with date of production and final position in structure.

#### 1.09 COORDINATION

- A. Coordinate the work of framing components not post tensioned but directly associated with the work of this section.
- B. Coordinate field cut openings with affected section.
- C. Coordinate location of hanger tabs and devices for mechanical and electrical work.
- D. Coordinate location of anchors to be placed in masonry walls.

### PART 2-PRODUCTS

#### 2.01 FABRICATORS

- A. The plank shall be prestressed hollow-core precast concrete plank as fabricated by the Spancrete Company, Flexicore Company, or equal.

#### 2.02 MATERIALS

- A. Materials shall comply with provisions of ACI 318.
- B. Cement grout for grouting joints shall be one part Portland Cement per ASTM C150, three parts sand and water.

#### 2.03 ACCESSORIES

- A. Connecting and supporting devices shall be 304 stainless steel, unless noted otherwise.
- B. Bearing pads shall be high-density plastic, 1/8 inch thick.
- C. Caulk as approved by plank manufacturer.

#### 2.04 FABRICATION

- A. Conform to AWS D1.4., PCI MNL-116, and PCI MNL-120, and PCI MNL-123.
- B. Embed anchors, inserts, plates, angles, and other items at locations indicated.
- C. Cut exposed ends flush.

#### 2.05 FINISHES

- A. Plank to be painted shall be field abrasive blasted and painted as specified in Section 09 91 00-Painting.
- B. Connecting and supporting steel devices shall be prime painted per Section 09 91 00-Painting. Do not paint surfaces in contact with concrete or surfaces

requiring field welding. Refer to Section 05 50 00—Metal Fabrications, Paragraph 3.06 for repair of galvanized areas damaged by welding.

## 2.06 FABRICATION TOLERANCES

- A. Conform to PCI-Tolerances for Precast and Prestressed Concrete.

## PART 3—EXECUTION

### 3.01 EXAMINATION

- A. Verify that site conditions and supporting structure are ready to receive work and field measurements are as indicated on shop drawings.

### 3.02 PREPARATION

- A. Prepare support devices for the erection procedure and temporary bracing.

### 3.03 ERECTION

- A. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.
- B. Align and maintain uniform horizontal and end joints as erection progresses.
- C. Maintain temporary bracing in place until final connection is made. Protect members from staining.
- D. Install bearing pads at bearing ends of planks as indicated.
- E. Adjust differential camber between precast members to tolerance before final attachment and grouting.
- F. Adjust differential elevation between precast members to tolerance before final attachment.
- G. Grout plank joints, trowel smooth. Any grout that may have seeped through to the ceiling below shall be removed before it hardens. Grout shall also be placed between masonry and underside of roof plank in spaces created by roof plank camber over all exterior walls and bearing walls. On nonbearing interior walls, a void over 1/2 inch shall be filled with 1/2-inch expansion material and grout the remainder. This grout shall be applied following roofing. It is the intent that a space of 1/4 inch to 1/2 inch be left for caulking as required in Section 07 90 00—Caulking and Sealants.
- H. Underside of joints between planks that remain exposed shall be caulked as required in Section 07 90 00—Caulking and Sealants.
- I. Where open cores at end of planks are to remain exposed to view. The cores shall be grouted full for a minimum 6-inch depth to provide finished end of plank.
- J. Secure units in place. Perform welding, where shown, in accordance with AWS D1.1.

### 3.04 ERECTION TOLERANCES

- A. Erect members level and plumb within allowable tolerances. Conform to PCI MNL-116.

### 3.05 CUTTING OPENINGS

- A. Cooperation shall be extended to all trades in permitting the insertion of anchors, hangers, vents, electrical outlets, etc. Holes needed for such devices shall be cut in the field by the various trades. Cuts shall be made with a masonry saw or core drill. The various trades shall be present during installation of the roof deck. All openings not dimensioned or shown on the Drawings shall be located by the trades requiring the openings. All openings larger than 8 inches in any dimension shall be made by the roof slab supplier, and where necessary, hangers shall be furnished by the supplier. All spalling shall be repaired by the roof plank supplier prior to caulking. It is essential that plank which will remain exposed from below have a neat finished surface. Particular care shall be given to appearance of holes and openings.

END OF SECTION

## SECTION 04 05 13

### MORTAR AND MASONRY GROUT

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. The work includes mortar and grout for masonry.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. 2015 International Building Code.
- B. ASTM C91—Masonry Cement.
- C. ASTM C144—Aggregate for Masonry Mortar.
- D. ASTM C150—Portland Cement.
- E. ASTM C207—Hydrated Lime for Masonry Purposes.
- F. ASTM C404—Aggregates for Masonry Grout.
- G. ASTM C476—Grout for Masonry
- H. ASTM C979—Pigments for Integrally Colored Mortar/Concrete.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Submit information on Portland cement, integral waterproofing compound, and hydrated lime for mortar. Include design mix with proportions of materials being used. Submit gradation on aggregates.
- C. Submit design mix for grout including gradation of aggregates.
- D. Manufacturer's certificate: Certify that products meet or exceed specified requirements.

##### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. All cement shall be stored in a dry, weatherproof, properly ventilated structure which will protect it from dampness and freezing.

##### 1.05 ENVIRONMENTAL REQUIREMENTS

- A. See Section 04 20 00—Unit Masonry System, for cold weather requirements.

## PART 2–PRODUCTS

### 2.01 MORTAR

- A. Provide Portland cement-lime mortar or masonry cement mortar with proportion restrictions as stated in the 2021 International Building Code. Provide integral waterproofing compound in mortar for all exterior masonry. Provide Type N mortar for exterior non-load bearing brick and split face block veneer. Provide Type S mortar for all other masonry.
- B. Portland cement shall conform to ASTM C150, Type I or III.
- C. Hydrated lime shall conform to ASTM C207, Type S.
- D. Masonry cement shall conform to ASTM C91.
- E. Integral waterproofing compound shall be Dry-Block by W.R. Grace Company, or equal.
- F. Mortar aggregate for ordinary tile, brick, stone, and block shall consist of clean, sharp sand, conforming to ASTM C144. The sand shall be graded within the following limits:

| Sieve Number | Percent by Weight Passing |
|--------------|---------------------------|
| 4            | 100                       |
| 8            | 95 to 100                 |
| 16           | 70 to 100                 |
| 30           | 40 to 75                  |
| 50           | 10 to 35                  |
| 100          | 2 to 15                   |
| 200          | ---                       |

- G. Sand from any one source shall not vary over the extreme limits shown above. For unusually thin joints, such as occur with a unit having cut or ground edges, the aggregate used shall conform to these specifications except that 95% shall pass a No. 16 sieve.
- H. Water used in mixing water shall be clean and free of injurious materials.
- I. Mortar shall be thoroughly mixed until of uniform color and consistency. Only sufficient mortar to meet the immediate requirements of the work shall be mixed at one time. No mortar shall be retempered after it has begun to set, and no partially set mortar shall be used. No antifreeze material shall be used in the mortar to lower the freezing point.
- J. Colored mortar shall be provided for split face block mortar. Colored mortar shall be Western Colored Masons Blend, premixed and colored as manufactured by Western Lime and Cement Company or equal. Color shall be selected by OWNER. White cement and sand will not be required.

### 2.02 GROUT

- A. Grout shall conform to ASTM C476–Mortar and Grout for Reinforced Masonry.
- B. Aggregates shall conform to ASTM C404–Aggregates for Masonry Grout.

- C. Grout shall have a minimum 28-day compressive strength of 2,500 psi with the following proportions:
  - 1. Fine Grout: 1 Portland Cement: 0 to 1/10 lime: 2 1/2 to 3 fine aggregate.
  - 2. Coarse Grout: 1 Portland Cement: 0 to 1/10 lime: 2 1/2 to 3 fine aggregate: 1 to 2 coarse aggregate.
- D. Fine grout shall be used in spaces with least horizontal dimension greater than 3/4 inch and less than 2 1/2 inches. Coarse grout shall be used in all spaces with least dimensions 2 1/2 inches or greater.

### PART 3—EXECUTION

#### 3.01 INSTALLATION

- A. Brace masonry for wet grout pressure.
- B. Work grout into masonry cores and cavities.
- C. Where joints occur in grout, they shall be made 2 inches below the block joint so that a key is provided.
- D. Grout full masonry walls from top of floor to underside of all lintels at openings for a distance of 16 inches adjacent to each side of opening, unless shown otherwise on the Drawings.

END OF SECTION



## SECTION 04 20 00

### UNIT MASONRY SYSTEM

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Concrete Block.
  - 2. Concrete Sound Absorptive Block.
  - 3. Ashlar Stone.
  - 4. Reinforcement, Anchorage, Control Joints, and Accessories.
  - 5. Cold Weather Requirements.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Comply with pertinent provisions of Section 01 33 00—Submittals.
- B. Provide complete shop drawings of all materials to be furnished and installed under this section.

##### 1.03 REFERENCES

- A. 2015 International Building Code.
- B. ASTM C67—Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
- C. ASTM C90—Standard Specification for Loadbearing Concrete Masonry Units.
- D. ASTM C216—Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
- E. ASTM C744—Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
- F. UL—Fire Resistance Directory.

##### 1.04 QUALITY ASSURANCE

- A. Variation from the plumb in the lines and surfaces of columns and walls shall not exceed 1/4 inch in 10 feet, 3/8 inch in a story height or 20 feet maximum or 1/2 inch in 40 feet or more. Variation from plumb for external corners, expansion joints, and other conspicuous lines shall not exceed 1/4 inch in any story or 20 feet maximum or 1/2 inch in 40 feet or more.
- B. Variation from the level of the grades indicated on the drawing for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines shall not exceed 1/4 inch in any bay or 20 feet or 1/2 inch in 40 feet or more.

- C. Variation of the linear building line from an established position in plan and related portion of columns, walls, and partitions shall not exceed 1/2 inch in any bar or 20 feet maximum or 3/4 inch in 40 feet or more.
- D. Variation in cross-sectional dimensions of columns and thickness of walls shall not exceed minus 1/4 inch or plus 1/2 inch from the dimensions indicated on the Drawings.

#### 1.05 MOCKUP

- A. Provide a 4-foot by 4-foot mockup panel of masonry, including anchor accessories and flashings, before any masonry work begins. Location will be indicated by OWNER. Mockup panel shall be approved by OWNER and used as a sample of the quality of work to be expected on the job. Mockup panel may not remain as part of the work.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Masonry units, when delivered to the site, shall be thoroughly cured and shall be dry. When stored on the site, they shall not be in contact with the ground, shall be kept clean and covered.

#### 1.07 COLD WEATHER REQUIREMENTS

- A. All masonry units delivered to use in freezing weather shall be fully protected by a weathertight covering to prevent accumulation of ice on the units. Loose board covering will not be permitted.
- B. Cold Weather Protection:
  - 1. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.
  - 2. Remove all masonry determined to be frozen or damaged by freezing conditions.
  - 3. Perform the following construction procedure while the work is progressing. When air temperature is from 40°F (4°C) to 32°F (0°C), heat sand or mixing water to produce mortar temperature between 40°F (4°C) and 120°F (49°C):
    - a. When air temperature is from 32°F (0°C) to 25°F (-4°C), heat sand or water to produce mortar temperature between 40°F (4°C) and 120°F (49°C); maintain temperature of mortar on boards above freezing.
    - b. When air temperature is from 25°F (-4°C) to 20°F (-7°C), heat sand and mixing water to produce mortar temperatures between 40°F (4°C) and 120°F (49°C); maintain temperature of mortar on boards above freezing; use salamanders or other heat sources on both sides of walls under construction; use wind breaks when wind is in excess of 15 mph.
    - c. When air temperature is from 20°F (-7°C) and below, heat sand and mixing water to produce mortar temperatures between 40°F (4°C) and 120°F (49°C); provide enclosures and auxiliary heat to maintain air temperature above 32°F (0°C); do not lay units which have a surface temperature of 20°F (-7°C).
  - 4. Perform the following protections for completed masonry and masonry not being worked on:
    - a. When the mean daily air temperature is from 40°F (4°C) to 32°F (0°C), protect masonry from rain or snow for at least 24 hours by covering with weather-restrictive membrane.
    - b. When the mean daily air temperature is from 32°F (0°C) to 25°F (-4°C), completely cover masonry with weather-restrictive membrane for at least 24 hours.

- c. When the mean daily air temperature is from 25°F (-4°C) to 20°F (-7°C), completely cover masonry with insulating blankets or similar protection for at least 24 hours. Extend time period to 48 hours for grouted masonry.
- d. When mean daily temperature is 20°F (-7°C) and below, maintain masonry temperature above 32°F (0°C) for 24 hours using enclosures, blankets, and supplementary heat. Extend time period to 48 hours for grouted masonry.

## PART 2-PRODUCTS

### 2.01 CONCRETE BLOCK

- A. Concrete block shall be load bearing and shall conform to the requirements of ASTM C90 and the 2015 International Building Code. Bond shall be running bond. Concrete block shall be the two-cell type and shall be made with normal weight aggregate.
- B. Concrete block shall have a minimum net area compressive strength  $f'_{cmu}$  of 3,250 psi.
- C. Unless otherwise indicated, interior concrete block at window sills and lintels, pilasters, and the top course of walls at roof lines shall be constructed of solid concrete block, lintel block filled with grout, or the cores of the block filled with grout. Interior block at window sills shall be solid concrete block unless otherwise noted. Bullnose block shall be used at all door, window, and wall corners that remain exposed.
- D. All interior concrete block walls shall extend to the underside of roof deck or floor above unless noted otherwise.
- E. Provide sash units with integral dovetail slots at masonry control joints.

### 2.02 CONCRETE SOUND-ABSORPTIVE BLOCK

- A. Where shown on the Drawings, walls shall be constructed of sound-absorptive concrete masonry units.
- B. Manufacturers of all sound-absorptive masonry units shall be licensed by Proudfoot Company, Inc. to produce SOUNDBLOX; by Warren Sales Co., to produce Sound Control Bloc; or equal. Sound-absorptive masonry units shall meet the current ASTM C90 requirements for hollow load-bearing concrete masonry units. All units shall have one end of the cavities tightly closed. Slots and edges shall be straight and clean. Filler elements supplied by the licensor shall be installed in the cavities of the blocks at the block plant. The fillers shall be of specially fabricated incombustible fibrous material cut accurately to size and installed as recommended by the licensor. SOUNDBLOX fillers shall have metal septa laminated to one side of the fibrous materials and shall be installed with the septa facing away from the slots. Fillers supplied by other licensors shall be equal in rigidity and sound absorption.
- C. Concrete masonry units shall be 8-inch by 16-inch nominal face size. Thickness shall be as shown on the Drawings. Masonry units shall be SOUNDBLOX Type RSC/RF, Sound Control Bloc, or equal.
- D. Provide open cavity units where vertical reinforcing in wall is required.

- E. Install sound-absorptive units in the same manner as standard concrete masonry units. Care should be exercised to avoid the intrusion of mortar or debris in the cut outs. Chipped or broken units should not be incorporated into the work. Units should not be cut; standard concrete masonry units should be used as fillers.
- F. Concrete blocks at lintels, around openings, and at top of walls shall be standard concrete block. The first course at all finished floor elevations shall be standard concrete blocks.

## 2.03 ASHLAR STONE

- A. Ashlar stone shall be Reflection Stone Masonry Units as manufactured by County Materials Corporation, or equal. Stone masonry units shall be 3 1/4-inch deep full veneer masonry units. Colors shall be selected by OWNER.

## 2.04 REINFORCEMENT AND ANCHORAGE

- A. For concrete block walls, masonry wall reinforcement shall be 220 Ladder-Mesh manufactured by Hohmann & Barnard, Inc., Ladder Wire, manufactured by Wire-Bond, or equal.
- B. For cavity walls, masonry wall reinforcement shall be 270-2X Ladder Eye-Wire as manufactured by Hohmann & Barnard, Inc., Ladder Adjustable Tab by Wire-Bond, or equal.
- C. Wall reinforcement and ties shall be hot-dipped galvanized having a minimum 1.50 ounce/square foot zinc coating in accordance with ASTM A153 Class B2.
- D. Side rods shall be 9-gauge wire, and cross rods and tabs shall be 9-gauge wire. Maximum spacing of tabs shall be 24 inches.
- E. Prefabricated corner and tee sections shall be used to form continuous reinforcement around corners and for anchoring abutting walls and partitions.
- F. Reinforcing Bar Positioners: Where vertical reinforcing bars are required, provide bar positioners by Hohmann and Barnard, or equal.

## 2.05 ACCESSORIES

- A. Cellular or honeycomb cell vents, 2 1/2 inches high, shall be provided at weep holes. Cell vents shall be UV-resistant polypropylene, QV-Quadro-Vent, or equal.
- B. Vertical expansion control joints shall be located as shown on the Drawings. Control joints shall be constructed with a factory-extruded section of rubber equal to RS Series—Rubber Control Joint by Hohmann & Barnard, Inc., Rubber Control Joint by Wire-Bond, or equal, and shall extend for the entire height of the wall. Care shall be taken so that the gap is free of mortar or debris. Control joint shall be caulked on exposed faces with caulk of a color to match mortar.
- C. See Section 05 50 00—Metal Fabrications for masonry veneer support system at lintels.
- D. See Section 07 26 00—Vapor and Air Barrier for air barrier on masonry walls.
- E. See Section 07 62 00—Flashing and Sheet Metal for masonry flashing specifications.

## PART 3-EXECUTION

### 3.01 MASONRY WORKMANSHIP

- A. All masonry shall be laid plumb and true to lines. Stone shall be laid with complete full mortar joints. Mortar beds shall be spread smooth or only slightly furrowed. The ends of stone shall be buttered with sufficient mortar to fill the end joint.
- B. All masonry shall be laid in running bond, unless specified otherwise.
- C. Avoid over-plumbing and pounding of the corners and jambs to fit stretcher units after being set in position. Where an adjustment must be made after the mortar has started to harden, the mortar shall be removed and replaced with fresh mortar.
- D. In building cavity walls, the cavity shall be kept clean by slightly beveling the mortar bed to incline toward the cavity or by placing wood strips with attached wire pulls on the metal ties. The strips shall be withdrawn and cleaned before placing the next row of metal ties. Any mortar fins that protrude into the cavity space as the wall is built shall be troweled flat onto the inner face of the wythe.
- E. Where cutting of exposed masonry is necessary, the cuts shall be made with a motor-driven masonry saw or by other methods that provide cuts that are straight and true.
- F. Where flashing is to be laid on or against masonry, the surface of the masonry shall be smooth and free from projections that might puncture the flashing material. Through-wall flashing shall be placed on a bed of mortar, and mortar shall be placed above the flashing.
- G. Weep holes spaced 32 inches on center 2 1/2 inches high shall be provided in the first course immediately above all flashing and at the uppermost course immediately below soffits or coping. Weep holes shall be kept free of mortar droppings.
- H. Outside joints around the perimeter of exterior door and window frames or other wall openings shall be not less than 1/4 inch nor more than 3/8 inch wide and shall be cleaned out to a uniform depth of at least 3/4 inch ready for placement of caulk.
- I. All walls shall be adequately braced until they are completed and anchored to the roof construction.

### 3.02 MORTAR JOINTS

- A. All joints shall be laid plumb to lines. Unless specified otherwise, mortar beds shall be full 3/8 inch thick and shall be spread smooth or only slightly furrowed. Vertical joints shall be shoved not over 3/8 inch thick, unless otherwise shown. All joints shall be completely filled.
- B. Interior and exterior joints shall be tooled concave. All joints shall be tooled to uniform depth and shall be straight and true. Mortar joints shall be cut flush with masonry where rigid thermal insulation will be applied to interior masonry surfaces.

### 3.03 REINFORCEMENT AND ANCHORAGE

- A. Reinforcement shall be installed in the first and second bed joint 8 inches apart immediately above lintels and below sills at openings. Elsewhere, spacing shall be at 16-inch vertical

intervals or as shown on the Drawings. Extend reinforcement in the second joint above and below openings 2 feet beyond the jambs. All other reinforcing shall be continuous.

- B. Side rods shall be lapped 6 inches minimum at splices. Reinforcement units shall be of widths required for wall thicknesses as shown. Reinforcement shall be placed to allow for a 5/8-inch mortar cover on the exterior face of walls and 1/2-inch mortar cover on interior faces.
- C. Vertical reinforcing bars shall be installed using prefabricated bar positioners. Provide one positioner at the top of the first course of block and one additional positioner at a maximum spacing of 200 bar diameters.

#### 3.04 BUILT-IN WORK

- A. As work progresses, install all built-in work (such as window and door frames, anchor bolts, plates, and lintels) to be provided by other sections.
- B. Install built-in items plumb and level.
- C. Bed anchors of metal door frames in adjacent mortar joints. Grout all steel door frames full with mortar except those called for to be "removable."
- D. Do not use built-in organic materials subject to deterioration.
- E. Steel members embedded in exterior masonry shall be "battered" with not less than 1/2 inch of setting mortar on all surfaces.

#### 3.05 JOINING OF WORK

- A. Where fresh masonry joins masonry that is partially set or totally set, the exposed surface of the set masonry shall be cleaned and lightly wetted so as to obtain the best possible bond with the new work. All loose brick and mortar shall be removed. If it becomes necessary to "stop-off" a horizontal run of masonry, this shall be done only by racking back brick in each course, and if grout is used, stopping grout 4 inches back of the rack. Tothing will not be permitted.

#### 3.06 PROTECTION OF WORK

- A. During erection, all walls shall be kept dry by covering at the end of each day or shutdown period with a canvas or waterproof covering. Partially completed walls not being worked on shall be similarly protected at all times. All covering shall overhang at least 2 feet on each side of the wall and shall be securely anchored.

#### 3.07 MASONRY CONTROL JOINTS

- A. Provide vertical masonry control joints as detailed on the Drawings.
- B. Where possible, joints shall be located at one or both edges of door, window, and louver openings and at changes in wall height.

### 3.08 CLEANING NEW WORK

- A. Masonry faces to remain exposed shall be wiped with a damp cloth as the work progresses and thoroughly cleaned and pointed upon completion. If stiff brushes and water will not suffice, the surface shall be thoroughly wetted with plain water and then scrubbed with a 5% or 10% solution of hydrochloric acid. Alternatively, a commercial cleaner such as Sure Klean, or equal, may be used. Immediately after, the surface shall be washed to remove all traces of acid. All surfaces not being cleaned shall be protected from the acid. All mortar shall be removed from surfaces other than masonry.

END OF SECTION

## SECTION 04 72 00

### CAST STONE

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work includes cast stone bands and sills.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM A184—Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
- B. ASTM A615—Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- C. ASTM A1064—Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- D. ASTM C33—Concrete Aggregates.
- E. ASTM C150—Portland Cement.
- F. ASTM C260—Air-Entraining Admixtures for Concrete.
- G. ASTM C494—Chemical Admixtures for Concrete.
- H. ASTM C979—Pigments for Integrally Colored Concrete.

##### 1.03 DESCRIPTION

- A. Cast stone is a building material manufactured from carefully controlled portions of Portland Cement and coarse and fine aggregates molded into shapes by the manufacturer.

##### 1.04 DESIGN REQUIREMENTS

- A. Units shall be designed to withstand dead and live loads, applicable snow load, erection forces, and other loads in accordance with the 2015 International Building Code.

##### 1.05 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00—Submittals.
- B. Shop drawings shall indicate layout, configuration, dimensions, joint locations, identification marks, reinforcement, connection details, openings, lifting devices, and relationship to adjacent materials.
- C. Submit sample of each type of unit illustrating surface finish, color, and texture.



## 1.06 QUALITY ASSURANCE

- A. Manufacturer shall have minimum 5 years of continuous successful experience in fabricating cast stone materials in compliance with Cast Stone Institute standards.
- B. Installer shall have minimum 5 years successful experience in handling and installing cast stone units on projects of comparable size and scope.

## 1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Provide protective coverings and temporary lateral support to prevent damage during shipping. Blocking and supports shall be clean, nonstaining, and shall not cause harm to exposed surfaces.
- B. Store stone units under cover, off the ground, away from areas subject to high humidity conditions.
- C. Where extended on-site storage is necessary, provide nonstaining wood cribbing between stacked units to promote air circulation and prevent condensation.

## PART 2-PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

- A. Cast stone members shall be as manufactured by Edwards Cast Stone Company, Dubuque, Iowa, or equal. Provide members as detailed on the Drawings.

### 2.02 MATERIALS

- A. Cement: ASTM C150, Portland, Type 1 or III, grey.
- B. Fine Aggregate: ASTM C33, graded and washed natural sand; gradation required to attain indicated texture and finish.
- C. Coarse Aggregate: ASTM C33, graded and washed natural gravel or crushed, graded limestone; gradation required to attain indicated texture and finish.
- D. Color Pigments: ASTM C979, inorganic iron oxide pigments, limeproof. Cement grade carbon black pigment is not acceptable.
- E. Reinforcing: ASTM A615, Grade 60, galvanized where embedment is less than 2 inches for No. 5 bars or greater; 1 1/2 inches for No. 4 bars or smaller.
- F. Steel Wire Reinforcement: ASTM A1064.
- G. Welded Wire Fabric: Comply with ASTM A1064, where applicable.
- H. Steel Bar or Rod Mat Reinforcement: Comply with ASTM A184, where applicable.
- I. Admixtures: Comply with ASTM C494.

- J. Water: Potable, free of impurities.
- K. Air Entrainment: Comply with ASTM C260. Wet-cast mixtures shall contain between 5 to 7% air entrainment where surfaces are exposed to freeze-thaw conditions.
- L. Mortar shall be as specified in Section 04 05 13–Mortar and Masonry Grout.

#### 2.03 SUPPORT DEVICES

- A. Connecting and supporting devices shall be Type 304 or 316 stainless steel.
- B. Bolts, nuts, and washers shall be Type 304 stainless steel.
- C. Provide cramp anchors for anchoring stones together at corners.
- D. Setting buttons, shims, and sheet shall be lead or resilient plastic, nonstaining, thickness to suit joint thickness. For pointed joints, sized to avoid interference with pointing operation.

#### 2.04 ACCESSORIES

- A. Sealant shall be type specified in Section 07 90 00–Caulking and Sealants.

#### 2.05 FABRICATION

- A. Factory fabrication shall comply with Cast Stone Institute recommended fabricating practices.
- B. Comply with Cast Stone Institute recommended tolerances and the following:
  - 1. Height and Width: Plus 1/16 inch; minus 1/8 inch.
  - 2. Lengths:
    - a. Up to 2 feet 0 inch: Plus 1/16 inch; minus 1/8 inch.
    - b. From 2 feet 0 inch to 5 feet 0 inch: Plus or minus 1/8 inch.
    - c. From 5 feet 0 inch to 10 feet 0 inch: Plus 1/8 inch; minus 3/16 inch.
- C. Color and texture shall match approved samples, when viewed in direct daylight at a 20-foot distance.
- D. Cast stone manufacturer is responsible for preparing design mix to attain compressive strength of 6,500 psi at 28 days.
- E. Water absorption shall be maximum 6% by dry weight.
- F. Reinforcing shall be placed according to Cast Stone Institute recommendations for safe handling, settling, and structural requirements and as indicated on approved shop drawings.
- G. After manufacturing, cure all dry-tamped cast stone minimum of 8 hours in a totally enclosed curing room at 85°F and 100% relative humidity; then steam cure for minimum 10 hours.
- H. For new design mixes, take daily test cylinders and test in-house using a certified technician, at 20 hours and 28 days after manufacture to provide compliance with minimum compressive

strength requirements. Cast stone manufacturer will not be required to retest previous tested and used standard design mixes.

- I. Maintain consistent quality during manufacture.
- J. Exposed-to-view finish surfaces shall be uniform in color and appearance.

### PART 3—EXECUTION

#### 3.01 EXAMINATION

- A. Examine surfaces to receive cast stone work and verify that building structure, anchors, devices, and openings are ready to receive work of this section. Do not proceed with installation until surfaces and conditions meet requirements for acceptable installation.

#### 3.02 PREPARATION

- A. Verify that installation of items required for stonework to be installed by others are proper type, size, finish, and are located at proper spacings with proper anchorage.

#### 3.03 ERECTION

- A. Install/set all units and accessories accurately, using skilled experienced personnel, according to approved shop and setting drawings.
- B. Clean stone surfaces before setting using only water or mild cleaning compounds containing no caustic or abrasives.
- C. Drench all stone units thoroughly with water just before setting.
- D. Provide chases, reveals, openings, and other spaces required to accommodate other work. Close up after other work is complete with cast stone which matches stone already set.
- E. Where an open cavity is indicated between cast stone and backup material, keep cavity free of mortar and grout.
- F. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure stonework in place. Attach anchors securely to stone and to supporting surfaces. Place anchors and dowels firmly, and fill holes with mortar or nonshrink grout.
- G. Set cast stone accurately, in patterns and locations indicated, with uniform joints of dimensions indicated and with edges and faces aligned according to established relationships and indicated tolerances.
- H. Set stones supported on solid structural members on setting buttons, shims, or sheets, or a combination of setting buttons and mortar.
- I. After setting each stone, sponge off mortar smears and splashes.
- J. Embed only ends of lugged sills and similar stones; leave remainder of joint open and tuckpoint on faces only.

- K. Set all partially or fully horizontal stones with unfilled vertical joints. After setting, install backer rod, prime ends, and caulk.
- L. Setting Tolerances: Set cast stone units to the following tolerances unless detailed otherwise:
  - 1. Variation from plumb of lines and surfaces of columns, walls, and arises: Maximum 1/4 inch in 10 feet.
  - 2. Variation from level of grades indicated for floors, exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines: Maximum 1/2 inch in any 20-foot bay; maximum 3/4 inch in any dimension over 40 feet.
  - 3. Variation of linear building lines from position in plan: Maximum 1/2 inch in any 20-foot bay.
  - 4. Variation in cross-sectional dimensions of column and wall thicknesses: maximum  $\pm 1/4$  inch.
  - 5. Variation between faces of adjacent pieces and panels is not permitted.

#### 3.04 FIELD QUALITY CONTROL

- A. Remove and replace work that is broken, chipped, stained, or otherwise damaged; work that does not match approved samples or approved mockup; and work containing defective joints. Replace unacceptable materials in accordance with the cast stone manufacturer, leaving no visible evidence of replacement.

#### 3.05 CLEANING

- A. Perform final cleaning as soon as possible after mortar has set and been tooled. Use no wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods which could damage or cause discoloration or etching of surfaces or joints, without written approval from cast stone manufacturer.

#### 3.06 PROTECTION

- A. Protect work from staining or damage to finished surfaces by ongoing construction until acceptance by OWNER.

END OF SECTION

SECTION 05 50 00  
METAL FABRICATIONS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Shop-fabricated carbon steel.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A36–Carbon Structural Steel.
- B. ASTM A53–Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- C. ASTM A123–Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- D. ASTM A143–Practice for Safeguarding Against Embrittlement of Hot-Dipped Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
- E. ASTM A153–Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- F. ASTM A240–Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- G. ASTM A276–Stainless Steel Bars and Shapes.
- H. ASTM A307–Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
- I. ASTM A384–Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
- J. ASTM A385–Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
- K. ASTM A500–Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- L. ASTM A780–Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- M. ASTM A992–Structural Steel Shapes.
- N. ASTM A1008–Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

- O. ASTM A1011—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.
- P. ASTM B209—Aluminum and Aluminum-Alloy Sheet and Plate.
- Q. ASTM B211—Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire.
- R. ASTM B221—Aluminum and-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
- S. AWS A2.0—Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- T. AWS A5.4—Stainless Steel Electrodes for Shielded Metal Arc Welding.
- U. AWS D1.1—Structural Welding Code—Steel.
- V. AWS D1.2—Structural Welding Code—Aluminum.
- W. AWS D1.6—Structural Welding Code—Stainless Steel.
- X. ASTM F593—Standard Specifications for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- Y. ASTM F594—Standard Specification for Stainless Steel Nuts.

#### 1.03 DESIGN REQUIREMENTS

- A. All fabrications shall meet applicable code requirements including OSHA.

#### 1.04 SUBMITTALS FOR REVIEW

- A. Comply with pertinent provisions of Section 01 33 00—Submittals.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, sections, elevations, and details where applicable.
- C. Mill Test Reports: Submit indicating structural strength and composition.
- D. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

#### 1.05 QUALITY ASSURANCE

- A. Fabricate steel members in accordance with AISC Code of Standard Practice.
- B. Welders Certificates: Certify welders employed on the work, verifying AWS qualification within the previous 12 months.

#### 1.06 QUALIFICATIONS

- A. Qualify welding processes and welding operators in accordance with AWS *Standard Qualifications Procedures*.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials to job site properly marked to identify the structure for which it is intended and at such intervals to allow uninterrupted progress of the work. Marking shall correspond to markings indicated on the shop drawings.
- B. Store all members off the ground using pallets, platforms, or other supports.
- C. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structures.
- D. In the event of damage, immediately make all repairs and replacements necessary at no additional cost to OWNER.

## PART 2-PRODUCTS

### 2.01 MATERIALS-CARBON STEEL

- A. Steel Sections:
  - 1. ASTM A36 (channels, angles, plates).
  - 2. ASTM A992 (wide flange sections).
  - 3. Pipe: ASTM A53, Grade B.
  - 4. Tubes: ASTM A500, Grade B.
  - 5. Silicon content of steel members to be hot-dipped galvanized shall be in the range of 0 to 0.04%. Submit mill test reports confirming compliance.
- B. Sheet Steel: ASTM A1011.
- C. Plain Washers: Round carbon steel complying with FS FF-W-92.
- D. Bolts, Threaded Rods, and Nuts: ASTM A307 Grade A, or galvanized to ASTM A153 for galvanized components for exterior use and where built into exterior walls.
- E. Lock Washers: Helical spring-type carbon steel complying with FS FF-W-84.
- F. Welding Electrodes: Comply with AWS D1.1. E70XX electrodes for carbon steel. For ASTM A992 steel and any other steel with 50 ksi or greater yield strength, use only E7018 or other E70XX electrodes specifically permitted by AWS D1.1.
- G. Select fasteners for the type, grade, and class required.

### 2.02 MATERIALS-STAINLESS STEEL

- A. Unless otherwise noted, all stainless steel bars and shapes shall meet the requirements of ASTM A276 and shall be Type 316L.
- B. Unless otherwise noted, all stainless steel bolts shall meet the requirements of ASTM F593 and shall be Type 316L.
- C. Unless otherwise noted, all stainless steel nuts shall meet the requirements of ASTM F594 and shall be Type 316L.

- D. If components are not available in Type 316L, other 300 Series type shall be used as approved by ENGINEER.
- E. Welding Electrodes:
  - 1. Comply with AWS D1.6.
  - 2. Use ER316L electrodes for 316L stainless steel.
  - 3. Use ER308L electrodes for 304L stainless steel.

## 2.03 MATERIALS—ALUMINUM

- A. Extruded Aluminum: ASTM B221, Alloy 6061, Temper T6.
- B. Sheet Aluminum: ASTM B209, Alloy 3005.
- C. Aluminum-Alloy Bars: ASTM B211, Alloy 6061, Temper T6.
- D. Bolts, Nuts, and Washers: Stainless steel.
- E. Welding Materials: AWS D1.2; type required for materials being welded.

## 2.04 ACCESSORIES

- A. Masonry Veneer Support System:
  - 1. For exterior masonry cavity wall construction, provide prefabricated, hot-dip galvanized steel masonry veneer support system to support brick or split face block veneer from concrete masonry backup wall.
  - 2. System shall be Hohmann and Barnard TBS Thermal Brick Support System, Fero Fast Thermal Bracket system, Halfen Brickwork Support System, or equal.
  - 3. When shelf angle size is not indicated on the Drawings, shelf angle design shall be provided by manufacturer. Manufacturer's design shall bear the seal of a professional engineer licensed in the state the project is located in.
  - 4. Fasten veneer support system to masonry backup wall using manufacturer standard adjustable brackets and 304 stainless steel masonry anchors. Fastener type and sizing shall be provided by the manufacturer. Manufacturer's fastener design shall bear the seal of a professional engineer licensed in the state the project is located in.
  - 5. Submit product details, shop drawings including overall layout, shelf angle sizes, bracket locations, and connections details, and design calculations bearing the seal of a professional or structural engineer, as appropriate, and licensed in the state the project is located in.

## 2.05 FABRICATION

- A. Fabrication and Assembly:
  - 1. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on the approved shop drawings.
  - 2. Properly mark and match-mark materials for field assembly and for identification as to structure and site for which intended.
  - 3. Fabricate for delivery sequence which will expedite erection and minimize field handling of materials.
  - 4. Where finishing is required, complete the assembly, including welding of units, before start of finishing operation.



5. Provide finish surfaces of members exposed in the final structure free of markings, burrs, and other defects.
- B. Connections:
1. Bolts and washers of all types and sizes shall be provided for completion of all field erection.
  2. Comply with AWS Code for procedures, appearance, and quality of welds used in correcting welded work.
  3. Assemble and weld built-up sections to produce true alignment of axes without warp.
  4. Welding shall be done by the shielded arc process.
  5. All welds shall be chipped, ground smooth, and primed immediately after fabrication.
- C. Workmanship:
1. Use materials of size and thickness shown or, if not shown, of size and thickness to produce strength and durability in the finished product.
  2. Work to dimensions shown or accepted on the shop drawings using proven details of fabrication and support.
  3. Form exposed work true to line and level, with accurate angles and surfaces, and with straight sharp edges.
  4. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing works.
  5. Cap all open ends of pipe and structural tubing.
  6. Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush; match and blend with adjoining surfaces.
  7. Provide for anchorage of the type shown. Coordinate with supporting structures. Fabricate and space the anchoring devices to provide adequate support for intended use.
  8. Cut, reinforce, drill, and tap miscellaneous metal work as indicated to receive hardware and similar items.

## 2.06 FINISHES

- A. Carbon steel surfaces shall be prepared by abrasive blasting to SSPC-SP10 as specified in Section 09 91 00–Painting.
- B. Do not prime surfaces where galvanizing or field welding is required.
- C. Immediately after surface preparation, prime paint carbon steel items with one coat in accordance with manufacturer's instructions and Section 09 91 00–Painting.
- D. Structural Steel Members: Galvanize after fabrication to the requirements in this section and ASTM A123.
- E. Surfaces that will be inaccessible after assembly or erection shall be finish painted prior to assembly or erection.
- F. Galvanizing:
1. All items, except piping designated to be galvanized, shall be hot-dipped galvanized in accordance with ASTM Specification A123 and A153. Piping shall be hot-dipped galvanized in accordance with ASTM A53. Furnish a Certificate of Compliance stating

- that the galvanizing complies with ASTM Specifications and Standards and all other applicable requirements specified herein.
2. Fabrication of items to be galvanized shall be in accordance with ASTM A143, A384, and A385. Structural steel shall be fabricated generally in accordance with Class 1 guidelines as shown in *Recommended Details for Galvanized Structures* as published by the American Hot Dip Galvanizer's Association, Inc.
  3. Galvanized items shall be handled, transported, and stored to prevent damage or staining to the coating. Maintain adequate ventilation and continuous drainage.
  4. Silicon content for steel to be hot-dipped galvanized shall be in the range of 0 to 0.04%.
  5. Steel work shall be precleaned utilizing a caustic bath, acid pickle and flux, or shall be blast cleaned and fluxed. In either case, all surface contaminants and coatings shall be removed.
  6. All welding shall be performed in accordance with the American Welding Society publication D19.0-72, *Welding Zinc Coated Steel*. All uncoated weld areas shall be touched up.
- G. Aluminum shall have a mill finish unless otherwise specified. Any aluminum in contact with concrete or dissimilar metal shall be coated with multiple coats of bituminous paint, minimum 10 mils dry.

### PART 3-EXECUTION

#### 3.01 EXAMINATION

- A. Correct conditions detrimental to the proper and timely completion of the work.
- B. Do not proceed until unsatisfactory conditions have been corrected.

#### 3.02 PREPARATION

- A. Furnish setting drawings, diagrams, templates, instructions, and directions for installation of anchorages such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors which are to be embedded in concrete construction.
- B. Coordinate delivery of such items to project.
- C. Clean and strip primed steel items to bare metal where site welding is required.

#### 3.03 INSTALLATION

- A. Setting Precast Anchorages:
  1. Clean bearing surfaces free from bond-reducing materials, and roughen to improve bond to surfaces. Clean the bottom surface of bearing plates.
  2. After the bearing members have been positioned and plumbed, tighten and anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout.
  3. Pack grout solidly between bearing surfaces and plates so that no voids remain.
- B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction including

threaded fasteners for concrete inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

C. Cutting, Fitting, and Placement:

1. Perform cutting, drilling, and fitting for installation of miscellaneous metal fabrications.
2. Set work accurately in location, alignment, and elevation and make plumb, level, true, and free from rack measured from established lines and levels.
3. Fit exposed connections accurately together to form tight hairline joints.
4. Weld connections that are not to be left as exposed joints, grind joints smooth, and touchup shop paint coat or galvanizing repair.

3.04 FIELD WELDING

- A. Comply with AWS Code for procedures of manual shielded metal arc welding (steel, stainless steel) and gas metal arc welding (aluminum), appearance and quality of weld made, and methods in correcting welding work.

3.05 TOUCH-UP PAINTING

- A. 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 in accordance with Section 09 91 00–Painting.

3.06 GALVANIZING REPAIR

- A. Areas damaged by welding, flame-cutting, or during handling, transport, or erection shall be repaired by one of the following methods whenever damage exceeds 3/16 inch in width.
1. Cold Galvanizing Compound:
    - a. Surfaces to be reconditioned with zinc-rich paint shall be clean, dry, and free of oil, grease, and corrosion products.
    - b. Areas to be repaired shall be power disc-sanded to bright metal. So that a smooth reconditioned coating can be effected, surface preparation shall extend into the undamaged galvanized coating.
    - c. Touch-up paint shall be an organic cold-galvanized compound having a minimum of 94% zinc dust in the dry film.
    - d. The paint shall be spray- or brush-applied in multiple coats until a dry film thickness of 8 mils minimum has been achieved. A finish coat of aluminum paint shall be applied to provide a color blend with the surrounding galvanizing.
    - e. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.
  2. Zinc-Based Solder:
    - a. Surfaces to be reconditioned with zinc-based solder shall be clean, dry, and free of oil, grease, and corrosion products.
    - b. Areas to be repaired shall be wire-brushed.
    - c. Heat shall be applied slowly and broadly close to but not directly onto the area to be repaired. The zinc-based solder rod shall be rubbed onto the heated metal until the rod begins to melt. A flexible blade or wire brush shall be used to spread the melt over the area to be covered. The zinc-based solder shall be applied in a minimum thickness of 2 mils.
    - d. Coating thickness shall be verified by measurements with a magnetic or electromagnetic gauge.

### 3.07 SCHEDULE

- A. The following schedule is a list of principal items only. Refer to Drawing details for items not specifically scheduled.
- B. Guard Posts: Steel pipe, concrete-filled, crowned cap, as detailed-galvanized and field finish paint in accordance with Division 09.

END OF SECTION

## SECTION 05 56 00

### ANCHOR BOLTS AND POST-INSTALLED ANCHORS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Anchor bolts, expansion bolts, adhesive anchors, and screw anchors.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM A36/A36M—Standard Specification for Carbon Structural Steel.
- B. ASTM F1554—Anchor Bolts, Steel, 36, 55, and 105-ksi yield strength.
- C. ICC-ES International Code Council—Evaluation Service.
- D. AC 193—Acceptance Criteria for Mechanical Anchors in Concrete Elements.
- E. AC 308—Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete.
- F. ACI 355.2—Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary.
- G. ACI 355.4—Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary.

#### PART 2—PRODUCTS

##### 2.01 GENERAL

- A. Unless indicated otherwise on the Drawings or specified, use the following bolt material for the various installation situations:
  - 1. Stainless Steel: For all submerged locations, below final grade, and in contact with aluminum appurtenances and other items not to be painted. Also for anchoring equipment, unless otherwise specified.
  - 2. Steel: In other locations in contact with items to be painted or encased in concrete.

##### 2.02 ANCHOR BOLTS

- A. Anchor bolts complete with washers and nuts shall be fabricated as shown or as specified by the equipment manufacturer and unless otherwise indicated shall be hot-dip galvanized carbon steel or 316 stainless steel. Anchor bolts shall, as a minimum, conform to the requirements of ASTM F1554-Grade 36.
- B. Stainless steel anchor bolts shall be used in all submerged locations, below final grade, and in contact with aluminum and other items not to be painted. Galvanized anchor bolts shall be used elsewhere.

## 2.03 EXPANSION BOLTS

- A. Expansion bolts shall be KWIK Bolt TZ by Hilti, Inc., Power-Stud+ SD2, SD4, or SD6 by DeWalt, Strong-Bolt or Strong-Bolt 2 by Simpson Strong-Tie Anchor Systems, or approved equal.
- B. All expansion bolts shall comply with the 2015 International Building Code, AC 193, and ACI 355.2. They shall be ICC-ES approved for use in cracked and uncracked concrete.
- C. Expansion bolts will not be permitted as substitutes for embedded anchor bolts except with the prior written acceptance of ENGINEER or where otherwise specifically called for.

## 2.04 ADHESIVE ANCHORS

- A. Adhesive anchors shall be HIT HY 200 by Hilti, Inc., Red Head C6+ or Red Head A7+ by ITW, Pure 110+ or AC200+ by DeWalt, Set-XP by Simpson Strong-Tie Anchor Systems, or approved equal.
- B. All adhesive anchors shall comply with the 2015 International Building Code, AC 308, and ACI 355.4. They shall be ICC-ES approved for use in cracked and uncracked concrete.

## 2.05 SCREW ANCHORS

- A. Screw anchors shall be KWIK HUS-EZ by Hilti, Inc., Screw-Bolt by DeWalt, Titen-HD by Simpson Strong-Tie Anchor Systems, or approved equal.
- B. All screw anchors shall comply with the 2015 International Building Code. They shall be ICC-ES approved for use in cracked and uncracked concrete.

# PART 3-EXECUTION

## 3.01 ANCHOR BOLTS

- A. Anchor bolts for structural members shall be located as shown and specified.
- B. Anchor bolts for mechanical equipment shall have embedment length, edge distances, and spacing as required by the equipment manufacturer.
- C. All dirt or foreign materials shall be removed prior to embedding into concrete. After anchor bolts have been embedded, their threads shall be protected by grease and by installing the nuts or by other means until the time of installation of the equipment or metal work.

## 3.02 EXPANSION BOLTS

- A. Unless otherwise noted on the Drawings, expansion bolt edge distance and spacing shall be in accordance with manufacturer's printed installation instructions.
- B. Bolt embedment shall at least equal 6-bolt diameters.
- C. Installation procedures shall be in accordance with the manufacturer's printed installation instructions.

- D. Where location of bolts is adjustable, reinforcing steel shall be located prior to drilling holes and bolts shall be located to clear reinforcing steel.

### 3.03 ADHESIVE ANCHORS

- A. At locations shown on the Drawings, reinforcing bars or threaded rod shall be provided in existing concrete by drilling holes, injecting epoxy adhesive, and inserting the reinforcing bar.
- B. All existing surfaces to receive adhesive anchors, including the entire area in contact with the new concrete, shall be cleaned and roughened to amplitude of 1/4 inch.
- C. Installation procedures shall be in accordance with the manufacturer's printed installation instructions.
- D. Adhesive anchors shall be installed in concrete having a minimum age of 21 days at the time of installation.
- E. Where location of anchors is adjustable, reinforcing steel shall be located prior to drilling holes and anchors shall be located to clear reinforcing steel.
- F. CONTRACTOR shall arrange an anchor manufacturer's representative to provide on-site installation training for installation of their adhesive anchor system products. Submit documentation that all CONTRACTOR's personnel or subcontractors who install adhesive anchors have been trained prior to the announcement of anchor installation.
- G. Adhesive anchors in horizontal and upwardly inclined orientations to resist sustained tension loads are subject to the following requirements:
  - 1. They shall be installed by personnel certified by an applicable certification program. Certification shall include written and performance tests in accordance with the ACI/CRSI Adhesive Anchor Installer Certification program, or equivalent, as approved by ENGINEER.
  - 2. They require continuous special inspection during installation. CONTRACTOR shall notify ENGINEER and CONTRACTOR of the schedule for these anchor installations to permit coordination of inspections.

### 3.04 SCREW ANCHORS

- A. Unless otherwise noted on the Drawings, screw anchor edge distance and spacing shall be in accordance with manufacturer's recommendations.
- B. Anchor embedment shall at least equal 6-bolt diameters.
- C. Installation procedures shall be in accordance with the manufacturer's printed installation instructions.
- D. Where location of anchors is adjustable, reinforcing steel shall be located prior to drilling holes and anchors shall be located to clear reinforcing steel.

END OF SECTION

## SECTION 06 11 00

### WOOD FRAMING AND SHEATHING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Roof Framing.
  - 2. Roof Sheathing.
  - 3. Miscellaneous Framing and Sheathing.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ALSC–American Lumber Standards Committee.
- B. APA–American Plywood Association.
- C. AWWA–American Wood Preservers Association.
- D. NFPA–National Forest Products Association.
- E. NLGA–National Lumber Grades Authority.
- F. SPIB–Southern Pine Inspection Bureau.
- G. WCLIB–West Coast Lumber Inspection Bureau.
- H. WWPA–Western Wood Products Association.

##### 1.03 DELIVERY, STORAGE, AND HANDLING

- A. Protect lumber and other building materials and keep under cover both in transit and at the job site. Protect from dampness. Stack framing lumber and plywood to provide proper air circulation. Locate stacks on well-drained areas. Support 6 inches above grade and protect with waterproof cover.

#### PART 2–PRODUCTS

##### 2.01 MATERIALS

- A. Lumber shall be kiln-dried with moisture content not to exceed 19% at time of installation and grade marked according to the National Lumber Manufacturer's Association.
- B. All studs shall be 2 inches by 4 inches nominal or 2 inches by 6 inches nominal as shown on the Drawings and shall be No. 2 Douglas Fir, No. 2 Southern Pine, or better.



- C. All roof joists shall be No. 2 Southern Pine or better.
- D. Plywood roof and wall sheathing shall be grade C-D (CDX), Exposure 1, or better, graded in accordance with the American Plywood Association.
- E. Wood sills, plates, blocking, etc., to be same grade as studs.

## PART 3-EXECUTION

### 3.01 FRAMING

- A. General: All rough framing lumber and all other wood framing, studs blocking, and furring shall be accurately set to required lines and levels, closely fitted, shimmed, and rigidly secured in place.
- B. Place all wood studs in sizes as shown and spaced at 16 inches o.c., unless noted otherwise. Erect studs on single bottom and single top plate at nonbearing walls, double studs at all openings, triple studs at corners. Install blocking between studs as required. Bolt plates and blocking to concrete at 32-inch centers, unless noted otherwise. Space framing to receive electrical piping or ductwork without cutting joist. Verify all duct and piping runs prior to framing to eliminate conflict. Stud walls shall extend a minimum of 8 inches above the ceiling line. Stud walls shall be adequately braced off of other stud walls and/or masonry walls.
- C. Construct load bearing, framing, and curb members full length without splices.
- D. Provide double studs at openings over 24 inches wide. Space short studs over and under opening to stud spacing.
- E. Unless shown otherwise, provide double joists at floor and ceiling openings over 24 inches wide and under wall stud partitions that are parallel to floor joists. Frame rigidly into joists.
- F. Unless shown otherwise, provide mid-span bridging between joists spanning 12 feet or more. Unless shown otherwise, provide solid wood blocking at ends of joists placed between alternate joist spaces.

### 3.02 PLYWOOD SHEATHING

- A. Plywood sheathing shall be nailed at 6 inches on center at edges and 12 inches on center at intermediate supports with 10d common nails.
- B. Secure roof sheathing perpendicular to framing members with ends staggered and sheet ends over firm bearing. Use sheathing clips between sheets between roof framing members, or provide solid edge blocking between sheets.

### 3.03 CONNECTIONS

- A. All framing connections and nailing shall be in accordance with the details shown and/or the 2015 International Building Code minimum requirements, whichever is more restrictive.

- B. Framing connectors shall be Simpson Strong Tie, Mitek, or equal. Connector numbers shown on details are Simpson. Submit engineering data on any substitutes.
- C. Connectors shall be installed in accordance with manufacturer's requirements.

END OF SECTION

## SECTION 06 11 10

### WOOD BLOCKING AND CURBING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Roof Curbs and Cants.
  - 2. Wood Blocking.
  - 3. Wood Furring and Grounds.
  - 4. Preservative Treatment of Wood.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ALSC–American Lumber Standards Committee.
- B. AWPAA–American Wood Preservers Association.
- C. ICC-ES–International Code Council Evaluation Service.
- D. NFPA–National Forest Products Association.
- E. NLGA–National Lumber Grades Authority.
- F. SPIB–Southern Pine Inspection Bureau.
- G. WCLIB–West Coast Lumber Inspection Bureau.
- H. WWPA–Western Wood Products Association.

##### 1.03 SUBMITTALS

- A. Submittals shall be in accordance with Section 01 33 00–Submittals.
- B. Submit an ICC-ES Evaluation report for each preservative treatment product to be used.

##### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. All materials shall be thoroughly sealed and protected from weather during transport and at the jobsite. Protect from dampness.

## PART 2–PRODUCTS

### 2.01 MATERIALS

- A. Lumber for roof curbs, cants, blocking, furring, and grounds shall be “standard” grade Douglas Fir, No. 2 Southern Pine, or better, graded in accordance with the WWPA, WCLIB, NLGA, or SPIB grading rules as applicable. Lumber shall bear the grading agency’s stamp.
- B. Wood shall be kiln-dried with moisture content not to exceed 19% at time of installation.
- C. All lumber furnished under this section shall be pressure-treated with a micronized copper azole (MCA) or chromated copper arsenate (CCA) waterborne preservative to a minimum retention in pounds per cubic foot of preservative actives as required by the manufacturer to meet the relevant use category as defined in AWPAs Standard U1-24–User Specification for Treated Wood.
- D. MCA and CCA preservative treatment shall comply with AWPAs Standards P61 and P23, respectively.

## PART 3–EXECUTION

### 3.01 INSTALLATION

- A. Provide and install wood curbs, cants, blocking, furring, and grounds of proper size and shape where shown on the Drawings and where required to secure other work or equipment in place.
- B. Members shall be installed true to lines, level, plumb, and secure.
- C. Connections and nailing shall be in accordance with the details shown and/or the 2015 International Building Code minimum requirements, whichever is more restrictive.
- D. Apply brush-on wood preservative treatment to cuts in accordance with manufacturer’s recommendations.

END OF SECTION

## SECTION 06 17 53

### PLATE CONNECTED WOOD TRUSSES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. All materials, equipment, and labor necessary for the prefabrication, delivery, and permanent setting of wood trusses on buildings.
  - 2. Bridging.
  - 3. Temporary and permanent bracing.
  - 4. Related hardware.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ALSC—American Lumber Standards Committee.
- B. APA—American Plywood Association.
- C. ASTM A653—Sheet Steel, Zinc-Coated (Galvanized) by the Hot Dip Process, (Structural Physical) Quality.
- D. AWWA—American Wood Preservers Association.
- E. NFPA—National Forest Products Association.
- F. SPIB—Southern Pine Inspection Bureau.
- G. TPI—Truss Plate Institute.
- H. WWPA—Western Wood Products Association.

##### 1.03 DESIGN REQUIREMENTS

- A. The basic design loads shall be in accordance with the 2021 International Building Code.
- B. Dead Loads and Collateral Loads: Trusses shall be designed for loads as shown on the Drawings.
- C. Live Loads:
  - 1. Roof live loads shall be computed in accordance with the 2021 International Building Code and loads as shown on the Drawings. Snow load and minimum roof live load shall be applied to the top chord.
  - 2. Design for unbalanced snow loads in accordance with the building code.
  - 3. Design for sliding and drifted snow loads as shown on the drawings.
  - 4. Roof live loads shall be applied to the horizontal projection of the roof.

- D. Wind Loads: Wind loads shall be computed in accordance with the 2015 International Building Code and loads as shown on the Drawings.
- E. Concentrated Loads: Design for any concentrated loads shown on the Drawings.
- F. Combination of Loads: The combining of loads for design purposes shall be as prescribed with the 2015 International Building Code.

#### 1.04 SUBMITTALS

- A. Submittals shall be as in Section 01 33 00–Submittals.
- B. Professional Engineer: All truss designs shall bear the name and seal of a State of Wisconsin licensed professional engineer. CONTRACTOR shall be responsible for submitting the required additional copies of truss drawings with original stamp and signature for submittal to the State of Wisconsin. These materials must be submitted prior to installation.
- C. Truss designs shall include the following information: Pitch, span, dimensions, and spacing of trusses; truss bearing sizes and locations; design loading of truss and allowable stress increase; axial forces in each truss member; nominal sizes and location of connector plates at all joints; size, species, and stress of grade of lumber for all truss members; camber; permanent lateral bracing as required by design to reduce buckling length of individual truss members; and handling and erection recommendations. Where sheathing is not attached directly to truss bottom chords, provide bottom chord bracing and bridging as required by design to resist wind uplift loads.

#### 1.05 QUALITY ASSURANCE

- A. The design and fabrication criteria of all wood trusses shall meet the following:
  - 1. "National Design Specifications for Stress-Grade Lumber and its Fastenings," by National Forest Products Association (latest revision).
  - 2. "Timber Construction Standards," by American Institute of Timber Construction (latest revision).
  - 3. "Design Specifications for Light Metal Plate Connected Wood Trusses," by Truss Plate Institute (latest revision).
  - 4. 2015 International Building Code.
- B. Fabricator Manufacturer: Minimum three years experience in successful fabrication of trusses comparable to type indicated for this project.
- C. Design Trusses under direct supervision of a professional engineer experienced in design of this work and licensed in the State of Wisconsin.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Fabricated trusses and subcomponents shall be so handled and stored that they are not subject to damage.
- B. If the trusses are to be stockpiled prior to erection, sufficient bearing points and/or bracing shall be provided to prevent excessive lateral bending or tipping over.

## PART 2–PRODUCTS

### 2.01 MATERIALS

#### A. Lumber:

1. All lumber used for truss members shall be Spruce-Pine-Fir, Douglas Fir, Southern Pine, Hem-Fir, or Western Larch and shall conform to lumber for trusses and shall have a minimum nonrepetitive fiber bending strength of 1,050 psi. If design calls for use of a lumber with greater strength, then that lumber shall be used for the associated members.
2. At the time of delivery, the moisture content of all lumber shall not exceed 19% kiln-dried.
3. All lumber shall conform to the species and shall be fully recognized nominal sizes shown on the Drawings or truss engineering design.
4. All members shall be cut from lumber which bear the proper grade-mark stamps of a licensed lumber inspection agency.

#### B. Connectors:

1. All truss connector plates shall be manufactured from ASTM A653, Grade A, prime commercial quality galvanized sheet steel of no less than 20-gauge thickness which has a minimum yield of 33,000 psi and a minimum ultimate tensile strength of 45,000 psi.
2. The corrosion-resistant coating shall be ASTM A924–Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, General Requirements, Coating Designation C90 or G60, ASTM A879–Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface, Coating Class C, or such treatment as will give equivalent corrosion protection.
3. The connectors shall have a series of nail-like projections which are designed to separate the fibers of the wood into which they are pressed in accordance with accepted nailing practices.
4. Where field-assembly of truss subcomponents is necessary, the connections shall be in accordance with the details shown on the truss design drawings, approved by a Professional Engineer.

### 2.02 FABRICATION

- A. All trusses and other roof structural components shall be fabricated in a properly equipped manufacturing facility of a permanent nature. They shall be manufactured by experienced workmen using precision cutting and truss fabricating equipment under the direct supervision of a qualified foreman. All trusses shall be fabricated under strict rules of inspection and quality control as the local code may require and be open to the observation of ENGINEER or its representative at all times.
- B. All truss members shall be accurately cut to length, angle, and be true to line to provide tight joints for finished truss.
- C. All truss members and connector plates shall be properly placed in special jigs and the members tightly clamped in place remaining in that position until the connector plates have been pressed into the lumber simultaneously on both sides of the joints.

- D. Camber shall be built into the trusses, as noted on the engineering truss designs, by properly positioning the members in the fabricating jig. No camber will be allowed on the bottom chord.

### PART 3-EXECUTION

#### 3.01 ERECTION

- A. Install trusses in accordance with manufacturer's instructions and TPI BWT (latest revision).
- B. Framing anchors and/or truss hangers shall be provided by CONTRACTOR, as required, or detailed to withstand all loads, both dead and live, as well as wind and transfer loads to bearing.
- C. Field erection of the trusses, including items such as handling, safety precautions, and temporary bracing to prevent toppling or the domino effect on the trusses during erection, and any other safeguards or procedures consistent with good workmanship and good building erection practices, shall be employed.
- D. During the entire construction period, all contractors shall provide means for adequate distribution of concentrated loads so that the carrying capacity of any one truss and/or other component is not exceeded.
- E. Proper erection bracing shall be installed to hold the trusses true and plumb and in safe condition until permanent truss bracing and bridging can be solidly nailed in place to form a structurally sound roof framing system. All erection and permanent bracing shall be installed and all components permanently fastened before the application of any loads. Provide all permanent bracing necessary for truss stability. Where sheathing is not attached directly to truss bottom chord and where required by design, provide bottom chord bracing and bridging as required to resist wind uplift loads.
- F. Frame openings between trusses with lumber in accordance with Section 06 11 00-Wood Framing and Sheathing.

END OF SECTION



## SECTION 07 21 12

### BOARD INSULATION

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work includes board insulation for cavity wall construction, for perimeter foundation walls, and under floor-slabs on-grade.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

#### PART 2–PRODUCTS

##### 2.01 CAVITY WALL INSULATION

- A. Cavity wall insulation shall be 3-inch-thick polyisocyanurate foam board with foil facing on both sides. Aged thermal resistance (R-value) at 72°F shall be a minimum of 19.0.
- B. Acceptable products include the following, or equal: Thermax Sheathing by DuPont.
- C. Adhesive for adhering insulation to backup wall shall be as recommended by the insulation manufacturer.

##### 2.02 FOUNDATION AND UNDER-SLAB INSULATION

- A. Foundation and under-slab insulation shall be 3-inch-thick extruded polystyrene closed cell rigid foam board with continuous skins on both sides. Aged thermal resistance (R-value) at 75°F shall be a minimum of 15.0.
- B. Acceptable products include the following, or equal:
  - 1. Styrofoam Square Edge by DuPont.
  - 2. Foamular NGX 250 by Owens Corning.

#### PART 3–EXECUTION

##### 3.01 INSTALLATION–CAVITY WALLS

- A. Insulation shall be installed horizontally within the cavity space between masonry wythes.
- B. Take care during installation so that all insulation boards are butted and installed between ties and fit flush against inner wythe or backup wall.
- C. Cut insulation neatly to fit around obstructions across the cavity such as vents, louvers, pipes, and conduits.

- D. Secure insulation in place against backup wall with mastic adhesive and observe label directions.

### 3.02 INSTALLATION—FOUNDATION WALLS AND UNDER FLOORS

- A. Rigid insulation shall be laid dry against the foundation walls as backfill is placed. Insulation shall be located at all perimeter frost walls and below-grade walls of buildings and structures containing areas that may be occupied by personnel.
- B. At perimeter frost wall foundations, insulation shall be 48 inches high and located on the inside of foundation walls.
- C. Insulation under edges of slab-on-grade floors shall be 24 inches wide.

END OF SECTION

## SECTION 07 21 13

### BATT AND BLOWN-IN INSULATION

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work includes batt insulation for attic spaces in roof and insulation vent system between roof trusses as called for on the Drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM C665–Specification for Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

#### PART 2–PRODUCTS

##### 2.01 EXTERIOR WALL AND ROOF INSULATION

- A. Batt insulation placed on top of precast plank in attic spaces shall be unfaced fiberglass batt 18 inches thick conforming to ASTM C665, Type 1, and providing a minimum R-value of 57. Layers of 6-inch batt placed perpendicular to each other may be used in place of one layer of 18-inch batt.
- B. All batt insulation in attic spaces shall be unfaced or foil-reinforced kraft-faced meeting the 2021 International Building Code or governing local building code requirements.
- C. Acceptable manufacturers include the following, or equal:
  - 1. Owens Corning.
  - 2. Manville.
  - 3. Certainteed.

##### 2.02 INSULATION VENTS

- A. Insulation vents shall be 2 inches high by 14 inches wide by 48 inches long, tear-resistant high-impact plastic as manufactured by proVent, or equal.

#### PART 3–EXECUTION

##### 3.01 INSTALLATION–ROOF INSULATION

- A. Prior to installing insulation, vapor barrier shall be in place (See Section 07 26 00–Vapor and Air Barrier).

- B. Insulation shall be loose laid on the precast plank over the vapor barrier. If two layers of insulation are used to make up the required thickness, upper layer shall be installed perpendicular to the lower layer.

### 3.02 INSULATION VENTS

- A. Insulation vents shall be installed between roof trusses at the truss bearing ends providing an unobstructed air channel from the soffit into the attic.

END OF SECTION

## SECTION 07 26 00

### VAPOR AND AIR BARRIER

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work includes:
  - 1. Vapor barrier under concrete floors on grade and on top of precast roof plank.
  - 2. Air barrier in masonry double wythe walls on concrete block backup wall.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

#### PART 2–PRODUCTS

##### 2.01 MATERIALS

- A. Vapor barrier for below slabs: Vapor barrier shall consist of 10 mil ASTM E1745 Class B polyethylene sheeting with less than 0.3 perm water vapor permeance in accordance with ASTM E96.
- B. Vapor barrier for precast plank construction: Vapor barrier shall consist of 6 mil ASTM D4397, Class B polyethylene sheeting with less than 0.3 perm water vapor permeance in accordance with ASTM E96.
- C. Permeable air barrier for masonry cavity wall construction shall be fluid applied membrane, ExoAir 230 by Tremco, or equal. Apply to outside face of inner wythe of concrete block prior to installation of rigid insulation. Apply in strict accordance with manufacturer's instructions. Air barrier shall be included in all new cavity wall construction on the project.

#### PART 3–EXECUTION

##### 3.01 INSTALLATION–UNDER CONCRETE FLOORS ON GRADE

- A. Provide continuous vapor barrier under concrete floors on grade that are 8 inches or less in thickness, lap all joints a minimum of 12 inches.
- B. Specific location of vapor barrier (whether directly under slab or under granular cushion) shall be as shown on the Drawings.

##### 3.02 INSTALLATION ON TOP OF PRECAST ROOF PLANK

- A. Provide continuous vapor barrier on top of precast plank.
- B. Lap all joints a minimum of 12 inches and tape all joints.

### 3.03 INSTALLATION OF AIR BARRIER

- A. Install air barrier on exterior side of exterior wall sheathing.
- B. Install air barrier on outside face of inner wythe of concrete block in cavity wall construction.
- C. Install air barrier per manufacturer's recommendations and approved details.

END OF SECTION

SECTION 07 46 46  
FIBER CEMENT SIDING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Includes: Cement-board siding and related accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. National Evaluation Report–No. NER-405.
- B. ASTM E136-24C–Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00–Submittals.
- B. Submit three 6-inch by 6-inch pieces of siding claddings in texture and widths shown and specified herein.
- C. Submit copies of specifications, installation data and other pertinent manufacturer's literature.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Stack product on edge or lay flat on a smooth, level surface. Protect edges and corners from chipping, Store sheets under cover and keep dry prior to installing.

1.05 WARRANTY

- A. Warrant plank siding, panel siding, and shingle cladding for 30 years. Warrant trim products for 15 years. Provide manufacturer's standard warranties.

PART 2–PRODUCTS

2.01 MANUFACTURER

- A. Acceptable manufacturers include James Hardie products, or equal.

2.02 MATERIALS

- A. Nonasbestos fiber-cement siding to comply with ASTM Standard Specification C1186 Grade II, Type A.

- B. Type: HardiePlank HZ5 lap siding with sloped top, beveled drip edge and nailing line as manufactured by James Hardie Buildings Products, Inc., or equal. Type: Select Cedarmill 5 to 14 inches with 4-inch exposure.
- C. Trim Type: HardieTrim HZ5 boards as manufactured by James Hardie Buildings Products, Inc., or equal.
- D. Fasteners: Provide per manufacturer's standard specifications.

## PART 3–EXECUTION

### 3.01 INSTALLATION–FASCIA AND MOLDING

- A. Install flashing around all wall openings.
- B. Fasten through trim into structural framing or code complying sheathing. Fasteners must penetrate minimum 3/4 inch or full thickness of sheathing. Additional fasteners may be required to provide adequate security.
- C. Place fasteners no closer than 3/4 inch and no further than 2 inches from side edge of trim board and no closer than 1 inch from end. Fasten maximum 16 inches on center.
- D. Maintain clearance between trim and adjacent finished grade.
- E. Trim inside corner with single board.
- F. Install single board of outside corner board then align second corner board to outside edge of first corner board. Do not fasten Harditrim board to Harditrim board.
- G. Allow 1/8-inch gap between trim and siding.
- H. Seal gap with high-quality, paintable caulk.
- I. Shim frieze board as required to align with corner trim.
- J. Install fascia over structural subfascia.

### 3.02 INSTALLATION–PLANK SIDING

- A. Starting: Install a minimum 1/4-inch-thick lath starter strip at the bottom course of the wall. Apply planks horizontally with minimum 1/4-inch-wide laps at the top. The bottom edge of the first plank overlaps the starter strip.
- B. Allow minimum 1-inch vertical clearance between roofing and bottom edge of siding.
- C. Align vertical joints of the planks over framing members.
- D. Maintain clearance between siding and adjacent finished grade.
- E. Locate splices at least one stud cavity away from window and door openings.



- F. Use off-stud metal joiner when vertical joints occur between framing members. Position metal joiner so that the bottom lip is resting on the solid course of planks. Fasten plank to the framing. Position and fasten abutting plank into place ensuring that the lower edges of the two planks align. Locate metal joiner centrally behind the joint. Locate off-stud splices a minimum of two stud cavities from wall corners and stagger all subsequent course splices at minimum 24-inch intervals when located in the same wall cavity.
- G. Wind Resistance: Where a specified level of wind resistance is required Hardiplank lap siding is installed to framing members and secured with fasteners described in Table 2 in National Evaluation Service Report No. NER-405.

### 3.03 FINISHING

- A. Finish unprimed siding with minimum one coat high quality, alkali-resistant primer and one coat of either 100% acrylic or latex or oil based, exterior grade topcoat or two coats high quality, alkali-resistant, 100% acrylic or latex, exterior grade topcoat within 90 days of installation. Follow paint manufacturer's written product recommendation and written application instructions.

END OF SECTION

SECTION 07 61 00  
SHEET METAL ROOFING

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Standing seam metal roof system.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM A653—Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. SMACNA—Architectural Sheet Metal Manual.
- C. NRCA—Roofing and Weatherproofing Manual (including construction details) and Handbook of Accepted Roofing Knowledge.
- D. Manufacturer's Handbook of Construction Details.
- E. AISI "Specifications for the Design of Light-Gauge Cold Formed Steel Structural Member, latest edition."

1.03 SUBMITTALS

- A. See Section 01 33 00—Submittals for general submittal requirements.
- B. Shop drawings: Submit fabrication details, jointing details, fastening methods, and termination details.
- C. Samples: Submit one sample of each type of prefinished and preformed panel showing color and profile match. Provide same for closures.
- D. Warranty from manufacturer: Submit sample of manufacturer's 20-year warranty on weather tightness, flashing, inclusive.

1.04 QUALITY ASSURANCES

- A. Perform work in accordance with manufacturer's instructions and these specifications.

1.05 QUALIFICATIONS

- A. Material Manufacturer: Five years documented experience with this type of construction.
- B. Installer: Five years of satisfactory documental experience in the installation of this type of work.

## 1.06 WARRANTIES

- A. Architectural finish coating shall be provided with a 20-year guarantee against cracking, chipping, peeling, and fading.
- B. Warrant materials and workmanship for 20 years for weather tightness, flashing, inclusive.

## 1.07 SYSTEM DESIGN

- A. All components of the paneling system shall be designed in accordance with sound engineering methods and practices.
- B. The panels shall be designed in accordance with AISI "Specifications for the Design of Light Gauge Cold Form Steel Structural Members," latest edition.
- C. The paneling system and its attachments shall be designed to support live, snow, and wind loads.
- D. Panels shall be designed for 30 psf live load.
- E. The roof system shall carry UL wind-uplift Class 90 rating.

## PART 2-PRODUCTS

### 2.01 MATERIALS

- A. Metal Roof System:
  - 1. Roof panels shall be roll formed panels of uniform width 12 to 18 inches wide with two major corrugations, 2 1/2 inches high, 16 inches (equal to panel width) on center.
  - 2. Panel materials shall be 24 gauge, hot-dipped galvanized steel (50,000 psi yield), G-90 coating conforming to ASTM A653 specification.
- B. Fasteners:
  - 1. All connections of panels to structural members, except at eave, shall be made with clips with moveable tabs that are seamed into the standing seam side lap.
  - 2. Panel clips shall be fastened to structural members with fasteners as per manufacturer's erection drawings.
  - 3. Panel-to-panel connections shall be made with a positive, field-formed standing double-lock seam, formed by a special seaming device.
- C. Underlayment and Eave Protection Membrane:
  - 1. Underlayment for all areas, except along eaves, shall be No. 30 unperforated asphalt saturated felt conforming to ASTM D226.
  - 2. Eave (ice dam) protection applied to 4 feet inside the exterior wall line eaves shall be a sheet membrane of rubberized asphalt bonded to sheet polyethylene, 40 mils minimum total thickness, with strippable release paper. Acceptable products include the following, or equal:
    - a. Ice and Water Shield by W.R. Grace Company.
    - b. Winter Guard Waterproofing Shingle Underlayment by Certainteed Corporation.

## 2.02 MANUFACTURERS AND PRODUCTS

- A. Roof panels shall be roll-formed Stand N' Seam panels as manufactured by Fabral, or equal.
- B. Sealants: Per Section 07 90 00—Caulking and Sealants.
- C. Flashing at eave, gable, ridge, and penetrations shall be in accordance with manufacturer's recommendations and Section 07 62 00—Flashing and Sheet Metal.
- D. Unless shown otherwise on the Drawings, provide continuous ridge venting using manufacturer's standard ridge/hip flashing and manufacturer's approved detail. Provide vent material to prevent entry of insects.
- E. Unless shown otherwise on the Drawings, provide snow guards on the roof above all exterior door openings, extending minimum 1 foot beyond each edge of door. Snow guards shall consist of a snow bar mounted to a nonpenetrating clamp attached to the standing seam ribs. Snow bar shall incorporate a prepainted metal strip to match the roof panel color. Acceptable products include Color Guard Snow Guard with prepainted insert and S-5-U clamps by LM Curbs, Longview, Texas, or equal.

## 2.03 FINISHES

- A. Finishes on all exterior surfaces shall be a 1.0 mil DFT two-coat, factory-applied, 70% Kynar, 500 fluoropolymer coating over an epoxy prime coat.
- B. All exposed fasteners shall be provided with the same finish as the sheet material products.
- C. Colors shall be selected by OWNER.

## PART 3—EXECUTION

### 3.01 INSTALLATION

- A. The panels shall be attached to the supporting structurals by means of a clip device. The clip shall occur at the panel major corrugation.
- B. Panel sidelaps shall be field-seamed by a seaming device; all sidelap sealant shall be factory-applied.
- C. Panel endlaps, when required, shall be at least 6 inches and sealed with field-applied sealant. One panel end shall be "swaged" to provide nestible, watertight endlaps.
- D. Provisions for thermal expansion/contraction movement of the panel shall be accomplished by the use of clips with a moveable tab. The tabs shall be factory-centered on the roof clip to provide full movement in either direction.
- E. The roof shall provide for thermal expansion/contraction without detrimental effect on the roof panel when there is a 100°F temperature differential between the interior structural framework of the building and the roof panels.

END OF SECTION

## SECTION 07 62 00

### FLASHING AND SHEET METAL

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work includes masonry wall flashing, custom-fabricated sheet metal flashing and counter flashing at eave, gable, and ridge lines; roof-mounted equipment; vent stacks; and other locations.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM A653—Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
- B. ASTM A924—General Requirements for Steel Sheet, Metallic Coated by the Hot-Dip Process.
- C. ASTM B32—Solder Metal.
- D. ASTM B209—Aluminum and Alloy Sheet and Plate.
- E. ASTM D4586—Asphalt Roof Cement, Asbestos-Free.
- F. SMACNA—Architectural Sheet Metal Manual.

##### 1.03 SUBMITTALS

- A. See Section 01 33 00—Submittals for general submittal requirements.
- B. Shop drawings: Submit fabrication details, jointing details, fastening methods, and termination details.

##### 1.04 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA standard details and requirements.

##### 1.05 QUALIFICATIONS

- A. Fabricator and installer shall be a company specializing in sheet metal fabrication work with a minimum of 5 years of verifiable experience in that field.

##### 1.06 WARRANTY

- A. Kynar 500 coating shall be provided with a 20-year guarantee against cracking, chipping, peeling, and fading.

## PART 2—PRODUCTS

### 2.01 MATERIALS

- A. Masonry wall flashing and flashing around windows, doors, and other openings shall be 32 mil of self-adhesive rubberized asphalt integrally bonded to 8 mil of cross-laminated, high-density polyethylene film to provide a minimum 40 mil thick membrane. Flashing shall be PERM-A-BARRIER wall flashing as manufactured by Grace Construction Products, or equal. Provide primer or surface conditioner as recommended by manufacturer.
- B. Galvanized Steel Sheet: 26 gauge meeting ASTM A525, Grade A with G90 zinc coating.
- C. Aluminum Sheet: 0.032-inch-thick meeting ASTM B209.
- D. Fasteners: Same material and finish as flashing sheet. Stainless steel fasteners may be used with any flashing material. Provide soft neoprene washers with fasteners.
- E. Primer: Zinc chromate type.
- F. Protective Backing Paint: Bituminous type.
- G. Sealant: See Section 07 90 00—Caulking and Sealants.
- H. Bedding Compound: Rubber asphalt or butyl type.
- I. Plastic Cement: ASTM D4586, Type I or II.
- J. Reglets: Galvanized steel or PVC, surface-mounted or recessed, or as shown on the Drawings.
- K. Solder: ASTM B32. Soldering is not permitted on aluminum or stainless steel sheet.

### 2.02 FABRICATION

- A. All flashing and fascia shall be formed to the configurations shown on the Drawings and/or the applicable manufacturer's details, or in accordance with SMACNA standard details where not shown on the Drawings, or in manufacturers details. Form sections true to shape, accurate in size, square, and free from buckles, kinks, or other defects.
- B. All exposed edges shall be folded or returned on themselves at least 1/2 inch. Corners shall be mitered and seamed.
- C. Form pieces in the longest possible lengths. Form material with flat lock seams.
- D. All sections shall be provided with slip joints at 8 feet on center.
- E. Cleats shall be fabricated of the same materials as the flashing sheets and shall be interlockable with the sheets.
- F. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form a drip.

- G. Fabricate corners from one piece with minimum 18-inch-long legs. Seam or solder for rigidity and seal with sealant.

## 2.03 FINISH

- A. Back paint all sheet metal with asphaltum paint where sheet metal surfaces come in contact with masonry or steel.
- B. Flashing and fascia shall be painted where exposed to view from the ground. Galvanized steel shall be painted in accordance with Section 09 91 00–Painting. Aluminum shall be coated with a Kynar 500 coating system.

## PART 3–EXECUTION

### 3.01 INSTALLATION

- A. Through-wall flashing shall be installed 1/2 inch back of the outside face of the wall, carried through the outside wythe, turned up in the collar, and adhered to back-up wall as shown on the Drawings. At no time should any portion of the flashing be allowed to hang or drape beyond the width of the wall. All laps shall be sealed and shall not be less than 3 inches in width. Flashing around openings shall extend at least 3 inches beyond each side of opening.
- B. Fit flashing tight in place. Make corners square, surfaces true and straight in planes, and line accurate to profiles. Seal metal joints watertight.
- C. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted by ENGINEER.
- D. Insert flashings into reglets where shown on the Drawings. Seal flashings into reglets with sealant.
- E. Counter flashing shall be provided at all vertical masonry and/or concrete walls which extend above the roof line. The counter flashing shall be installed in a reglet unless otherwise shown. Surface-mounted reglets shall be used where noted.
- F. CONTRACTOR shall provide copper sleeves for hot pipes penetrating the roof as approved by the roofing manufacturer. The annular space between the sleeve and the pipe shall be packed with insulation capable of withstanding the maximum temperature of the pipe. CONTRACTOR to provide a galvanized steel rain collar welded to the hot pipe.

END OF SECTION

## SECTION 07 71 00

### MANUFACTURED ROOF SPECIALTIES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Metal fascia and soffit.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. SMACNA—Architectural Sheet Metal Manual.

##### 1.03 SUBMITTALS

- A. Submittals shall comply with requirements of Section 01 33 00—Submittals.
- B. Submit sample panels for selection of anodized or Kynar 500 finish colors.

##### 1.04 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA standard details.

##### 1.05 WARRANTY

- A. Kynar 500 coating shall be provided with a 20-year guarantee against cracking, chipping, peeling, and fading.

#### PART 2—PRODUCTS

##### 2.01 FASCIA

- A. Metal fascia system shall be constructed of 24 gauge galvanized steel and shall include all necessary angles, clips, corners, and other accessories of the same material as the finish panels.
- B. Acceptable products include the following, or equal: Fascia System by Fabral, Peterson Aluminum Corporation, and shall be made by the same manufacturer as the sheet metal roofing in Section 07 61 00—Sheet Metal Roofing.

##### 2.02 SOFFIT

- A. Metal soffit system shall be constructed of 0.032-inch-thick aluminum sheet and shall include all necessary channels, angles, clips, flashing, fasteners, and other accessories of the same material as the soffit panels. Soffit panels shall be fully vented to allow for ventilation and shall have stiffener grooves spaced at 6 inches on center.



- B. Acceptable products include the following, or equal: Fabral, PAC 750 by Peterson Aluminum Corporation, and shall be made by the same manufacturer as the sheet metal roofing in Section 07 61 00–Sheet Metal Roofing.

## 2.03 FINISHES

- A. Finish on all products shall be a 1.0 mil DFT two-coat factory-applied 70% Kynar 500 fluoropolymer coating over an epoxy prime coat. Colors shall be selected by OWNER. All exposed fasteners shall be provided with the same finish as the sheet metal products.

## PART 3–EXECUTION

### 3.01 INSTALLATION

- A. Install components in accordance with the Drawings and the manufacturer's instructions.
- B. Installation details shall be such as to allow for thermal expansion and contraction of the components and to provide for a complete weatherproof installation.

END OF SECTION

## SECTION 07 71 23

### GUTTERS AND DOWNSPOUTS

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Aluminum Gutters and Downspouts.
  - 2. Precast Concrete Splash Pads.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM B209–Aluminum and Aluminum Alloy Sheet and Plate.
- B. SMACNA–Architectural Sheet Metal Manual.

##### 1.03 DESIGN REQUIREMENTS

- A. Conform to SMACNA manual for sizing components for a 10-year storm event.

##### 1.04 REGULATORY REQUIREMENTS

- A. Conform to the 2015 International Building Code or governing local building code for size and method of rainwater discharge.

#### PART 2–PRODUCTS

##### 2.01 GUTTERS AND DOWNSPOUTS

- A. Gutters and downspouts shall be constructed of 0.032-inch-thick aluminum sheet conforming to ASTM B209 and shall be made from the same manufacturer as the fascia and soffit system.

##### 2.02 ACCESSORIES

- A. Anchorage devices shall meet SMACNA or manufacturer's requirements.
- B. Gutter supports shall be straps and fasteners at maximum 3 feet 0 inch on center.
- C. Downspout supports shall be brackets of the appropriate size and spacing.
- D. Fasteners shall be aluminum or stainless steel.

### 2.03 SPLASH PADS

- A. Splash pads shall be precast concrete of the appropriate size with minimum 28-day compressive strength of 3,000 psi and minimum 5% air entrainment.

### 2.04 FABRICATION

- A. Form gutters and downspouts to SMACNA requirements.
- B. Fabricate with required connection pieces.
- C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion by providing expansion joints as required.
- D. Hem exposed edges of metal.
- E. Fabricate gutter and downspout accessories; seal watertight.

### 2.05 FINISHES

- A. Finish on gutters and downspouts shall match finish on fascia system. All components, including fasteners and supports, shall be prefinished to match gutters and downspouts.

## PART 3—EXECUTION

### 3.01 INSTALLATION

- A. Install gutters, downspouts, and accessories with manufacturer's instructions.
- B. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts and accessories.
- C. Install gutters level.
- D. Seal metal joints watertight.
- E. Set splash pads under downspouts.

END OF SECTION

## SECTION 07 84 00

### FIRESTOPPING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Silicone firestopping foam for sealing annular spaces around ductwork penetrations through fire-rated assemblies.
  - 2. Silicone firestopping sealant for sealing annular spaces around piping and conduit penetrations through fire-rated assemblies and to seal gaps at intersections of walls and floors/ceilings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. UL 1479–Fire Tests of Through-Penetration Fire Stops.
- B. UL–Fire Hazard Classifications.

##### 1.03 REGULATORY REQUIREMENTS

- A. Firestopping materials and installation shall conform to the 2015 International Building Code requirements, including fire-resistance ratings and surface-burning characteristics.
- B. Provide certificate of compliance from local building inspector indicating approval of firestopping materials and installation.

##### 1.04 ENVIRONMENTAL REQUIREMENTS

- A. A small amount of hydrogen gas is released as the firestopping foam cures. Use forced-air ventilation when installing if areas of installation have less than 2 cubic feet of free air for each pound of liquid mixture being formed.

#### PART 2–PRODUCTS

##### 2.01 FIRESTOPPING FOAM

- A. Firestopping foam for duct penetrations through fire-rated assemblies shall be a foamed-in-place silicone elastomer produced from two liquid components.
- B. Acceptable products include the following, or equal: Fire Barrier Rated Foam, FIP 1 Step by 3M Corporation.

## 2.02 FIRESTOPPING SEALANT

- A. Firestopping sealant for piping and conduit penetrations through fire-rated assemblies shall be a single-component silicone elastomer.
- B. Acceptable products include the following, or equal: Fire Barrier Silicone Sealant 2000 by 3M Corporation.

## 2.03 DAMMING MATERIAL

- A. Damming material shall be fire-resistant mineral fiber (if left in place) or other combustible material (if removed), as directed by the appropriate fire-tested designs.

## 2.04 PRIMER AND WRAP STRIP

- A. Primer for firestopping sealant shall be 3M Corporation, or equal.
- B. Wrap strip for firestopping sealant shall be 3M Fire Barrier FS-195 Wrap/Strip, or equal.

# PART 3-EXECUTION

## 3.01 INSTALLATION

- A. Firestopping foam and sealant shall be applied according to manufacturer's written instructions and shall achieve a fire rating equal to rating of construction which is penetrated. Substrate shall be free of all combustible materials (except damming material for later removal), loose impediment, oil, and other free liquids.
- B. Install damming material to establish the thickness and hold the firestopping foam/sealant in place. Follow the manufacturer's installation instructions. All gaps or cracks left after damming materials are in place must be sealed.
- C. Firestopping Foam: Immediately after mixing, dispense liquid foam into the penetration opening in accordance with manufacturer's installation instructions. Do not overfill penetration openings with liquid foam. Foam expands approximately three times its original volume during cure. Follow manufacturer's guidelines. If the opening is not filled when the cured foam has completed its expansion, repeat the installation and cure procedure until the opening is filled to the desired level. Allow 15 minutes between application of each shot.
- D. Firestopping Sealant: Apply primer and wrap strip in accordance with manufacturer's instructions prior to installing sealant. Apply sealant to a minimum depth of 1 1/2 inches and with uniform density and texture.
- E. Remove combustible damming material after foam/sealant has cured. Noncombustible damming material may be left in place.

## 3.02 QUALITY CONTROL

- A. Firestopping Foam:
  - 1. Perform manufacturer's four-step in-line quality control check at least once daily and upon changing to a new lot of material in order to review performance of both dispensing

equipment and foam product prior to installing penetration seals. The four-step quality check includes evaluation for: snap time (cure rate); foam color and uniformity; foam cell structure; and foam density (weight).

2. Check cured penetration seal after 24-hour cure by removing damming materials to examine seal.
3. Cured foam should completely fill penetration. Fill all remaining gaps with freshly mixed foam or firestopping sealant.
4. Recheck after added material has cured 24 hours.
5. Damming materials required to achieve a fire rating must be returned to the penetration.
6. Clean up spills of liquid components with high-flash mineral spirit solvent, following manufacturer's instructions.
7. If necessary, trim excess cured foam with a sharp knife or blade.

B. Firestopping Sealant:

1. Check completed work for complete adhesion and seal 48 hours after sealant application.
2. Clean adjacent surfaces of excess sealant using a compatible solvent in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 07 90 00  
CAULKING AND SEALANTS

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included: Caulking and sealants on the project, including primers and backer rod material.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ASTM C920–Elastomeric Joint Sealants.

1.03 SUBMITTALS

- A. Submittals shall comply with provisions of Section 01 33 00–Submittals.
- B. Submit color chart for each sealant used on project. Colors will be selected by ENGINEER.
- C. Submit copies of warranty.

1.04 WARRANTY

- A. Caulked joints shall be weathertight and guaranteed watertight by installer for two years from the earlier of either the date established for partial utilization in accordance with GC 15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project. Deliver original guarantee to OWNER with copies to ENGINEER.

PART 2–PRODUCTS

2.01 CAULK–NONSUBMERGED AND SUBMERGED NON-POTABLE APPLICATIONS–GENERAL

- A. Caulk for nonsubmerged and submerged non-potable water contact applications in all locations except floor joints shall be a one-part or two-part polyurethane sealant.
- B. Acceptable products include the following, or equal:
  - 1. Masterseal NP1 by Master Builders Solutions.
  - 2. Vulkem 116 by Tremco, Inc. (exterior applications only).
  - 3. Dymonic 100 by Tremco, Inc.
  - 4. Sikaflex-2c NS EZ Mix by Sika Products.

## 2.02 CAULK—NONSUBMERGED AND SUBMERGED NON-POTABLE WATER APPLICATIONS—FLOOR JOINTS

- A. Caulk for floor joints in nonsubmerged and submerged non-potable water contact applications shall be a one-part, self-leveling, polyurethane sealant.
- B. Acceptable products include the following, or equal:
  - 1. MasterSeal SL1 by Master Builders Solutions.
  - 2. Vulkem 45 SSL by Tremco, Inc.
  - 3. Sikaflex-2c SL by Sika Products.

## 2.03 ACCESSORIES

- A. Backer rod shall be flexible, closed-cell polyethylene rod stock sized to be under at least 25% compression when positioned in the joint. In shallow joints and where backer rod is not used, polyethylene bond breaker tape shall be used. It is essential that the caulk bond to the side of the joint but not to the base of the joint.
- B. Primer(s) shall be used where required by the manufacturer for the specific product(s) used and the specific application(s) intended. Specific product(s) shall be as recommended by the manufacturer.
- C. Cleaning fluid shall be methyl ethyl ketone (MEK), methyl isopropyl ketone (MIK), or similar solvent material, which will not etch or mar metal finishes and shall be the product of a nationally recognized manufacturer of type expressly recommended for use with the caulking or sealant compound used.

## PART 3—EXECUTION

### 3.01 INSTALLATION

- A. Seal completely all joints around entire perimeter of all openings in all exterior walls (inside and outside faces), including joints at all exterior doors, windows, louvers, sills, and elsewhere as noted on the Drawings and as necessary to seal all open joints in the building in a complete manner. Joints in exterior walls shall be caulked in a completely weathertight manner. Joints between interior walls and concrete ceilings and other interior joints shall be caulked as indicated on the Drawings. Caulking not specified in other sections shall be performed under this heading.
- B. All caulking shall be done in accordance with manufacturer's specifications. Allow minimum 28-day curing period for concrete, grout, or mortar prior to caulking unless requested otherwise. Caulking work shall be done before the final coat of paint is applied except at moving joints which shall be finish painted before caulking or caulking shall be protected during painting. All caulking shall occur only when the temperature is above 40°F.
- C. Joints shall be thoroughly cleaned and primed before caulking in accordance with manufacturer's instructions. Unless otherwise shown, joints shall be square in cross section 1/2-inch by 1/2-inch and shall comply with manufacturer's joint width/depth ratio limitations.



- D. Backer rod shall be used in all openings 3/4 inch or more in depth and shall be tightly packed to completely fill the space to 1/2 inch back of face. The 1/2 inch shall then be filled with caulking compound.
- E. Caulking shall be done by hand gun. Compound shall be driven into joint grooves with sufficient pressure to force out all air and fill joint grooves solidly. Caulking where exposed shall be free of wrinkles and shall be uniformly smooth.
- F. At completion of caulking, clean off all excess material from adjoining surfaces and material. Entire installation shall be left in a clean, weathertight condition.

END OF SECTION

## SECTION 08 11 00

### STANDARD STEEL DOORS AND FRAMES

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Thermally-insulated steel doors and frames.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ANSI/SD1-100–Standard Steel Doors and Frames.
- B. UL 10B–Fire Tests of Door Assemblies.

##### 1.03 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00–Submittals.
- B. In addition to shop drawings and product data, indicate type of primer paint to be used and verify compatibility with field paint system specified.

##### 1.04 REGULATORY REQUIREMENTS

- A. Fire-Rated Door and Frame Construction: Conform to UL 10B.

#### PART 2–PRODUCTS

##### 2.01 THERMALLY-INSULATED DOORS

- A. Thermally-insulated doors shall be hollow full flush, 1 3/4-inch-thick, 16 gauge steel sheet in accordance with ANSI/SD1-100 with polyurethane core rigid reinforcing full thickness.
- B. Acceptable products include the following, or equal:
  - 1. Ceco Imperial.
  - 2. Curries 707 Series.

##### 2.02 FABRICATION–DOORS

- A. Doors shall be fully-sealed, continuously-welded construction with all surface welds, joints, and seams filled and ground smooth.
- B. Tops and bottoms of doors shall be completely closed with 16 gauge channels. Outside edges of doors shall be flush without depressions. No inverted channels will be allowed.

- C. Mortise, reinforce, drill, and tap doors to receive hardware. Reinforcement shall be welded within the stiles and rails. Reinforce top rails to accommodate closers on either side and reinforce bottom for kickplate.
- D. Glass in exterior doors shall be 1 inch thick.

#### 2.03 FRAMES

- A. Steel door frames shall be made of 14 gauge, cold-rolled, prime-quality steel in accordance with ANSI/SD1-100.
- B. Frames shall be removable where shown on the Drawings.

#### 2.04 FABRICATION–FRAMES

- A. Fabricate frames as welded unit. Weld joints continuously through full throat width of frames, including rabbets, soffits, and stops; grind, fill, dress, and make smooth, flush, and invisible.
- B. Welded frames shall be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and shall not be used to size the frame opening.
- C. Frames shall be 2 inches by 5 3/4 inches. Frames shall have 4-inch head member at 7 feet 0 inches doors in masonry walls.
- D. Fabricate frames with hardware reinforcement plates welded in place.
- E. Provide anchors appropriate to wall type.
- F. Provide frames for all steel doors.

#### 2.05 FINISH

- A. Doors and frames shall receive one coat of rust-inhibitive, shop-applied primer paint. Primer paint must be compatible with field-paint system specified.
- B. Frames shall be finish-painted as specified in Section 09 91 00–Painting prior to installation. This includes back sides of door frames.

### PART 3–EXECUTION

#### 3.01 INSTALLATION–FRAMES

- A. Install frames in accordance with ANSI/SD1-100.
- B. Coordinate installation of frames with wall construction for anchor placement.
- C. Coordinate installation of frames with installation of doors, hardware, joint sealers, and field painting.
- D. Set all frames as supplied by manufacturer.

- E. Frames in masonry walls shall be grouted full.

### 3.02 INSTALLATION-DOORS

- A. Install doors in accordance with ANSI/SD1-100.
- B. Coordinate installation of doors with installation of frames, hardware, glass and glazing, and field painting.
- C. Set all doors as supplied by manufacturer. Hang all doors allowing for expansion and contraction at time of setting.
- D. Set all hardware in accordance with templates as supplied by hardware supplier.
- E. Cover all exposed hardware until completion of painting and finishing.
- F. Examine hardware at completion; test, oil, grease, and adjust as needed for smooth operation.

### 3.03 SCHEDULE

- A. See Door Schedule on the Drawings.

END OF SECTION

## SECTION 08 22 10

### FIBERGLASS DOORS AND FRAMES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Includes:
  - 1. Fiberglass Doors.
  - 2. Fiberglass Frames for Nonrated Doors and Doors With Up to 90-Minute Fire Rating.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ASTM E84—Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. ASTM E152—Standard Method of Fire Tests of Door Assemblies.
- C. ASTM D635—Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
- D. NFPA 252—Standard Methods of Fire Test of Door Assemblies.
- E. UL10C—Positive Pressure Fire Tests of Door Assemblies.

##### 1.03 REGULATORY REQUIREMENTS

- A. Fire-rated Door Construction: Conform to ASTM E152, UL10C, and NFPA252.
- B. Install door assembly conforming to NFPA 80 for fire-rated class.
- C. Flame Spread: All FRP component parts, including the gel-coat finish, shall have a flame-spread classification of 25 or less per ASTM E84 and shall be self-extinguishing according to ASTM D635.

##### 1.04 WARRANTY

- A. Provide manufacturer's 20-year warranty against failure due to corrosion.

#### PART 2—PRODUCTS

##### 2.01 MANUFACTURERS

- A. Acceptable products include the following, or equal: CORRIM Company, Oshkosh, Wisconsin, or equal.

## 2.02 MATERIALS

- A. Resins:
  - 1. Manufacturer's formulation for corrosion-resistant resin system with light-stabilizing additives.
  - 2. Minimum glass fiber to resin ratio: 40%.
- B. Anchors: Manufacturer's standard stainless steel expansion anchors for existing openings and stainless steel masonry tee anchors for new construction.
- C. Fasteners: Stainless steel.
- D. Glazing: Type specified in Section 08 81 00—Glazing; factory installed.

## 2.03 DOORS

- A. Thickness: 1 3/4 inches.
- B. Thermal Insulating Value: Minimum R value of 11.
- C. Construction:
  - 1. Core: Polyurethane foam for nonfire-rated doors and 1 1/2-hour mineral core for fire-rated doors.
  - 2. Face Sheets: FRP molded in one continuous piece, resin reinforced with hand-laid glass fiber mat, nominal 0.120 inch thick, minimum 15 mil gel-coated surface.
  - 3. Stiles and rails shall be 1 1/2 inch square pultruded fiberglass tubes. Provide polymer blocking for all hardware reinforcing.
- D. Door Edges: Smooth, seamless finish.
- E. Seals: Intumescent seals factory-applied around perimeter required for all fire doors.
- F. Label: UL fire door label required on hinge edge of all fire doors.

## 2.04 FIBERGLASS FRAMES

- A. Provide fiberglass frames for nonrated doors and doors with up to 90-minute fire rating.
- B. Construction: One-piece pultruded fiberglass-reinforced plastic, minimum 1/4-inch wall thickness, jamb-to-head joints mitered and reinforced with FRP clips and stainless steel fasteners; providing for performance equivalent to 16 gauge steel frames.
- C. Frame Profile: 5 3/4 inches deep, 2 inches wide face; double-rabbeted with 5/8-inch-high stop. Provide 4-inch head frames in masonry openings.
- D. Finish: Gel-coat 15 mils thickness on all exposed surfaces. Color to match doors.

## 2.05 HARDWARE

- A. All doors and frames shall be mortised and reinforced with polymer blocking for all hardware in accordance with manufacturer.

- B. Remainder as specified in Section 08 71 00–Door Hardware and called for in Door Schedule.
- C. All fasteners shall be 316 stainless steel.

#### 2.06 FINISH

- A. Doors shall have a 15 mil gel-coat finish. Finish for frames shall be as specified above.
- B. Color shall be a custom color selected by OWNER.

### PART 3–EXECUTION

#### 3.01 INSTALLATION

- A. Set all doors and frames as supplied by manufacturer. Use stainless steel masonry anchors to support frame.
- B. Hang all doors allowing for expansion and contraction at time of setting.
- C. Set all hardware in accordance with templates as supplied by hardware supplier.
- D. Examine hardware at completion; test, oil, grease, and adjust as needed for smooth operation.
- E. Maintain plumb and level tolerances as specified in manufacturer's installation instructions.

#### 3.02 SCHEDULE

- A. See Door Schedule on the Drawings.

END OF SECTION

## SECTION 08 51 13

### ALUMINUM WINDOWS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work includes exterior extruded aluminum window frames and extruded aluminum sashes (for operable windows).
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. AAMA 101—Specifications for Aluminum Prime Windows and Sliding Glass Doors.
- B. ASTM E283—Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors.
- C. ASTM E330—Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
- D. ASTM E331—Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
- E. ASTM B221—Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.
- F. AAMA 611—Specification and Inspection Methods for Electrolytically Deposited Color Anodic Finishes for Architectural Aluminum.

##### 1.03 PERFORMANCE REQUIREMENTS

- A. Design and size components to withstand a minimum static air pressure difference of 90 psf for exterior windows and 60 psf for interior windows in accordance with ASTM E330.
- B. Limit member deflection to 1/175 with full recovery of glazing materials.
- C. System to accommodate, without damage to components or deterioration of seals, movement between window and perimeter framing, deflection of lintel.
- D. Limit air leakage through assembly to 0.10 cfm/min/sq ft of wall area measured at a reference differential pressure across assembly of 6.24 psf as measured in accordance with ASTM E283.
- E. Water leakage: None when measured in accordance with ASTM E331 with a test pressure difference of 10 psf.

##### 1.04 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00—Submittals.



## PART 2–PRODUCTS

### 2.01 EXTERIOR WINDOWS

- A. Exterior window frames shall be 2-inch-deep extruded aluminum, in accordance with ASTM B221, with thermobreak.
- B. Acceptable products include the following, or equal: Kawneer Sealair 8225T Isolock, Fixed Windows.

### 2.02 FABRICATION

- A. Aluminum extrusions shall be not less than 0.125 inch thick.
- B. All fabrication and erection fasteners shall be 18-8 stainless steel.
- C. Unless shown otherwise, provide 0.040-inch aluminum sill plates on exterior of window. Finish shall match window.
- D. Permit internal drainage weep holes and channels to migrate moisture to exterior. Provide internal drainage of glazing spaces to exterior through weep holes.
- E. Nominal window height and length for all windows shall be as shown in the schedule. CONTRACTOR shall measure all openings and coordinate sizes with window supplier.

### 2.03 FINISH

- A. Finish on all exposed aluminum shall be architectural class 1, anodic coating, conforming to AAMA 611. Color to be selected by OWNER.

## PART 3–EXECUTION

### 3.01 INSTALLATION

- A. Field verify wall opening sizes.
- B. Frames shall be securely attached to masonry as recommended by the window manufacturer.

### 3.02 SCHEDULE

- A. See Window Schedule on the Drawings.

END OF SECTION

## SECTION 08 60 10

### PLASTIC UNIT SKYLIGHTS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Factory-fabricated skylights with double acrylic domes and aluminum frames mounted on built-up wood curb (shingled roofs), or insulated aluminum curbs (flat single-ply membrane roofs).
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. FS TT-C-494—Coating Compound, Bituminous, Solvent Type, Acid Resistant.

#### PART 2—PRODUCTS

##### 2.01 SKYLIGHTS AND FRAMES

- A. Skylights on sloping shingled roofs shall be WASCO EcoSky Series Model E3CS by WASCO Products, Inc., of Sanford, Maine, or equal.
- B. Units shall be mounted on built-up wood curbs as detailed on the Drawings.
- C. Curb frames and retainer frames shall be fabricated from 6063-T5 or 6063-T6 aluminum extrusion 0.060 inch thick. Corners to be filled and welded. Curb frames shall have built-in condensation gutter. Curb shall have thermal break for improved thermal performance.
- D. Skylights shall be insulated double domes constructed of 100% cast acrylic. Outer dome shall be impact modified, infrared blocking, light diffusing, and 100% haze white. Inner dome shall be a clear Lumira<sup>®</sup> aerogel-filled multi-wall polycarbonate panel.
- E. Thermal performance values shall equal or exceed the following:
  - 1. Solar heat gain coefficient 0.34.
  - 2. Visible light transmission 43%.
- F. See schedule for unit sizes.

##### 2.02 ACCESSORIES

- A. Anchorage Devices: Type recommended by manufacturer.
- B. Counter Flashing: Same metal type and finish as skylight frame.
- C. Protective Back Coating: Bituminous.

D. Sealant: See Section 07 90 00—Caulking and Sealants.

## 2.03 FABRICATION

- A. Fabricate units free of visual distortion and defects.
- B. Fabricate units for a weather-tight assembly.
- C. Apply bituminous paint on aluminum surfaces of units in contact with cementitious materials or dissimilar metals.

## 2.04 FINISHES

- A. Aluminum: Mill finish.

# PART 3—EXECUTION

## 3.01 EXAMINATION

- A. Verify that openings and materials are ready to receive work of this section.

## 3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install aluminum curb frame on wood curb.
- C. Place unit and secure to curb frame with retainer frame. Flash and counter flash into roof system.
- D. Apply sealant and seal watertight and weathertight.

## 3.03 CLEANING

- A. Remove protective material from prefinished aluminum surfaces.
- B. Wash down exposed surfaces; wipe surfaces clean.
- C. Remove excess sealant.

## 3.04 SCHEDULE

| Building   | Model | Size               | No. Required |
|------------|-------|--------------------|--------------|
| Well No. 6 | E3CS  | 48-inch by 48-inch | 1            |

END OF SECTION

## SECTION 08 71 00

### DOOR HARDWARE

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Hardware to Fully Equip All Doors.
  - 2. Thresholds and Weatherstripping.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. NFPA 80—Fire Doors and Windows.

##### 1.03 REGULATORY REQUIREMENTS

- A. Hardware shall conform to the Wisconsin Commercial Building Code for requirements applicable to fire-rated doors and frames. Hardware shall comply with NFPA 80 and shall be properly stamped or labeled for easy identification.
- B. Hardware for the building shall comply with barrier-free requirements.

#### PART 2—PRODUCTS

##### 2.01 LOCKSETS AND LATCHSETS

- A. Mortise locksets and latchsets with stainless steel (ss) finish, as indicated in Paragraph 3.02 Schedule shall be Sargent mortise type Series 8200 line, Style L, Schlage L9000 Series, or equal.
- B. Locksets and latchsets shall have 2 3/4-inch backset. Strikes shall be curved lip.
- C. Lockset and latchset numbers listed in Paragraph 3.02 Schedule are Sargent or Accurate (listed first) followed by Schlage or Schwepper number (listed second in parentheses).
- D. Provide removable core brass 6- or 7-pin cylinders for all locksets and latchsets.

##### 2.02 EXIT DEVICES

- A. Exit devices shall be Sargent 8813 x ETL Series, or equal, and shall be equipped with reinforced cross bars and functions as indicated on the hardware sets. The exit device shall be operated by a lockable lever from the exterior side.

## 2.03 HINGES

- A. Butt hinges shall be Stanley FBB 191, Hager BB 1191, or equal, full mortise, ball bearing, nonferrous, nonrising, loose pin, and flat bottom tip, unless otherwise specified. Provide three 4 1/2-inch by 4 1/2-inch hinges per door for doors 7 feet or less in height with one additional hinge for each additional 30 inches or fraction thereof, unless otherwise specified. Provide additional hinges or heavyweight hinges for all doors that are over 36 inches wide, unless specified otherwise. Finish on aluminum entrance doors shall match framing.

## 2.04 DOOR CLOSERS

- A. Door closers shall be LCN Series 1460 for exterior doors and 1461 for interior doors, or equal. Provide aluminum finish on closers. Provide full covers. Door closers for locations noted as (ss) shall have the SRI primer for corrosion resistance. Door closers specified in Paragraph 3.02 are LCN. (H-Hold Open).

## 2.05 OVERHEAD DOOR HOLDERS

- A. Overhead door holders shall be Glynn Johnson GJ 81H Series, or equal, unless otherwise specified. Holders for locations noted as (ss) shall be fabricated with stainless steel components. Numbers specified in Paragraph 3.02 are Glynn Johnson.

## 2.06 SURFACE BOLTS

- A. Surface bolts shall be 8-inch Ives 1640 Series, or equal.

## 2.07 KICKPLATES

- A. Kickplates shall be Rockwood, or equal, 6 inches high. Kickplate width shall be 2 inches less than door width.

## 2.08 DOOR STOPS

- A. Provide wall- or floor-mounted door stops at all interior doors. Stops shall be Glynn Johnson GJFB-13, GJ60C, or GJ60W for locations noted as (ss), or equal.

## 2.09 THRESHOLD AND WEATHERSTRIPPING

- A. All exterior doors shall be weatherstripped with Reese DS75, National Guard Products, Inc. 156, or equal, weatherstripping. Provide Reese 323C, Pemko 315AN, or equal, sweeps; and Reese S425A, Pemko 171A, or equal, thresholds. Exterior doors without mullion shall have Reese No. 87, Pemko 352A, or equal, positive sealing astragal.

## 2.10 KEYING

- A. Door keys shall be keyed to match OWNER's existing key system.. Provide two keys per lock. Doors shall have temporary construction cylinders. Provide permanent cylinders at project completion.

## 2.11 FINISH

- A. Finish for all hardware, except as noted below, shall be US 26D or US 32D where stainless steel (ss) hardware is specified in Paragraph 3.02.
- B. Finish for surface bolts shall be US 26D; finish for kickplates shall be 32D.
- C. Where stainless steel (ss) is specified, all hardware, including threshold and weatherstripping, shall be installed with stainless steel fasteners.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Provide finish hardware to fully equip all doors.
- B. Install hardware in accordance with manufacturer's instructions.

### 3.02 SCHEDULE

- A. Provide the following hardware groups in the amounts indicated on the door schedule or required for a complete and proper installation:

#### Group 1

EXTERIOR DOOR SS US32D  
SARGENT (SCHLAGE)

Lockset-8205LNL (ss) (L9050)  
Door Closer-1460 (ss)  
(Parallel Arm)  
Hinges and Kickplate (ss)

#### Group 2

EXTERIOR DOOR-CHEMICAL  
ROOM

Exit Device-8813 x PRK (ss)  
Door Closer-1460 (ss)  
(Parallel Arm)  
Hinges and Kickplate (ss)

#### Group 3

INACTIVE DOOR (SS)

Lever-Rigid, pull side only (ss)  
Surface bolts-One top and bottom (ss)  
Overhead Door Holder GJ 81 H-HD (ss)  
Hinges and Kickplate (ss)

#### Group 4

INTERIOR DOOR SS  
SARGENT (SCHLAGE)

Lockset 8215LNL (ss) (L9010)  
Door Closer-1460 BF (ss) (Regular Arm)  
Hinges and Kickplate (ss)

Group 5

Lockset 8265LNL  
Hinges

BATHROOM PRIVACY LOCK  
SARGENT (SCHLAGE)

END OF SECTION

## SECTION 08 81 00

### GLAZING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work includes glass and glazing for windows.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. GANA–Glass Association of North America.
- B. NFPA 257–Standard on Fire Test for Window and Glass Block Accessories.
- C. NFPA 80–Standard for Fire Doors and Other Opening Protectives.
- D. UL 9–Standard for Safety Fire Tests of Window Assemblies.

##### 1.03 WARRANTY

- A. Exterior insulating glass shall be provided with a 10-year warranty against failure of the seal.
- B. Coated glass shall be provided with a 10-year warranty against peeling, cracking, or deterioration of the coating.

#### PART 2–PRODUCTS

##### 2.01 SPANDREL GLASS

- A. Spandrel glass shall be fully tempered, 1/4-inch thick, Vari-Tran shadow box spandrel by Interpane Glass Company, or equal. Color to be chosen from manufacturer's standard colors (minimum 8).

##### 2.02 GLAZING COMPOUNDS AND ACCESSORIES

- A. Glazing system shall consist of a polyisobutylene-butyl tape, liquid polymer sealant, and vinyl roll-in strip.
- B. Acceptable products include the following, or equal:
  - 1. Tremco Vision Strip System.
  - 2. General Electric Silglaze.

##### 2.03 FABRICATION

- A. Glazing of windows shall be from the interior.



- B. Accessories such as setting blocks, clips, etc., shall be provided to properly set glass.
- C. Obtain sizes from work at the site or from the manufacturer of work into which the materials will be set. Responsibility for the correctness of measurements shall be assumed by CONTRACTOR.

### PART 3—EXECUTION

#### 3.01 INSTALLATION

- A. Comply with “Glazing Manual” by Glass Association of North America (GANA), except as specifically recommended otherwise by manufacturers of the glass and glazing materials.
- B. Completed installation shall be water- and airtight.

END OF SECTION

## SECTION 09 91 00

### PAINTING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Surface preparation and application of paints and coatings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. AMPP–Association for Materials Protection and Performance.
- B. ASTM B117–Standard Practice for Operating Salt Spray (Fog) Apparatus.
- C. ASTM D2247–Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
- D. ASTM D3363–Standard Test Method for Film Hardness by Pencil Test.
- E. ASTM D4060–Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
- F. ASTM D4541–Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
- G. ASTM D4585–Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation.
- H. Federal Register–Code of Federal Regulations (CFR).
- I. Federal Register–Resource Conservation and Recovery Act (RCRA).
- J. Federal Register–Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).
- K. ICRI–International Concrete Repair Institute.
- L. NACE–National Association of Corrosion Engineers.
- M. SSPC–The Society for Protective Coatings–Steel Structures Painting Manual.

##### 1.03 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00–Submittals.
- B. Shop primer proposed for use shall be submitted with all material and equipment submittals. All shop primers shall be of the same generic type and quality as those specified herein.

- C. Submit manufacturer's Safety Data Sheets (SDS) for each type of paint with each shop drawing submittal. SDS sheets shall be posted at the construction site at all times painting is in progress.
- D. Substitution submittals shall include performance test data, as certified by a qualified testing laboratory, for the ASTM tests specified in Paragraph 2.01.

#### 1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: All paints, surface preparation, and application methods shall conform to federal requirements for allowable exposure to lead and other hazardous substances.
- B. Prepainting Meeting:
  - 1. A prepainting meeting shall be held immediately following the project preconstruction conference. The prepainting meeting is to be held prior to any material and equipment that requires painting is delivered to the site.
  - 2. CONTRACTOR, the paint subcontractor, and the paint manufacturer's representative shall be present to review the specifications and project scope.
  - 3. The paint manufacturer's representative shall review progress at the site as requested by ENGINEER. These are generally expected to be prior to monthly progress meetings.

#### 1.05 FIELD QUALITY CONTROL

- A. Furnish testing apparatus as applicable for observing surface preparation, testing atmospheric conditions and testing coatings, prior to beginning surface preparation. Provide the following apparatus:
  - 1. One set of U.S. Department of Commerce thickness calibration plates, certified by the National Bureau of Standards, to test dry film thickness.
  - 2. One wet-film thickness gauge.
  - 3. One dry-film thickness gauge, Mikrotest III, 0 to 40 mils with calibration standard approved by the Bureau of Standards.
  - 4. One Bacharach Sling Psychrometer, Model 12-7011.
  - 5. Tinker and Razor Model M-1 Holiday Detector and recommended wetting agent.
  - 6. One set of SSPC-VIS 1-89 Visual Standards for Abrasive Blast Cleaned Steel.
- B. Provide access via scaffolding or staging for inspection.
- C. Entire surface of coated submerged concrete shall be tested with holiday detector. Mark and repair all pinholes, then retest until no pinholes are found.
- D. CONTRACTOR shall provide documentation to ENGINEER of conditions before and during painting operations for each area and each day's work. Documented conditions shall include the following at a minimum: date, area of work, system used, preparation methods, environmental conditions, quantity and thickness of coating placed, noted conditions, and nonconforming items. ENGINEER can provide sample report form if CONTRACTOR does not have their own.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be delivered to the site in original containers with labels intact and seals unbroken.

- B. Drop cloths shall be used in all areas where painting is done to fully protect other surfaces.
- C. Oily rags and waste must be removed from the building each night or kept in an appropriate metal container.

#### 1.07 ENVIRONMENTAL REQUIREMENTS

- A. CONTRACTOR shall dry-heat, dehumidify, and ventilate to obtain painting conditions recommended by the paint manufacturer during surface preparation, application, and cure.
- B. Relative humidity conditions as specified by the paint manufacturer's data sheet shall be adhered to. This includes times in which supplemental heat is used. Supplemental heat shall be indirect-fired hot air furnaces or electric heat. Open-flame heaters shall not be used.
- C. No unprotected, unheated exterior painting shall be undertaken when damp weather appears probable, nor when the temperature of the substrate is below 55°F, unless approval in writing is received from the paint manufacturer.

#### 1.08 COLOR SELECTIONS

- A. Provide color charts for all coatings being used on the project. After initial selection of colors by OWNER, provide draw down samples of selected colors for OWNER's final approval. For stained wood, provide specified wood species sample with selected color for final approval.
- B. CONTRACTOR shall provide a summary sheet at the completion of the project listing the finish paint products used and the manufacturer's color identification for each item painted. This summary sheet should be submitted to ENGINEER and OWNER for review.

### PART 2-PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. All materials required for painting shall be types and quality as manufactured by Tnemec Company, Inc., Sherwin-Williams Company, Carboline, PPG Protective and Marine Coatings, or equal, unless noted otherwise in the schedule.
- B. Where thinning is necessary, only the products of the manufacturer furnishing the paint will be allowed. All such thinning shall be done strictly in accordance with the manufacturer's instructions.
- C. Paint and paint products of Tnemec Company and Sherwin-Williams, listed in the following specifications, are set up as standard of quality. Carboline and PPG Protective and Marine Coatings have preapproved equivalent products that shall be used. Other manufacturer's products will be considered as a substitution if CONTRACTOR and paint manufacturer certify that the products offered are recommended for the service intended, are compatible with the shop primers used, are equal in solids content and composition, and are of the same type. Submittal shall include the following performance data as certified by a qualified testing laboratory. ASTM Specifications shall be the latest revision:
  - 1. Abrasion-ASTM D4060, CS-17 Wheel, 1,000 grams load.
  - 2. Adhesion-ASTM D4541.
  - 3. Hardness-ASTM D3363.
  - 4. Humidity-ASTM D2247 and D4585.

5. Salt (Fog) Spray–ASTM B117.

## PART 3–EXECUTION

### 3.01 SURFACE PREPARATION

#### A. General:

1. All surfaces to be painted shall be prepared as specified herein and by the manufacturer's published data sheet and label directions. The objective shall be to obtain a uniform, clean, and dry surface.
2. No field painting shall be done before the prepared surfaces are observed by ENGINEER. Surfaces painted without such observation shall be abrasive-blast-cleaned and repainted.
3. Prior to field-blasting, a sample of the blast abrasive shall be provided to ENGINEER for pH testing. Additional samples of subsequent deliveries or batches of blast abrasive shall be provided to ENGINEER for pH testing.
4. For on-site abrasive-blasting, low-dust, low-silica content material shall be used. Coal slag abrasive shall be used on pipe and ferrous materials. Staurolite abrasive shall be used on concrete and concrete block.
5. Quality of surface preparations listed below are considered a minimum. If paint manufacturer requires a better preparation for a particular application, it shall be considered a requirement of this specification.
6. All concrete surfaces shall be tested for moisture in accordance with ASTM D4263 and, if necessary, F1869. Surfaces shall also be verified that the pH of the cleaned concrete surface to be coated is within the range of 8 to 11.

#### B. Ferrous Metal:

1. All ferrous metal to be primed in the shop shall have all rust, dust, and mill scale, as well as all other foreign substances, removed by abrasive blasting. Cleaned metal shall be primed or pretreated immediately after cleaning to prevent new rusting.
2. All ferrous metals not primed in the shop shall be abrasive-blasted in the field prior to application of the primer, pretreatment, or paint.
3. Abrasive blasting of metals in the shop shall be in accordance with SSPC-SP 10 Near White Blast Cleaning. Abrasive blasting of metals in the field for immersion service shall be in accordance with SSPC-SP 10 Near White Blast Cleaning. Abrasive blasting of metals in the field for nonimmersion service shall be in accordance with SSPC-SP6 Commercial Blast Cleaning.
4. Solvent cleaning in accordance with SSPC-SP1 shall precede all abrasive-blasting operations.
5. Ductile iron pipe shall be prepared by abrasive blasting per National Association of Pipe Fabricators NAPF 500-03-04 Abrasive Blast Cleaning.
6. Prior to finish coating, all primed areas that are damaged shall be cleaned and spot-primed.

#### C. Concrete:

1. All concrete surfaces, including precast concrete to be painted, shall be cleaned of all form oil, curing compound, and other foreign matter. Concrete floors containing oil and grease residues shall be cleaned with detergent to remove all residues.
2. All new concrete and precast concrete walls, floors, and ceilings shall be abrasive-blast cleaned in accordance with SSPC-SP13/NACE No. 6 in order to prepare the surfaces for adherence of the painting systems as specified. Abrasive blasting of concrete shall result in a surface profile in accordance with ICRI No. 03732 at CSP-3 to CSP-5.

3. Bug holes, pits, voids, and cracks shall be filled as specified in Section 03 30 00—Cast-In-Place Concrete without placing a friable sand-cement surface overall. The dried surface shall be stoned down.
  4. Paint manufacturer shall observe and approve the surface preparation method and the prepared surface prior to painting.
  5. After cleaning, the surface shall be washed and all dust, sand, and loose particles shall be removed by vacuuming. If CONTRACTOR elects to blow the surfaces off with air, it shall be oil-free air, and the methods shall conform to OSHA requirements.
- D. Galvanized: Where galvanized items are not submerged or buried, they shall be cleaned with nonhydrocarbon solvent cleaner (such as Clean N Etch, or equal) in accordance with SSPC-SP1 and shall be abrasive-blasted in accordance with SSPC-SP16 Brush-Off Blast Cleaning.
- E. Copper: Where copper piping is not submerged or buried, it shall be solvent-cleaned in accordance with SSPC-SP1 and shall be lightly sanded.
- F. PVC and CPVC: All PVC and CPVC to be painted shall be solvent-cleaned in accordance with SSPC-SP1 and shall be lightly sanded.
- G. Aluminum: Where listed in the Schedule to be painted, it shall be solvent-cleaned in accordance with SSPC-SP1 and shall be lightly sanded.

### 3.02 APPLICATION

- A. All materials shall be used as specified by the manufacturer's published data sheets and label directions.
- B. No paint shall be applied on a wet or damp surface and in no case until the preceding coat is dry and hard. Each coat shall be allowed to dry in accordance with manufacturer's data sheets before the next coat is applied.
- C. Drying time shall be construed to mean "under normal conditions." Where conditions are other than normal because of the weather or because painting must be done in confined spaces, other drying times will be necessary.
- D. Additional coats of paint shall not be applied, nor shall units be returned to service until paints are thoroughly dry and cured.
- E. Steel that will be inaccessible in the completed work shall receive the final coat before enclosure.
- F. Paint shall be applied to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, or other surface imperfections will not be acceptable. Tops and bottoms of walls and areas that are "cut-in" by brush prior to rolling shall have a uniform appearance in comparison with adjoining surfaces.
- G. Concrete block walls shall be back-rolled to achieve a pinhole-free surface coat.
- H. Walls and ceiling surfaces shall receive a minimum of one coat of paint before surface-mounted items such as conduits, boxes, piping, etc., are installed on these surfaces.

- I. Crevices and other hard-to-apply areas shall be back-rolled/back-brushed in conjunction with application of the first field coat of primer or intermediate coat. This includes, but is not limited to, between pipe flanges, pipe flange/pipe barrel joints, equipment fittings, and other narrow openings.
- J. No paint shall be applied to new or existing surfaces until joints have been caulked according to Section 07 90 00–Caulking and Sealants requirements, except at moving joints which shall be finish-painted before caulking or caulking shall be protected during painting.
- K. For PVC and CPVC piping, unions and valves shall not be painted.
- L. No field coating of paint shall be applied to ductile iron piping until the piping has been tested, the pipe gaps or joints have been caulked, and the caulk has fully cured, as specified in Section 40 05 00–Piping and Appurtenances.

### 3.03 FIELD QUALITY CONTROL

- A. Examination of work on the site by the manufacturer's representative shall be performed when requested by ENGINEER.

### 3.04 CLEANING

- A. All stains and marks shall be removed from other surfaces upon completion of the work.

### 3.05 SCHEDULE

- A. General:
  - 1. At the completion of the project, all painted surfaces which have been damaged shall be repainted or touched-up.
  - 2. See Finish Schedule on the Drawings for an additional reference for areas to be painted.
  - 3. The painter shall use some discretion in what should and should not be painted. Do not paint over labels and other information, bronze, machined surfaces, moving parts where painting may impair movement, hot surfaces which may peel, etc. If in doubt whether a part should be painted, ask ENGINEER.
  - 4. Products listed first are Tnemec and second are Sherwin-Williams.
- B. New Work:
  - 1. All new work done by all trades shall be painted by CONTRACTOR in accordance with the following schedule and in accordance with paint manufacturer's recommendation. It is the intent of these specifications that all non-galvanized ferrous metal items scheduled for painting be shop-primed. If items are not shop-coated, surfaces shall be prepared and painted in the field as specified. If any items of new construction are not listed, CONTRACTOR shall request paint system from ENGINEER, and the items shall be painted as part of this Contract without additional cost.
  - 2. Interior concrete floors, including equipment bases:
    - a. One prime coat of 201 Epoxoprime, ArmorSeal 1000 HS Epoxy (reduced), hand broadcast antiskid sand into the wet paint between finish coats in locations as requested by OWNER, and two finish coats of 280 Tneme-Glaze, ArmorSeal 1000 HS Epoxy.
    - b. See Section 03 30 00–Cast-In-Place Concrete for sealed concrete floors.

3. Interior concrete block walls: One filler coat of Epoxoblock WB 1254, Kem Cati-Coat HS, and two coats Series N69 Hi-Build Epoxoline II, Macropoxy 646 Fast Cure.

Note: Paint shall be roller- or brush-applied to concrete sound-absorptive block.

4. Interior concrete walls:
  - a. One filler coat (1/16-inch minimum thickness) Mortarclad 218, Duraplate 2300.
  - b. Two coats of Series N69 Hi-Build Epoxoline II, Macropoxy 646 Fast Cure.

Note: Interior face of concrete tank walls and floors channels and pipe trenches are not to be painted.

5. All exposed concrete ceilings (ceilings of water-containing tanks are not considered exposed): Two coats of Series N69 Hi-Build Epoxoline, Macropoxy 646 Fast Cure.
6. Cast or ductile iron; not submerged or buried (including pipes to be insulated):
  - a. One shop coat of N69-1255 Hi-Build Epoxoline, Macropoxy 646 Fast Cure Beige as primer;
  - b. Touch-up prime coat prior to finish coating; and apply either:
    - (1) Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 Fast Cure for interior surfaces, or
    - (2) One coat of N69 Hi-Build Epoxoline II, Macropoxy 646 Fast Cure, and one coat of 1094 Endura-Shield, Acrolon 218HS for exterior surfaces.
7. Cast or ductile iron, tar coated; buried: Not painted.
8. Steel, machinery, and equipment; not submerged (including pipes to be insulated):
  - a. One shop coat of N69-1255 Hi-Build Epoxoline, Macropoxy 646 Fast Cure Beige as primer.
  - b. Touch-up primer prior to finish coat, and either:
    - (1) Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 Fast Cure for interior surfaces; or
    - (2) One coat of N69 Hi-Build Epoxoline II, Macropoxy 646 Fast Cure; and one coat of 1094 Endura-Shield, Acrolon 218HS for exterior surfaces.

FIRST FIELD COAT SHALL BE APPLIED PRIOR TO INSTALLATION TO SURFACES INACCESSIBLE AFTER INSTALLATION INCLUDING BACK SIDES OF DOOR FRAMES. SEE DIVISION 08 FOR FACTORY-APPLIED DOOR PRIMERS.

9. Motors, gear drives, and doors delivered with nonepoxy primers:
  - a. Degrease per SSPC-SP1.
  - b. Lightly hand-sand per SSPC-SP2.
  - c. Apply one coat 135-1255 Chembuild Beige, Macropoxy 646 Fast Cure Beige.
  - d. Apply two finish coats as follows:
    - (1) Two coats of N69 Hi-Build Epoxoline II, Macropoxy 646 Fast Cure for interior surfaces, or
    - (2) One coat of N69 Hi-Build Epoxoline II, Macropoxy 646 Fast Cure, and one coat of 1094 Endura-Shield, Acrolon 218HS for exterior surfaces.
10. Steel, machinery, and equipment, submerged:
  - a. One shop coat Series 1 Omnithane (N69-1255 Epoxoline), Dura-Plate 235 Beige as primer.
  - b. Touch-up prime coat prior to finish coating, and one stripe coat on all edges of N69 Hi-Build Epoxoline, Dura-Plate 235.
  - c. Two coats of N69 Hi-Build Epoxoline, (one coat) Sher-Glass FF.



- d. For areas in contact with potable water:
  - (1) Tnemec Products:
    - (a) Primer or shop coat shall be Series 94-H20.
    - (b) Stripe coat shall be Series 21.
    - (c) Finish coat shall be Series 21 (tank white).
  - (2) Sherwin-Williams Products:
    - (a) Primer or shop coat shall be Corothane I Galvapak 1K.
    - (b) Stripe coat shall be Macropoxy 5500LT (beige).
    - (c) Intermediate Coat shall be Sherplate 600 (beige).
    - (d) Finish coat shall be Sherplate 600 (white).
- 11. Galvanized, copper, brass, CPVC, and PVC; not submerged or buried:
  - a. Two coats of N69 Hi-Build Epoxoline, Macropoxy 646 Fast Cure for interior surfaces, or
  - b. One coat of N69 Hi-Build Epoxoline, Macropoxy 646 Fast Cure, and one coat of 1094 Endura-Shield, Acrolon 218HS for exterior surfaces.
- 12. Insulation of equipment, pipes, and ductwork:
  - a. Two coats of Series 1029 Endurotone, DTM Acrylic.
  - b. Colored PVC jacketing shall not be painted.
- 13. Galvanized, copper, CPVC, and PVC; submerged or buried: Not painted.
- 14. Aluminum items:
  - a. Exposed areas of structural items such as railings and grating shall not be painted.
  - b. For structural items in contact with concrete, see Division 05.
- 15. Stainless steel: Not painted.
- 16. Steel and Ductile Iron Insulated Coating Systems:
  - a. Tnemec Products:
    - (1) Primer coat shall be Tnemec Series 94-H20 Hydro Zinc.
    - (2) Two intermediate coats shall be Tnemec Series 971 Aerolon.
    - (3) Finish coat shall be Tnemec Series 1028T Enduratone HDP.
  - b. Sherwin Williams Products:
    - (1) Primer coat shall be Corothane I Galvapak 1K.
    - (2) Five Intermediate Coats shall be Heat-Flex® Hi-Temp 3500.
    - (3) Two finish coats shall be Shercryl HPA.
  - c. All finish colors selected by OWNER.
  - d. If equipment to be coated does not have a zinc-rich shop primer coating option, CONTRACTOR shall either surface prepare area as necessary or provide manufacturer recommended tie-coat.

C. Coverage:

- 1. Dry mil thickness shall conform to those specified. Mil test measurement shall conform to SSPC Steel Structures Painting Manual. Dry Film Thickness (DFT) shall be verified in accordance with SSPC-PA2.
- 2. The coatings listed will provide the mil thickness given when applied at the coverages listed. Upon the request of ENGINEER, such surfaces shall be checked by the painter with a calibrated mil thickness gauge and any deficiencies found in the film shall be remedied by additional coat(s) at the expense of CONTRACTOR.
- 3. On masonry, application rates will vary according to surface texture; however, in no case shall the manufacturer's stated coverage rate be exceeded. On porous surfaces, it shall be the painter's responsibility to achieve a protective and decorative pinhole-free finish either by decreasing the coverage rate or by applying additional coats of paint.
- 4. Coverages reflect manufacturer's recommendations using spray application techniques. Where brushing or rolling is specified or performed at the discretion of the

painter, one additional coat, minimum, will be required to achieve total DFT as specified and recommended by the manufacturer.

|                                                                           | Min.<br>Sq. Ft.**<br>Coverage | Min. Dry Mil**<br>Thickness<br>Per Coat |
|---------------------------------------------------------------------------|-------------------------------|-----------------------------------------|
| <b>Products</b>                                                           |                               |                                         |
| 1029 Endurotone, DTM Acrylic                                              | 200                           |                                         |
| N69 Hi-Build Epoxoline II, Macropoxy 646 Fast Cure                        |                               |                                         |
| Steel or Impervious Substrate Primer Coat                                 | ---                           | 4.0                                     |
| Steel or Impervious Substrate Intermediate Coat(s)                        | ---                           | 5.0                                     |
| Steel or Impervious Substrate Finish coat                                 | ---                           | 5.0                                     |
| 135-1255 Chembuild, Macropoxy 646 Fast Cure                               | 335                           | 4.0                                     |
| Steel Doors                                                               | ---                           | 3.0                                     |
| 20HS Pota-Pox, Macropoxy 646 Fast Cure                                    |                               |                                         |
| Steel or Impervious Substrate Primer                                      | ---                           | 4.0                                     |
| Steel or Impervious Substrate Intermediate Coat(s)                        | ---                           | 5.0                                     |
| Steel or Impervious Substrate Finish Coat                                 | ---                           | 5.0                                     |
| 1094 Endura-Shield II, Acrolon 218HS                                      | ---                           | 2.5                                     |
| 201 Epoxoprime, ArmorSeal 1000 HS Epoxy                                   | 250                           |                                         |
| 280 Tneme-Glaze, ArmorSeal 1000 HS Epoxy                                  | 250                           |                                         |
| Epoxoblock WB 1254, Kem Cati-Coat HS                                      | 80                            |                                         |
| N69 Hi-Build Epoxoline, Macropoxy 646 Fast Cure<br>(Masonry and Concrete) | 250                           |                                         |
| Series 1 Omnithane, DuraPlate 235 (Primer)                                |                               | 3.0, 5.0                                |
| N69 Hi-Build Epoxoline II (Submerged)                                     |                               | 6.0                                     |
| Sher-Glass FF (Submerged)                                                 |                               | 12.0                                    |
| Macropoxy 5500 LT (potable water system)                                  |                               |                                         |
| Stripe Coat                                                               | ---                           | 5.0                                     |
| Tnemec Series 94-H20, Sherwin Williams Corothane I<br>Galvapac 1k         |                               |                                         |
| Potable Water System Primer                                               | ---                           | 3.0                                     |
| Insulating Coating System Primer                                          | ---                           | 3.0                                     |
| Tnemec Series 21,                                                         |                               |                                         |
| Potable Water Stripe and Finish Coat                                      | ---                           | 12.0                                    |
| Sherwin Williams SherPlate 600                                            |                               |                                         |
| Potable Water Intermediate and Finish Coats                               | ---                           | 6.0                                     |
| Tnemec Series 1224 Epoxoline                                              |                               |                                         |
| Insulating Coating Tie-Coat                                               | ---                           | 6.0                                     |
| Tnemec Series 971 Aerolon                                                 |                               |                                         |
| Insulating Coating                                                        | ---                           | 50.0                                    |
| Tnemec Series 1028 Enduratone                                             |                               |                                         |
| Insulating Coating Topcoat                                                | ---                           | 3.0                                     |
| Sherwin Williams Heat-Flex® Hi-Temp 3500                                  |                               |                                         |
| Insulating Coating                                                        | ---                           | 20.0                                    |
| Sherwin Williams Shercryl HPA                                             |                               |                                         |
| Insulating Coating Topcoat                                                | ---                           | 3.0                                     |

\*\* Roller or brush application requires two or more coats to obtain recommended film thickness. No allowance is made here for overspray, waste in handling, mixing, or application. Final, minimum total DFT shall be equal to that specified. Paint submittals shall note where roller or brush application is proposed and the paint manufacturer's recommendations of number of coats to achieve the required thickness shall be noted.

Primer, intermediate and/or final surface colors shall be of contrasting colors to promote coverage.

- D. Pipe Colors: Colors are to be selected by OWNER, with the following piping colors used where applicable. Pipe color shall be in accordance with the requirements of the Wisconsin Administrative Code.

| Pipe Type           | WATER PIPING COLORS       |
|---------------------|---------------------------|
|                     | WI DNR NR 811             |
| Water Lines         |                           |
| Raw                 | Olive green               |
| Finished or Potable | Dark blue                 |
| Chemical Lines      |                           |
| Chlorine (solution) | Yellow                    |
| Fluoride            | Light blue with red bands |

Section 653.120 Piping Identification:

- 1) Piping in a water treatment facility shall be identified clearly by legends and color coding as described in the Standards or American National Standards Institute (ANSI) Standard A-13.1. A consistent standard shall be used throughout the system.
  - 2) Potable water lines shall be clearly and permanently identified where dual water lines or pressure sewer systems exist.
- E. Shop Finish Painting: The following items shall have factory-applied finishes and will not require field painting. CONTRACTOR shall field touch-up any damaged areas with factory-provided touch-up coating.
1. Sectional overhead doors and overhead coiling doors.
  2. Aluminum windows, doors and entrances.
  3. Factory-finished HVAC equipment. Rooftop units are to be field-painted.
  4. Chemical feed system pumps and accessories.

END OF SECTION

## SECTION 09 96 35

### CHEMICAL-RESISTANT COATING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work includes high-performance chemical-resistant epoxy coating system.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00–Submittals.
- B. Submit copy of manufacturer's Safety Data Sheets (SDS) for each product.

##### 1.03 QUALITY ASSURANCE

- A. Applicator shall have minimum 5 year's of satisfactory documented experience on projects of similar size and scope.
- B. Furnish primers, pretreatments, thinners, and finish coats by the same manufacturer.

##### 1.04 ENVIRONMENTAL CONDITIONS

- A. Storage and application temperatures shall be in strict accordance with manufacturer's recommendations.

#### PART 2–PRODUCTS

##### 2.01 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers include the following, or equal: Tnemec Company, Inc.; Sherwin Williams.

##### 2.02 MATERIALS

- A. Primer shall be compatible with coating; Series 201 Epoxoprime, Corobond Epoxy Primer, or equal.
- B. Coating for floor and tank base in chemical containment area shall be chemical-resistant, Novolac epoxy coatings, Tnemec Series 239SC ChemBloc, Cor-cote HCR Novolac intermediate coatings, followed by Series 282, Core-Cote HCR FF Novolac top coat or equal.
- C. Coating for walls in chemical containment area from floor up to top of containment wall shall be Novolac epoxy coating, Tnemec Series 282, Core-Cote HCR FF Novolac, or equal.

## PART 3-EXECUTION

### 3.01 PREPARATION

- A. Concrete surfaces shall be abrasive cleaned in accordance with SPCC-SP13/NACE No. 6 and provide a surface profile in accordance with ICRI NO. 03732 at CSP-3 to CSP-5.
- B. A representative of the manufacturer shall observe and approve the surface preparation prior to application of coating.

### 3.02 APPLICATION

- A. Mix components in strict accordance with manufacturer's instructions.
- B. Surface and material temperature shall be between 70°F and 90°F during application.
- C. Coating for Floors and Bases:
  - 1. Primer shall be applied at the rate of 160 square feet per gallon.
  - 2. Intermediate coat shall be applied within 4 to 6 hours of prime coat. Intermediate coat shall be applied to 1/8 inch (125 mils) thickness, aggregate filled, and in accordance with manufacturer's instructions.
  - 3. Top coat shall be applied at 250 square feet per gallon.
- D. Coating for walls shall be applied as follows:
  - 1. One primer coat (160 square feet per gallon).
  - 2. One top coat (180 square feet per gallon).
  - 3. One top coat (250 square feet per gallon).
- E. Exposed perimeter edges of topcoat, including doorways, drains, traffic aisle sides, etc., shall be "keyed" into substrate to allow full 1/8 inch thickness at these points. Sawcut substrate using power saw with carbide or diamond tip blades.
- F. Where the concrete floor meets the wall, provide a 45 degree angle cove with a height of 1 to 2 inches.
- G. Do not install coating over expansion joints.

END OF SECTION

SECTION 10 28 00  
TOILET AND BATH ACCESSORIES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. Toilet and Washroom Accessories.
  - 2. Grab Bars.
  - 3. Attachment Hardware.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. ANSI A117.1–Safety Standards for the Handicapped.
- B. ASTM A123–Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- C. ASTM A269–Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- D. ASTM A1008–Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
- E. ASTM B456–Electro-deposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.

1.03 REGULATORY REQUIREMENTS

- A. Conform to ANSI A117.1 and Federal ADA-AG code and the Wisconsin Commercial Building Code for access for the handicapped.

PART 2–PRODUCTS

2.01 TOILET TISSUE DISPENSERS

- A. Multiroll dispensers shall be surface-mounted. Bobrick B-288, Bradley 5402, or equal. Provide total of one.
- B. Unit shall be Type 304 stainless steel with satin finish.

2.02 HOOKS

- A. Heavy-duty hooks shall be Bobrick B-2116, Bradley Model 911, or equal. Provide total of two.

- B. Hook and flange shall be brass castings with satin nickel-plated finish.

#### 2.03 TOWEL DISPENSERS

- A. Surface-mounted, 400 single-fold towel dispensers shall be Bobrick B-263, Bradley 251-15, or equal. Provide total of one.
- B. Unit shall be Type 304 stainless steel with satin finish.
- C. Locate near toilet room sink.

#### 2.04 WASTE RECEPTACLE

- A. Waste receptacles shall be swing-type, free-standing Bobrick B-2250, Bradley 377, or equal.
- B. Units shall be stainless steel with satin finish.
- C. Provide one unit for each toilet room.

#### 2.05 MIRRORS

- A. Mirrors shall be shelfless mirrors with frames, 24 inches by 36 inches high. Bobrick B-290-2436, Bradley Model 780, or equal. Provide total of one.
- B. Mirrors shall have heavy gauge 304 stainless steel frame with satin finish and No. 1 quality, 1/4-inch float plate-glass mirror.

#### 2.06 GRAB BARS

- A. Provide stainless steel, peen grip with satin finish, 1 1/4-inch-diameter grab bars. Bars shall be concealed mounted-type, Bobrick B-550.99X18, B-550.99X36 and B-550.99X42; Bradley 832-00118, 832-00136 and 832-00142, or equal.
- B. See Drawings for configuration of grab bars.

#### 2.07 UNDERSINK PROTECTIVE PIPE COVERS

- A. ADA-conforming, wheelchair-accessible lavatory P-trap and angle valve assemblies shall be covered with molded, antimicrobial undersink protective pipe covers, TRUE BRO, INC. LAV GUARD 2 No. 103 E-Z and No. 402 with 105 E-Z accessory, 1-800-340-5969, or equal.
- B. Cover shall be secured with reusable fasteners and access covers.
- C. Coordinate protective pipe covers for tailpiece and extensions to fit lavatories.
- D. Standard color to be selected by OWNER.

#### 2.08 KEYING

- A. Supply two keys for each accessory to OWNER.
- B. Key all accessories alike.

## PART 3-EXECUTION

### 3.01 INSTALLATIONS

- A. Install accessories in accordance with manufacturers' instructions, ANSI A117.1, Federal ADA-AG, and the Wisconsin Commercial Building Code.
- B. Install plumb and level securely and rigidly anchored to substrate.

END OF SECTION



## SECTION 10 44 43

### FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Fire Extinguishers.
  - 2. Accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ANSI/NFPA 10–Portable Fire Extinguishers.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Product Data: Provide extinguisher operational features, color and finish, anchorage details, and cabinet dimensions.

##### 1.04 QUALITY ASSURANCE

- A. Provide units conforming to NFPA 10 requirements for portable fire extinguishers.
- B. Provide fire extinguisher, cabinets, and accessories by single manufacturer.

#### PART 2–PRODUCTS

##### 2.01 MANUFACTURERS

- A. Larsen's Manufacturing Company, Product MP Series.
- B. Substitutions: Under provisions of Section 01 60 00–Materials and Equipment.

##### 2.02 EXTINGUISHERS

- A. Provide two dry-chemical-type, Larsen's MP Series, 10-pound-capacity fire extinguishers. Fire extinguishers shall be UL-approved for Class A, Class B, and Class C fires.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Place extinguishers in brackets where shown on the Drawings.
- C. Mount fire extinguisher so the handle is at 48 inches above the finished floor.

END OF SECTION

## SECTION 20 05 53

### IDENTIFICATION FOR FIRE SUPPRESSION, PLUMBING, AND HVAC PIPING AND EQUIPMENT

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Perform all work required to furnish and install equipment, pipe, and wire identification with supplementary items necessary for proper installation as specified herein, or shown on the Drawings. CONTRACTOR shall identify all equipment, piping, ductwork, dampers, pumps, and wires.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- B. Schedule: Submit equipment schedule complete with building number, room number, equipment tag numbering system, equipment function, equipment type, area served, year installed, manufacturer, model number, size, emergency power (Y or N) and rated capacity.

##### 1.03 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
  - 1. ASME A13.1—Scheme for the Identification of Piping Systems.
  - 2. NFPA 13—Installation of Sprinkler Systems.
  - 3. NFPA 14—Installation of Standpipe and Hose Systems.
  - 4. SPS 382—Wisconsin Plumbing Code.

##### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging with labels clearly identifying product name and manufacturer until ready for installation.
- B. Storage: Store materials in clean, dry area indoors until ready for installation.
- C. Handling: Protect materials and finish from damage during handling and installation.

## PART 2-PRODUCTS

### 2.01 MANUFACTURERS

- A. Equipment tags and pipe markers shall be manufactured by Marking Services, Incorporated, Seton Name Plate Company, WH Brady Company, or Graphic Products, Inc.

### 2.02 EQUIPMENT TAGS

- A. Plastic Labels For Equipment (Indoor Application):
  - 1. Use: All equipment purchased by CONTRACTOR or OWNER and CONTRACTOR installed included in Divisions 21, 22, or 23.
  - 2. Materials and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16-inch thick.
  - 3. Character Color: Black.
  - 4. Background Color: White.
  - 5. Minimum Label Size: Length and width vary for required label content, but not less than 1-inch by 3-inch.
  - 6. Minimum Letter Size: 1/4 inch.
  - 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment (Outdoor Application):
  - 1. Use: All equipment purchased by CONTRACTOR or OWNER and CONTRACTOR installed included in Divisions 21, 22, or 23.
  - 2. Material: MS-215 Max-Tek with printed graphics protected by a chemical and UV resistant MS-3000 top laminate.
  - 3. Letter Color: Black.
  - 4. Background Color: White.
  - 5. Minimum Label Size: Length and width vary for required label content, but not less than 1-inch by 3-inch.
  - 6. Minimum Letter Size: 1/4 inch.
  - 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

### 2.03 LABELING TAGS

- A. Labeling Tags:

Use: Field-mounted devices (Limit switches, Natural gas pressure regulators, etc.).

Size: 1-inch by 3-inch.

Material: 1/32-inch-thick stainless steel.

Character Size: 1/4 inch.

Engraving: As requested by ENGINEER.

### 2.04 WIRE MARKERS

- A. Wire markers shall be permanently attached wraparound adhesive, sleeve- or heat-shrink-type labels. Wire numbering preprinted on the conductor, flag-type labels, and individual wraparound numbers (such as Brady preprinted markers) are not acceptable.
- B. Wire markers shall be specifically printed for this project using a wire marker printer. Handwritten markers are not acceptable.

## 2.05 PIPE MARKERS

- A. Manufacturers: Marking Systems, Inc., Seton Name Plate Company, W.H. Brady Company, or equal.
- B. Pipe markers shall conform to ANSI A13.1. Arrow markers must have same ANSI background colors as their companion pipe markers or be incorporated into the pipe identification marker.
- C. Plastic Pipe Markers: Factory-fabricated, flexible, semirigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Pipe markers and arrow markers also shall be provided for all piping systems.
- E. Use Seton Setmark type SNA or Brady Snap-on type identification for all piping systems, up through 6 inches. For piping systems larger than 6 inches, use Seton or Brady strap-on markers, or similar, by Marking Services, Inc. Self-adhesive labels that stick directly to the pipe or insulation jacketing are not acceptable. Provide lettering in accordance with the following table.

PIPE MARK SIZE CHART

| Outside Pipe Diameter<br>(Including Covering), Inch | Minimum Length of<br>Label Field Color, Inch | Minimum Height<br>of Letters, Inch |
|-----------------------------------------------------|----------------------------------------------|------------------------------------|
| 3/4 to 1 1/4                                        | 8                                            | 1/2                                |
| 1 1/2 to 2                                          | 8                                            | 3/4                                |
| 2 1/2 to 6                                          | 12                                           | 1 1/4                              |
| 8 to 10                                             | 24                                           | 2 1/2                              |

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Installation shall meet or exceed all applicable federal, state, and local requirements and referenced standards and conform to code and ordinances of authorities having jurisdiction.
- B. Degrease and clean surfaces to receive nameplates.
- C. Install nameplates parallel to equipment lines.
- D. Affix nameplates with stainless steel screws or sticky-back adhesive.
- E. Affix labeling tags with permanent bonding cement or locking wire ties. Provide 3/8 inch hole to accommodate wire tie.
- F. Prepare and install neatly typed directions in all panels, including existing panels, where work is done under this Contract.
- G. Four-inch-round, 4-inch-square, and 4 11/16-inch junction boxes concealed above ceilings may be identified with neat lettering on the cover with a permanent-type black marking pen.

### 3.02 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, control panels, thermostats, junction boxes, and at load connection. Identify with branch circuit or feeder number for power circuits and with control wire number as indicated on schematic and interconnection diagrams for control wiring. Wire markers shall be permanently attached wraparound adhesive or heat-shrink-type markers. Wire numbering preprinted on the conductor, individual wraparound numbers, and flag-type labels are not acceptable.
- B. Conductors in pull boxes, motor control centers, control panels, cabinets, and panelboards shall be grouped as to circuits and arranged in a neat manner. All conductors of a feeder or branch circuit shall be grouped, bound together with nylon ties, and identified. Phase identification shall be consistent throughout the system.

### 3.03 PIPE MARKERS

- A. Install pipe markers in accordance with manufacturer's instructions.
- B. Install in clear view and align with axis of piping.
- C. All pipes shall be labeled with a minimum of two labels in each room, crawl space, or compartment. Locate identification at maximum 20-foot centers on straight runs, including risers and drops adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction. Labels shall be abbreviated as noted under fluid abbreviations on the Drawings.
- D. All piping containing or transporting hazardous or corrosive chemicals shall be identified with labels every 10 feet and with at least two labels in each room, closet, or pipe chase.
- E. Labels shall identify fluid being conveyed and include flow direction arrow. Provide a double-ended arrow marker when flow can be in either or both directions.
- F. Indicate delivered water temperature on domestic hot water supply and return lines.
- G. CONTRACTOR shall include a schedule in its submittal identifying the various pipe designations, abbreviations, and labeling scheme. Colors, text, and piping abbreviations are to be selected by OWNER, with the following piping marker scheme used where applicable.

| Pipe Contents             | Label Colors (Background/Text) |
|---------------------------|--------------------------------|
| Water Lines               |                                |
| Non-potable water         | Green/White                    |
| Potable water             | Green/White                    |
| Other Lines               |                                |
| Condensate                | Blue/White                     |
| Fire protection           | Red/White                      |
| Natural gas               | Brown/White                    |
| Plumbing drains and vents | Green/White                    |

END OF SECTION

## SECTION 21 10 00

### WATER-BASED FIRE SUPPRESSION SYSTEMS

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: The automatic fire sprinkler zone is scheduled and outlined on the Drawings. One zone begins with a zone control valve with tamper switch, flow switch, 1-inch inspector's test valve, and auxiliary drain valve.
- B. Provide complete fire protection systems that are compatible with the fire alarm system in accordance with the Factory Mutual Research Approval Guide. The fire protection system shall include all necessary piping, valves, controls, fittings, and hardware:
- C. Work under this section shall commence with a connection to the potable water service and all interior fire protection systems.
- D. CONTRACTOR may install additional piping and fittings and valves not shown on the Drawings for testing purposes or for the convenience of the installation. Where such materials are installed, they shall comply with the specifications and shall be sized to be compatible with the system design. Remove such installed materials when they interfere with the design conditions.
- E. Information given herein and on Drawings is as exact as could be secured but is not guaranteed. Do not scale Drawings for exact dimensions. Where architectural features govern location of work, refer to architectural drawings. Check, verify, and coordinate work with drawings and specifications prepared for other trades. Include all modifications, relocations, or adjustments necessary to complete work or to avoid interference with other trades.
- F. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 CODES AND STANDARDS

- A. Comply with requirements of Wisconsin Building Code, local fire chief or fire marshal, insurance underwriter, and applicable National Fire Protection Association (NFPA) Standards (latest editions).
- B. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- C. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
  - 1. ASSE 1015–Double Check Backflow Prevention Devices and Double Check Fire Prevention Backflow Prevention Assemblies.
  - 2. NFPA 13–Installation of Sprinkler Systems.
  - 3. NFPA 24–Installation of Private Fire Service Mains and Their Appurtenances.

4. NFPA 25—Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
5. NFPA 45—Fire Protection for Laboratories Using Chemicals.
6. NFPA 72—National Fire Alarm and Signaling Code.
7. NFPA 231—General Storage.
8. NFPA 329—Handling Releases of Flammable and Combustible Liquids and Gases.
9. Underwriters Laboratories Fire Protection Equipment Directory.
10. Local and State Building, Mechanical and Fire Codes.

### 1.03 QUALITY ASSURANCE

- A. All Drawings and hydraulic calculations shall be signed and sealed by a registered architect, Professional Engineer, or fire protection systems designer or signed and dated by the contractor responsible for the design and installation of the system, in accordance with the Wisconsin Administrative Code.
- B. CONTRACTOR shall be licensed by the State of Wisconsin for installation of sprinkler fire protection systems.
- C. CONTRACTOR(s) shall submit prequalification evidence of at least five projects of comparable size and scope successfully completed with their Bid, if requested. Distortion or misrepresentation of qualification evidence may result in Contract cessation.
- D. UL and FM Compliance: Unless otherwise indicated, all products shall be listed in the latest publication of Approval Guides for Underwriters Laboratory and Factory Mutual for the service intended. All system components shall be in conformance with applicable NFPA Standards.
- E. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to OWNER.
- F. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

### 1.04 DESIGN CRITERIA

- A. Available water model data (preliminary) is as follows:

| Flow      | Static Pressure | Residual Pressure |
|-----------|-----------------|-------------------|
| 3,023 gpm | 43 psi          | 36.6 psi          |

- B. Water data is taken from a preliminary water model for Bidding purposes. CONTRACTOR shall perform flow tests prior to preparation of design calculations. Test shall be representative of high water-use periods.
- C. Design fire protection systems in accordance with codes, standards, and regulations noted above. Design sprinkler systems for the most hydraulically remote area based on the following:



| Zone Description | Area (sf) | Sprinkler System Type | Area of Sprinkler Operation (sf) | Sprinkler Density (gpm/sf) | Occupancy Classification | Total Combined Inside/Outside Hose (gpm) |
|------------------|-----------|-----------------------|----------------------------------|----------------------------|--------------------------|------------------------------------------|
| Zone 1           | 205       | Wet                   | 1,500                            | 0.2                        | Ordinary Hazard, Group 2 | 250                                      |

- D. Maximum head spacing according to NFPA 13 for each occupancy hazard indicated.
- E. Hydraulic Calculations: Sprinkler systems which shall be hydraulically designed must be designed a minimum of 10% or 10 psi, whichever is greater, below the available water curve.
- F. Hose Streams: Add indicated hose streams to all sprinkler zone hydraulic calculations at the base of the riser.
- G. Water velocity throughout the entire system shall not exceed 20 feet per second.
- H. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows.
- I. Fire protection system components shall be rated for minimum operating pressure of 175 psig.
- J. Hangers and Supports for Fire Suppression Piping and Equipment:
  - 1. Materials and application of pipe hangers and supports shall be in accordance with MSS SP-58 Pipe Hangers and Supports—Materials, Design, Manufacture, Selection, Application and Installation unless noted otherwise.
  - 2. Materials and application of pipe hangers and supports shall be in accordance with NFPA rulings and be UL/FM listed and approved.
  - 3. Piping connected to pumps, compressors, or other rotating or reciprocating equipment is to have vibration isolation supports for a distance of 100 pipe diameters or three supports away from the equipment, whichever is greater. Standard pipe hangers/supports as specified in this section are required beyond the 100-pipe diameter/3 support distance.
- K. Corrosive Atmosphere(s): Corrosive atmospheres include the following:
  - 1. Chemical storage rooms.
  - 2. Other locations specifically noted on the Drawings.

#### 1.05 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00—Submittals.
- B. Submittals shall be sent to and approved by the Authority Having Jurisdiction prior to submitting to ENGINEER. Include copy of approval letters in submittal to ENGINEER.
- C. Submit fire protection system drawings at minimum scale of 1/8 inch equals 1 foot 0 inch for floor plans and 1/2 inch equals 1 foot 0 inch for details. Drawings shall include water supply locations and size, piping layout and size, sprinkler locations and type, piping and fire protection specialty locations and type, valve stem movement, hanger locations and type, lighting, ductwork, equipment locations and type, valve locations and type, occupancy classes, hydraulic reference points, design areas, hose locations, and discharge densities.

Include incidental details not usually shown or specified but necessary for proper installation and operation. Submittal drawings shall be stamped by the designer.

- D. Prepare floor plans, reflected ceiling plans, elevations, sections, and details to conclusively coordinate and integrate all fire protection installations. Indicate locations where space is limited and where sequencing and coordination of installations are of importance to other trades.
- E. Submit hydraulic calculations for water supply and sprinkler systems. Include summary sheet and detailed work sheets. Describe characteristics of water supply and location of effective point used in calculations. Include graph illustration of water supply, hose demand, and sprinkler demand.
- F. Furnish product submittals for all equipment and systems. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number as indicated in the Contract Documents. Where more than one item appears on a manufacturer's catalog sheet, the item(s) to be used shall be indicated by a red marking or an arrow. Include project specific wiring diagrams of electrically powered equipment.
- G. Material submittals shall include all items listed in the product section and all additional items necessary to provide a complete installation.

#### 1.06 OPERATION AND MAINTENANCE MANUALS

- A. Assemble materials as noted in Section 01 33 00—Submittals for each system or type of equipment. In addition to the Division 01 requirements, include the following information:
  - 1. Copies of all approved submittals along with approval letters.
  - 2. Manufacturer's wiring diagrams for electrically powered equipment.
  - 3. Records of tests performed to certify compliance with system requirements.
  - 4. Certificates of inspection by regulatory agencies.
  - 5. Parts lists for equipment and specialties.
  - 6. Manufacturer's installation, operation, and maintenance recommendations for equipment and specialties.
  - 7. Valve types and locations.
  - 8. Warranties.
  - 9. Additional information as required for records and maintenance of system.
  - 10. Lubrication instructions including list/frequency of lubrication.
  - 11. Two copies of NFPA 25 current for the year the system is installed.

#### 1.07 RECORD DRAWINGS

- A. Maintain at the site an up-to-date marked set of "record" drawings that shall be corrected and delivered to ENGINEER upon completion.
- B. Upon completion of the Work and final acceptance by the local authority, CONTRACTOR shall submit Record Drawings to OWNER and ENGINEER under the provisions of Division 01.
- C. Sprinklers shall be referred to on drawings, submittals, and other documentation by the sprinkler identification or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

## 1.08 TRAINING

- A. Instruct OWNER's personnel in the proper operation, maintenance, and testing of systems and equipment provided as part of this project. Include not less than 2 hours of instruction using the Operation and Maintenance Manuals and Record Drawings during this instruction. Demonstrate testing, start-up, and shutdown procedures for all equipment. All training shall be during normal working hours. Record all instructions and provide OWNER with copy.

## PART 2-PRODUCTS

### 2.01 FIRE PROTECTION PIPING

- A. Piping Belowground: Ductile iron pressure pipe, mechanical joint, AWWA C111 Class 53, 150 psi working pressure, ANSI/AWWA C151/A21.51. Ductile iron fittings, ANSI/AWWA C111/A21.11. Include cement mortar lining, ANSI AWWA C104 A21.4.
- B. Piping Aboveground:
  - 1. Steel Pipe: Black and galvanized steel pipe welded and seamless, Type F, Grade A, ASTM A53; black and galvanized welded and seamless steel pipe for fire protection use, Type F, ASTM A795; electric resistance welded steel pipe, Grade A, ASTM A135. Threaded light wall pipe and plastic pipe are not acceptable.
  - 2. Pipe Wall Thickness: Threaded pipe shall have a minimum wall thickness of Schedule 40. All other pipe shall have a minimum wall thickness of Schedule 10. Piping 2 inches and under shall be minimum Schedule 40 unless stated otherwise herein.
  - 3. Fittings: Cast iron pipe flanges and flanged fittings, Class 125/250, ASTM A126/ANSI B16.4. Malleable iron threaded fittings, Class 150/300, ASTM A197/ANSI B16.3. Standard weight seamless carbon steel weld fittings, ASTM A234 grade, ANSI B16.9. Fittings on galvanized pipe systems shall be galvanized.
  - 4. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.
  - 5. CPVC Pipe (NEMA 4X Corrosive): Piping located in NEMA 4X corrosive environments shall be Schedule 80 CPVC. Piping shall be listed conforming to ASTM F442. All fittings and components within these spaces shall be CPVC matching piping material.
- C. Unions and Flanges:
  - 1. Unions, flanges, and gasket materials shall have a pressure rating of not less than 175 psig.
  - 2. 2-Inch and Smaller Steel: ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping.
  - 3. 2 1/2-Inch and Larger Steel: ASTM A181 or A105, Class 150, Grade 1 hot forged steel flanges of threaded, welding neck, or slip-on pattern on black steel and threaded only on galvanized steel. ANSI B16.1 or ANSI B16.5, Class 150 cast iron threaded flanges. Use raised face flanges ANSI B16.5 for mating with other raised face flanges or equipment with flat ring or full-face gaskets. Use ANSI B16.1 flat face flanges with full-face gaskets for mating with other flat face flanges on equipment. Provide galvanized flanges on galvanized piping.

## 2.02 HANGERS, SUPPORTS AND ANCHORS

### A. General:

1. Comply with the requirements of applicable NFPA Standards. Hangers shall be UL-listed and FM-approved, unless otherwise specified.
2. Corrosive Atmosphere Coatings:
  - a. Corrosive environments shall be as noted on the Drawings.
  - b. Pipe in chemical feed rooms shall be supported with a plastic support system, Aickinstrut, or equal.
3. Provide all supporting devices as required for the installation of fire suppression equipment and materials. All supports and installation procedures are to conform to the latest requirements of the ANSI Code for building piping.
4. Do not hang any fire suppression system item directly from a metal deck or run piping so it rests on the bottom chord of any truss or joist.
5. Fasteners depending on soft lead for holding power or requiring explosive powder actuation will not be accepted.
6. Support apparatus and material under all conditions of operation, variations in installed and operating weight of equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.

### B. Manufacturers: B-Line, Anvil, Tolco, Roof Products & Systems.

### C. Structural Supports: Provide all supporting steel required for the installation of mechanical equipment and materials, including angles, channels, beams, etc. to suspended or floor supported tanks and equipment. All of this steel may not be specifically indicated on the Drawings.

### D. Pipe Hangers and Supports:

1. Hangers for Pipe Sizes 1/2-inch through 4-inch:
  - a. Carbon steel, adjustable swivel ring with 3/8-inch min. UL/FM approved hanger rods. B-Line B3170NF, Anvil 69 or 70.
  - b. Carbon steel, adjustable clevis, standard, with UL/FM approved size hanger rods. B-Line B3100, Anvil 260.
2. Hangers for Pipe Sizes 4-inch through 8-inch:
  - a. Carbon steel adjustable swivel ring with 1/2-inch min. UL/FM approved hanger rods. B-Line B3170NF, Anvil 69 or 70.
  - b. Carbon steel, adjustable clevis, standard with UL/FM approved size hanger rods. B-Line B3100, Anvil 260.
3. Hangers for Pipe Sizes 10-inch and Up: Carbon steel, adjustable clevis, standard with UL/FM approved size hanger rods. B-Line B3100, Anvil 260.
4. Multiple or Trapeze Hangers: Manufactured steel channel system with manufacturers slotted interlocking pipe clamps with screw/nut securing and threaded hanger rods or steel channels with welded spacers and threaded hanger rods.
5. Wall Support:
  - a. Carbon steel welded bracket with hanger. B-Line 3060 Series, Anvil 190 Series.
  - b. Steel channels with pipe clamps.
6. Vertical Support: Carbon steel riser clamp. B-Line B3373, Anvil 261 for above floor use.
7. Floor Support: Carbon steel pipe saddle, stand and bolted floor flange. B-Line B3088T/B3093.
8. Copper Pipe Supports: All supports, fasteners, clamps, etc. directly connected to copper piping shall be copper plated or polyvinylchloride coated. Where steel channels are used, provide flexible elastomeric/thermoplastic isolation cushion material to

completely encircle the piping and avoid contact with the channel or clamp, equal to B-Line B1999 Vibra Cushion or provide manufacturers clamp and cushion assemblies, B-Line BVT series.

9. Pipe Hanger Rods: Steel Hanger Rods:
  - a. Threaded both ends, threaded one end, or continuous threaded, complete with adjusting and lock nuts.
  - b. Size rods for individual hangers and trapeze support as indicated in the following schedule.

| Pipe Size              | Diameter of Rod      |
|------------------------|----------------------|
| Up to and Including 4" | 3/8" or 9.5 mm min.  |
| 5", 6", and 8"         | 1/2" or 12.7 mm min. |
| 10" and 12"            | 5/8" or 15.9 mm min. |

10. Beam Clamps:
  - a. MSS SP-58 Types 19 and 23 malleable black iron clamp for attachment to beam flange to 0.62 inch thick with a retaining ring and threaded rod of 3/8-, 1/2-, and 5/8-inch diameter. Furnish with a hardened steel cup point set screw. B-Line B3036L/B3034, Anvil 86/92.
  - b. MSS SP-58 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable for rod sizes to 1 1/2-inch diameter. B-Line B3054, Anvil 228.
11. Concrete Inserts:
  - a. Poured In Place:
    - (1) MSS SP-58 Type 18 wedge type to be constructed of a black carbon steel body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter. Wedge design to allow the insert to be held by concrete in compression to maximize the load carrying capacity. B-Line B2505, Anvil 281.
    - (2) MSS SP-58 Type 18 universal type to be constructed of black malleable iron body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter. B-Line B3014N, Anvil 282.
  - b. Drilled Fasteners:
    - (1) Concrete Construction: Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Hilti, Rawl, Redhead.
    - (2) Wood Construction: Side or bottom mount lag thread by rod thread one piece hanger attachment installed per the Manufacturers standard and carrying capacity limit. Powers Fastener Vertigo, Erico Hangermate or equal.
12. Continuous Concrete Insert Channels: Steel inserts with an industry standard pre-galvanized finish, nominally 1 5/8-inch by 1 3/8-inch deep by length to suit the application, designed to be nailed to concrete forms and provide a linear slot for attaching other support devices. Installed channels to provide a load rating of 2,000 pounds per foot in concrete. Manufacturer's standard brackets, inserts, and accessories designed to be used with channel inserts may be used. Select insert length to accommodate all pipe sizes in the area.
13. Anchors: Use welding steel shapes, plates, and bars to secure piping to the structure.
14. Equipment Stands: Use structural steel members welded to and supported by pipe supports. Clean, prime and coat with three coat rust inhibiting alkyd paint or one coat epoxy mastic. Where exposed to weather, treat with corrosive atmosphere coatings.

## 2.03 SPRINKLERS

- A. Manufacturer: Sprinkler head model numbers establish type and style of head. Products of the following manufacturers, determined to be equal by ENGINEER, will be accepted: Tyco, Reliable, Victaulic, and Viking.
- B. Standard coverage sprinkler heads are to be the basis for design unless noted otherwise on the Drawings or within these specifications.
- C. All sprinkler heads shall be UL listed and FM approved, fusible link or glass bulb type, cast brass or bronze construction. Provide heads with nominal 1/2-inch discharge orifice except where greater than normal density requires large orifice.
- D. Select fusible link or glass bulb temperature rating to not exceed maximum ambient temperature rating allowed under normal conditions at installed location and as indicated. Provide ordinary temperature fusible link or glass bulb type except at skylights, sealed display windows, unventilated attics and roof spaces, over cooking equipment, adjacent to diffusers, unit heaters, uninsulated heating pipes or ducts, mechanical rooms, storage rooms, or where otherwise indicated.
- E. Listed corrosion-resistant sprinkler heads shall be installed in locations where chemicals, moisture, or other corrosive vapors sufficient to cause corrosion of such devices exist. Sprinkler heads located in areas listed in design requirements shall be listed corrosion-resistant heads.
- F. Sprinkler Cabinets: Provide cabinets complete with required number of spare heads of each type and temperature rating and special wrenches in accordance with NFPA 13. Provide multiple cabinets as required. Cabinet shall be finished steel suitable for wall mounting with hinged cover and adequate space for required spare heads and wrenches. Coordinate cabinet location with OWNER's representative. Coordinate quantities with the authority having jurisdiction over the project.

## 2.04 VALVES

- A. Manufacturers: Kennedy, Milwaukee, Nibco, Stockham, Victaulic, Viking, and Watts.
- B. Isolation Valves 2 Inches and Smaller:
  - 1. Ball Valves: Bronze body, threaded or grooved ends, standard port, blowout-proof stem, chrome-plated ball, glass-reinforced seats, UL approved, 350 psi rating, Victaulic Series 728, or equal..
  - 2. Butterfly Valve: Bronze body butterfly valve, 365 psig, geared operator, visible position indicator, normally open tamper switch with double wire leads, Buna or Viton seat, stainless steel disc and stem, Victaulic Series 765, or equal.
- C. Isolation Valves 2 1/2 Inches and Larger:
  - 1. Gate Valve: UL listed/FM-approved, outside screw and yoke (OS&Y) gate valves, 175 psig, cast or ductile iron body, bronze-mounted, bolted bonnet, rising stem, solid wedge, with normally open tamper switch with double wire leads. Valves shall be capable of being repacked under pressure with valve wide open. Equal to Nibco F-607-OTS or Victaulic Series 771F or 771H.
  - 2. Butterfly Valve: Cast or ductile iron body butterfly valve, lug style or grooved, 250 psig, geared operator, visible position indicator, normally open tamper switch with double wire

leads, EPDM resilient seat, EPDM seals, nickel-plated ductile iron disc. Valve assembly to be bubble tight to 175 psig with no downstream flange/pipe attached. Use cap screws for removal of downstream piping while using the valve for system shutoff. Equal to Nibco LD3510-8 or Victaulic Series 705.

D. Test and Drain Valves:

1. Threaded or grooved bronze globe type with composition disc, 175 psi WOG. Valves shall be equal to Nibco KT-65 for piping assemblies built on site. Victaulic Series UTD or equal may be installed to save space and assembly time.
2. Drain Valves: UL listed, 3/4-inch minimum, two- or three-piece bronze body ball valve; threaded ends, chrome-plated bronze ball; glass-filled Teflon seat; Teflon packing and threaded packing nut; blowout-proof stem; 400 psig WOG. Low point drain valves shall have, in addition, a 1-inch brass nipple with 3/4-inch male hose threads and cap.
3. Combination test, drain, and pressure relief valves:
  - a. Victaulic Series UTD, AGF Model 1011A TESTanDRAIN, or equal.
  - b. Valve shall be UL listed and FM approved.
  - c. 3/4-inch minimum size, bronze body and relief valve, Teflon seat, brass ball, stem, and bypass fittings, braided nylon bypass tubing.
  - d. Orifice size shall be determined by sprinkler heads in system.
  - e. Pressure relief valve shall be factory-rated for 175 psi and field adjustable.

E. Check Valves: Cast or ductile iron body, flanged or grooved ends, bolted cap, renewable bronze seat and disc, stainless steel clapper with a replaceable rubber seal (a rubber seal integral with the seat is not acceptable), and 175 psig suitable for installation in a horizontal or vertical line with flow upward. Valve equal to Viking Model D or Victaulic Series 717. Provide 1/2-inch automatic drip drain on inlet to fire department connection check valve. Provide full-sized check valve bypass with shutoff valve and tamper switch to facilitate annual testing of backflow preventer.

## 2.05 BACKFLOW PREVENTER

- A. Manufacturers: Ames, Conbraco, Febco, Watts, Beeco, Cla-Val, Wilkinson.
- B. ASSE 1015 double check backflow preventer with two independent spring-loaded check valves, two isolation ball or gate valves with normally open tamper switches, double wire leads, 4-valved test ports, and lockable valves. Constructed of bronze or epoxy-coated cast iron or stainless steel body with bronze and plastic internal parts, stainless steel springs, silicone rubber valve discs, bronze seats, rated for 175 psig. Size for a minimum pressure drop of 10 psig at 675 gpm. Backflow preventer discharge shall be routed to nearest floor drain.

## 2.06 SPECIALTY VALVES

- A. Manufacturer: Central Sprinkler Corporation, Grinnell, Reliable, Star Sprinkler, Viking, and Victaulic.

## 2.07 ALARM DEVICES

- A. Supervisory/Tamper Switches:
1. Manufacturer: Potter, System Sensor, or equal.

2. For OS&Y valve or butterfly valve installations, UL listed/FM-approved, to monitor position of valve, tamper-resistant cover screws, single or double SPDT switch contacts, corrosion-resistant, for indoor or outdoor use, NEMA 4 and 6P enclosures.
- B. Flow Switches:
1. Manufacturer: Potter, System Sensor, or equal.
  2. Flow switches shall be UL listed and FM-approved capable of transmitting a signal when the flow of water equals or exceeds the discharge of a single head. Unit shall be vane type, with retard chamber and electrical characteristics compatible with fire alarm system. Provide flow switches for each riser.
- C. Local Alarm Bell:
1. Manufacturer: Potter, System Sensor, or equal.
  2. Weatherproof electric alarm bell with red-painted metal housing, mounting base and gong; solenoid operator; weatherproofing O-ring seal and electrical characteristics compatible with alarm system.

## 2.08 ACCESSORIES

- A. Fire Department Connection:
1. Manufacturers: All equipment shall be UL listed and FM-approved by Elkhart Brass, Potter-Roemer, Badger-Powhatan, Croker Corp., J.W. Moon, and W.D. Allen.
  2. Fire Department Pumper Connection: Pumper connection shall be flush type, cast brass body with drop clappers, polished chrome cover plate with lettering reading "AUTO SPRINKLER." Unit shall include 4 by 2 1/2 by 2 1/2 chrome-plated brass snoots with rigid end threading to match local fire department standards by pin-lug hose thread swivels, pin-lug plugs, and chains. Pumper connection shall be Potter-Roemer Series 5026-D, or equal.
  3. Ball Drip: Provide a bronze ball drip for the fire department connection inside of the building and pipe to the nearest floor drain.

## PART 3-EXECUTION

### 3.01 GENERAL INSTALLATION

- A. Install pipe, fittings, equipment, and components in accordance with referenced standards, manufacturer's recommendations, recognized industry practices, and the authority having jurisdiction.
- B. General Coordination: Install all piping parallel to building walls and ceilings and at heights that do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of fire protection piping with piping, ductwork, conduit, and equipment of other trades to allow sufficient clearances. In all cases, consult Drawings for location of pipe spaces, ceiling heights, ceiling grid layout, light fixtures, and grilles before installing piping.
- C. Where piping must be embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.



- D. Maintain piping, fittings, and fire protection system components in clean condition internally during construction. All material shall be kept at proper temperature to promote proper jointing. Pipe and fittings shall be corresponding materials when assembled.
- E. Provide clearance for access to valve and piping specialties to facilitate maintenance and repair or replacement.
- F. Pipe shall be hung from building members using concrete inserts or beam clamps. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- G. Install sprinkler piping so that the system can be drained in accordance with NFPA 13. Where possible, slope to main drain valve. Where piping not susceptible to freezing cannot be fully drained, install nipple and cap for drainage of less than 5 gallons or ball valve with hose thread outlet and cap for drainage over 5 gallons. Pipe main drain valve, inspector's tests, and auxiliary drains to grade or to air gap sewer receptor.
- H. Provide 3/32 inch minimum thickness steel nailing plates behind or on either side of piping where the possibility of penetration from nails or drywall screws exists.
- I. Piping between sprinkler heads and test/auxiliary drain piping shall be galvanized steel to retard or eliminate corrosion because of oxidation in these subsystems. Fittings shall match piping installed such as galvanized fittings on galvanized pipe. Provide dielectric fittings between dissimilar pipe materials.
- J. Mitered ells, notched tees, and orange peel reducers are not acceptable. Bushings and reducing couplings are not acceptable.
- K. Install auxiliary drains at all low points in the system, air vents at all high points in the system, and as required by the referenced standards. Drains and vents shall consist of, as a minimum, a 1-inch ball valve, 1-inch brass nipple with 3/4-inch male hose threads and cap.
- L. Fire Barrier Penetrations: Where pipes pass through fire-rated wall assemblies, partitions, ceilings, or floors, the fire rating integrity shall be maintained.
- M. Do not install piping within exterior walls.
- N. Do not route piping above transformers, panelboards, or switchboards including the required service space for this equipment, unless the piping is serving this equipment.
- O. Floor and Roof Protection:
  - 1. CONTRACTOR shall take extra precautions to protect the floors and roofs from oil spillage and dripping. Any operation, such as cutting and threading of pipe that can result in dripping of oil and thread cuttings, shall be done over a drain pan that will collect all drippings. Tarpaulins, plywood, or drop cloths shall be used around such piping to prevent workers from tracking oil over the area. Workers shall be cautioned about cleaning their feet. Any liquids, such as oil, that will be used in this work shall be kept in tightly stoppered containers; extreme care shall be used when charging equipment with these materials to avoid any spills.
  - 2. All residual matter deposited on floors, roofs, walls, and other surfaces because of the system installation shall be completely removed.

### 3.02 WELDED PIPE JOINTS

- A. Welded joints shall be made in a fabrication shop. No welding is allowed at the project site.
- B. Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and the Wisconsin Building Code where applicable. Electrodes shall be Lincoln, or approved equal, with coating and diameter as recommended by the manufacturer for the type and thickness of work being done.
- C. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half the diameter of the main.

### 3.03 THREADED PIPE JOINTS

- A. Joints of threaded pipe shall be made by cutting pipe square and reaming inside. Ream ends of pipe to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly. Threads shall be cut so that exposed threads shall not exceed three. Exposed threads shall be coated with asphaltum. Use joint compound sparingly.
- B. Use a thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

### 3.04 UNIONS AND FLANGES

- A. Install a union, flange, or grooved coupling combination at each connection to each piece of equipment and at other items that may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connections on the equipment side of the valve. Concealed unions, flanges, or couplings are not acceptable.

### 3.05 HANGERS, SUPPORTS, AND ANCHORS

- A. Installation:
  - 1. Size, apply and install supports and anchors in compliance with manufacturers recommendations.
  - 2. Install supports to provide for free expansion of the piping system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.
  - 3. Coordinate hanger and support installation to properly group piping of all trades.
  - 4. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes or continuous insert channels for the supporting steel. Where continuous insert channels are used, pipe supporting devices made specifically for use with the channels may be substituted for the specified supporting devices provided that similar types are used and all data is submitted for prior approval.
  - 5. Perform welding in accordance with standards of the American Welding Society.
  - 6. Support piping in accordance with NFPA 13, other sections of this specification, and in accordance with all state and local requirements.
  - 7. Provide hangers to support all piping in perfect alignment without sagging or interference, to permit free expansion and contraction and to meet the requirements of NFPA 13. Strap hangers, wire hangers, or trapeze hangers will not be acceptable.

B. Hanger and Support Spacing:

1. Use hangers with minimum vertical adjustment.
2. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.
3. Support riser piping independently of connected horizontal piping.
4. Adjust hangers to obtain the slope specified in the piping section of these specifications.
5. Space hangers for pipe as follows:

| Pipe Material | Pipe Size             | Maximum Horizontal Spacing | Maximum Vertical Spacing |
|---------------|-----------------------|----------------------------|--------------------------|
| Copper        | 3/4" through 1"       | 8'-0"                      | 10'-0"                   |
| Copper        | 1 1/4" through 1 1/2" | 10'-0"                     | 10'-0"                   |
| Copper        | 2" through 3"         | 12'-0"                     | 10'-0"                   |
| Copper        | 3 1/2" through 8"     | 15'-0"                     | 10'-0"                   |
| Steel         | 1" through 1 1/4"     | 12'-0"                     | 15'-0"                   |
| Steel         | 1 1/2" through 8"     | 15'-0"                     | 15'-0"                   |
| Steel         | 8" through 12"        | 15'-0"                     | 20'-0"                   |
| CPVC          | 1" through 1 1/4"     | 6'-0"                      | 10'-0"                   |
| CPVC          | 1 1/2"                | 7'-0"                      | 10'-0"                   |
| CPVC          | 2"                    | 8'-0"                      | 10'-0"                   |
| CPVC          | 2 1/2"                | 9'-0"                      | 10'-0"                   |
| CPVC          | 3"                    | 10'-0"                     | 10'-0"                   |

6. Hangers, supports and hanger spacing for CPVC plastic piping systems shall conform to the requirements of NFPA 13 and the manufacturer's requirements. CONTRACTOR shall provide details on the installation drawings for all proposed means of support.
7. Restraint hangers shall be installed at all sprinkler head location within 1-foot 0-inch for a single restraint and within 5-foot 0-inch for two points of restraint. The requirements for hanger restraint for systems in excess of 100 psi pressure shall be followed.
8. Hangers for CPVC systems shall not compress, distort, cut or abrade the piping and shall allow free movement of the pipe to permit thermal expansion and contraction.
9. Unsupported length from the last hanger and an end sprinkler for steel piping systems shall be as follows:

|                         |                      |
|-------------------------|----------------------|
| 1" piping               | Not greater than 36" |
| 1 1/4" piping           | Not greater than 48" |
| 1 1/2" piping or larger | Not greater than 60" |

- C. Riser Clamps: Support vertical piping with clamps secured to the piping and resting on the building structure or secured to the building structure below at each floor. Use method of securing the vertical risers to the building structure below in stairwell locations.
- D. Anchors: Install where indicated on the Drawings and details. Where not specifically indicated, install anchors at ends of principal pipe runs and at intermediate points in pipe runs. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

### 3.06 SPRINKLER HEADS

- A. Install sprinkler heads as recommended by manufacturer. Locate sprinkler heads as indicated on fire protection plan and reflected ceiling plan maintaining minimum clearances from obstructions, ceilings, and walls. Install sprinkler heads level in locations not subject to

spray pattern interference. When ducts, lights, or other objects are obstructions to sprinkler distribution, additional heads shall be provided beneath the obstruction.

- B. All sprinkler heads installed in finished ceilings shall be fed by a swing joint or return bend arrangement for final positioning in ceiling grid pattern during construction phases.
- C. All sprinkler heads shall be centered in ceiling tile.

### 3.07 GAUGES

- A. Provide a valved pressure gauge in main fire protection riser, at or near each test connection, and at the top of each piping riser. Provide gauge with a connection having a soft metal seated globe valve arranged for draining pipe between gauge and valve. Install gauges to permit removal and where they will not be subject to freezing.

### 3.08 VALVES

- A. Properly align piping before installation of valves. Do not support weight of piping system on valve ends. Mount valves in locations that allow access for operation, servicing, and replacement. Install all valves with the stem in the upright or horizontal position. Valves installed with the stems down will not be accepted. Provide a riser shutoff valve and a capped hose thread drain valve at the bottom of each riser. Provide capped hose thread drain valves to allow draining of each portion of piping.
- B. Install supervised-open gate valves located to control all sources of water supply except fire department connections. Sprinkler riser shall have an independent control valve.
- C. Provide permanently marked identification signs indicating the portion of the system controlled by each valve.
- D. Provide tamper switch on each shutoff valve where noted on the Drawings.
- E. Install locking device with each shutoff valve to prevent inadvertent closing of the valve. Keys shall be indexed to identify valve location.

### 3.09 SPECIALTY VALVES

- A. Install fire protection riser in vertical position. Install trim recommended by manufacturer including drain and test valves. Route drains to hub or floor drains. Test and adjust operation of valves, alarms, pressure maintenance devices, and deluge/preaction controls.

### 3.10 FIRE DEPARTMENT CONNECTIONS

- A. Fire department connections will be installed in the same location as the double check valve assembly. Mount on wall where indicated and/or as required. Support from structure independent of piping. Locate between 2 feet to 3 feet above grade. Fill wall penetration with insulation and caulk exterior and interior face of wall opening weathertight.
- B. Provide 1/2-inch automatic drip drain on inlet of fire department connection check valve and where indicated.

### 3.11 TEST CONNECTIONS

- A. Install test connections sized and located in accordance with NFPA Standards, complete with shutoff valve. Test connections may also serve as drain pipes.
- B. Provide test connections for each flow switch. Test connections shall discharge to appropriate receptacles.
- C. When test valves are located remote from the flow switch, the valve shall be identified with a brass tag denoting which flow switch is being tested.

### 3.12 FIRE ALARM SYSTEMS

- A. CONTRACTOR shall coordinate their work with the Fire Alarm System Contractor. The system (Fire Alarm and Fire Protection) must be compatible as listed in the Factory Mutual Research Approval Guide.

### 3.13 FINISHES

- A. See Section 09 91 00–Painting for methods and materials required for work under this section.

### 3.14 TESTING

- A. Flush, test, and inspect sprinkler piping systems in accordance with NFPA 13.
- B. The sprinkler system shall be tested as an entire system or partial system. The system shall be hydrostatically tested at 200 psi for 2 hours. No leakage allowed. All defective joints shall be replaced with new materials. No caulking of defective joints shall be allowed. After defective joints are replaced, the system shall be retested until satisfactory results are obtained. Pipe shall not be concealed until satisfactorily pressure-tested.
- C. ENGINEER and OWNER shall be notified 24 hours prior to any pressure test. This test shall be performed in the presence of appropriate representatives for OWNER and ENGINEER. A log of tests shall be kept stating who performed test, time and date of test, what section of system was tested, and results of test with properly executed Contractor's Material and Test Certification forms from NFPA 13. This log shall be kept at the job site and submitted to ENGINEER for review.
- D. Flow switches shall be operated to test that proper signals are transmitted to the Fire Alarm System.
- E. Include tests for tamper switches.

### 3.15 IDENTIFICATION

- A. Provide system identification as noted in Section 20 05 53–Identification for Fire Suppression, Plumbing, and HVAC Piping and Equipment.
- B. Identify equipment with engraved nameplates.

- C. Identify interior piping mains not less than once every 25 feet, not less than once in each room, adjacent to each access door or panel, and on both sides of the partition where exposed piping passes through walls or floors. Place flow directional arrows at each identification location.
- D. Identify valves with signs according to NFPA rulings.
- E. Provide a hydraulic design information sign of permanently marked weatherproof metal or engraved nameplate material. Secure to alarm valve with brass chain or nylon wire ties. Information shall include location of the design areas. Include discharge densities, required flow and residual pressure at base of the riser, hose stream demand, square footage of area protected, and fire sprinkler head demand.

END OF SECTION

## SECTION 22 05 19

### GENERAL PLUMBING PIPING SPECIALTIES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Piping specialties for all plumbing piping systems unless noted otherwise.
- B. Related Sections and Divisions: Applicable provisions of Division 01 govern work under this section.

##### 1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within this specification.

##### 1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session. New start-up shall be for the purpose of determining alignment, lubrication, voltage, and amperage readings. New start-up shall confirm all proper electrical connections, discharge, and suction gauge readings. A copy of the start-up report shall be made and sent to both CONTRACTOR and ENGINEER.

##### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.
- C. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.
- D. Submit manufacturer's installation instructions.
- E. Submittals must be specific to this project. Generic submittals will not be accepted.

## 1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

## 1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule and activities.
- B. Include replacement and spare parts lists.

## 1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

# PART 2-PRODUCTS

## 2.01 THERMOMETERS

- A. Manufacturers: Ashcroft, H.O. Trerice, Ametek/U. S. Gauge.
- B. Stem Type: Cast aluminum case, 9-inch scale, clear acrylic window. Adjustable angle brass stem with stem of sufficient length so the end of the stem is near the middle of a pipe without reducing the thickness of any insulation, red indicating fluid, black lettering against a white background, with scale ranges as follows:

| Service         | Hot Water |
|-----------------|-----------|
| Scale Range, °F | 30-180    |
| Increment, °F   | 2         |

## 2.02 THERMOMETER SOCKETS

- A. Brass with threaded connections suitable for thermometer stems and temperature control sensing elements in pipeline. Furnish with extension necks for insulated piping systems.



## 2.03 WATER HAMMER ARRESTORS

- A. Manufacturer: Sioux Chief, Wade, or Watts.
- B. ANSI A112.26.1, ASSE 1010; sized in accordance with PDI WH-201, precharged piston type constructed of hard drawn Type K copper, threaded brass adapter, brass piston with O-ring seals, FDA-approved silicone lubricant, suitable for operation in temperature range 35 to 150°F, maximum 250 psig working pressure, 1500 psig surge pressure. Watts Series LF15M2 or LF15M2S, or equal.

## 2.04 BACKFLOW PREVENTERS

- A. Backflow Preventers—Reduced Pressure Zone (RPZ) Type:
  - 1. Manufacturers: Watts, or equal.
  - 2. The assembly shall meet the requirements of ASSE 1013, AWWA C511.
  - 3. The assembly shall consist of a pressure differential relief valve located in a zone between two positive seating check valves and captured springs. Back siphonage protection shall include provision to admit air directly into the reduced pressure zone via a separate channel from the water discharge channel. The assembly shall include two tightly closing shutoff valves before and after the valve and test cocks.
  - 4. Test cocks.
  - 5. Seats: Bronze, removable and replaceable, without removing valve from the line.
  - 6. Checks: Independently operating.
  - 7. Relief Valve: Independently operating, located between the two check valves.
  - 8. Rated 175 psi maximum working pressure with continuous temperature range of 33°F to 140°F.
  - 9. Unit to be complete with vent-port funnel to maintain the air gap and to provide a drain connection point.
  - 10. Sizes 1/2 inch through 2 inches: Bronze body, bronze strainer, upstream and downstream quarter-turn ball valves, union connections. Watts Regulator Company Series LFU009.
  - 11. Sizes 2 1/2 inches through 10 inches: FDA epoxy-coated cast iron body, FDA epoxy-coated strainer, upstream and downstream OSY-UL/FM outside stem and yoke resilient seated gate valves, flange connections: Watts Regulator Series LF-909.

## 2.05 WALL HYDRANTS (WH)

- A. Manufacturer: Watts, Woodford, or Zurn.
- B. WH-1: Freezeproof automatic draining wall hydrant with exposed chrome plated bronze wall plate, 3/4-inch inlet, 3/4-inch hose thread ASSE 1019-93 backflow preventer outlet, copper or bronze casing, loose key operator. Woodford model 65, or equal.

## 2.06 HOSE BIBBS (HB)

- A. Manufacturer: Woodford, Watts, or Wade.
- B. HB-1: Hose bibbs shall be Woodford Model 24, Watts, HB-1, or Wade HB-1. Provide 3/4-inch garden hose thread, 3/4-inch inlet, and ASSE 1011 approved backflow preventer outlet. Interior hose valves shall be equipped with approved vacuum breaker, Watts 8A, Nidel Model 34H, or equal. Provide metal handle and chrome plate finish. Hose bibbs providing non-potable water shall be provided with a removable key handle.

- C. HB-2: Hose bibbs located in corrosive or hazardous environments shall be of plastic construction. Provide 3/4-inch garden hose thread, 3/4-inch inlet, and ASSE 1011 approved backflow preventer outlet.

## 2.07 NON-POTABLE WATER SIGNS

- A. Non-potable Water Caution Signs: Place non-potable water signs permanently mounted at every hose bib or faucet on the non-potable water system. Sign shall include as a minimum the wording "CAUTION, NON-POTABLE WATER, DO NOT DRINK" or similar standard language. Signs shall be Brady Safety sign, or equal, minimum size 7 inches by 10 inches, constructed of fiberglass. Mount signs on building wall or structures with stainless steel screws or fasteners.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Install thermometer in piping systems as indicated on the Drawings and/or details using a separable socket in each location.
- B. Install thermometer sockets at each point where a thermometer or temperature control sensing element is located in a pipeline.
- C. Install water hammer arrestors where indicated and at quick closing valve installations.
- D. Install backflow preventers in accordance with Wisconsin Department of Safety and Professional Services requirements maintaining minimum clearance distances for servicing and testing. Provide indirect waste piping with air gap installation from relief opening to above hub drain or floor drain.
- E. Where backflow preventers requiring Department of Safety and Professional Services registration are installed, provide initial registration, testing and report filing required by Department of Safety and Professional Services. List the name and address of the building that the backflow preventer installations occur in.
- F. Mount wall hydrants recessed in exterior wall construction with valve plug extended beyond interior side of building insulation. Slope to drain to exterior. Install so discharge is 18 inches minimum above finished grade. Set wall box in grout or caulk and fill exterior wall penetration with insulation.
- G. Mount hose bibbs securely fastened to wall where indicated. Provide water hammer arrestor in line to hose bibb. Hose bibbs providing non-potable water shall be provided with non-potable water warning signage as outlined in this section.

END OF SECTION

## SECTION 22 05 23

### GENERAL-DUTY VALVES FOR PLUMBING PIPING

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Valves of all descriptions except where indicated elsewhere.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within this specification.

##### 1.03 QUALITY ASSURANCE

- A. Quality assurance shall be in accordance with Section 01 45 00—Quality Control.

##### 1.04 SYSTEM DESCRIPTIONS

- A. Performance Requirements:
  - 1. Lead-Free Requirements: All materials that contact potable water shall be lead free. Lead free refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content  $\leq 0.25\%$  per the Federal Safe Drinking Water Act as amended January 4th, 2011 Section 1417. All products used in potable water systems shall be UL classified in accordance with ANSI/NSF 61 for potable water service and shall meet the low lead requirements of NSF-372.
  - 2. ANSI Z21.22—Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems.
  - 3. ASSE 1003—Water Pressure Reducing Valves for Domestic Water Supply Systems.
  - 4. Where valve types (ball, butterfly, etc.) are specified for individual plumbing services (i.e., domestic water, gas, etc.), each valve type shall be of the same manufacturer unless prior written approval is obtained from OWNER.
  - 5. Valves shall be line size unless specifically noted otherwise.

##### 1.05 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- B. Schedule of all valves indicating type of service, dimensions, materials of construction, and pressure/temperature ratings for all valves shall be used on the project. Temperature ratings specified are for continuous operation.

## 1.06 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under Section 01 33 00–Submittals.

## PART 2–PRODUCTS

### 2.01 WATER SYSTEM VALVES (CW, HW, TMW, TMWR, NPW)

- A. All water system valves to be rated at not less than 125 psig water working pressure at 240°F unless noted otherwise.
- B. Provide valve extensions for valves installed in all piping with insulation.
- C. All local shutoff valves serving emergency eyewash and shower stations shall be lockable.
- D. All valves on potable water supplies shall be suitable for potable water applications.
- E. Shutoff valves in CPVC piping 3 inches in diameter and smaller shall be hand-operated 150 psi CPVC ball valves, Chemtrol TU Series Tru-bloc, Hayward, Walworth, or equal. Valves and all components shall be suitable for potable water applications.
- F. Shutoff valves in copper piping 3 inches in diameter and smaller shall be two-piece bronze body, solder joint or threaded ends, chrome plated bronze ball, glass filled Teflon seat, Teflon packing and threaded packing nut, blowout-proof stem, 600 psi. Apollo 70LF-200, Milwaukee UPBA150, Nibco S580-80-LF.
- G. Check valves in copper piping 3 inches in diameter and smaller shall be bronze body, wye pattern, swing check, with bronze disc, rated for 300 psig CWP, and NSF certified lead free Apollo valves 161S-LF, or equal.
- H. Potable Water Circuit Setters/Balance Valves:
  - 1. Manufacturers: Bell and Gossett, or equal.
  - 2. Valve shall be designed to allow installing contractor to pre-set balance points for proportional system balance prior to system start-up.
  - 3. All valves shall be of Lead-Free Brass body and stainless steel ball construction with glass and carbon filled TFE seat rings.
  - 4. Valves shall have differential pressure read-out ports across valve seat area. Read-out ports shall be fitted with internal EOT inserts/check valves. Valve bodies shall have 1/4-inch NPT tapped drain/purge ports.
  - 5. Valves shall have memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. All valves shall have calibrated nameplates to provide specific valve settings. Valves shall be designed for positive shut-off.
  - 6. Valves shall be suitable for 400 psi service up to 250°F.
- I. Drain Valves: 3/4-inch ball valve with integral threaded hose adapter, sweat or threaded inlet connections, with threaded cap and chain on hose threads, Apollo 70LF-200-HC, Milwaukee BA-100H or BA-150H, or Nibco T-585-70-HC.

## PART 3-EXECUTION

### 3.01 GENERAL

- A. Properly align piping before installation of valves. Install and test valves in strict accordance with valve manufacturer's installation recommendations. Do not support weight of piping system on valve ends.
- B. Mount valves in locations which allow access for operation, servicing, and replacement.
- C. Provide valve handle extensions for all valves installed in insulated piping.
- D. Install all valves with the stem in the upright or horizontal position. If possible, install butterfly valves with the stem in the horizontal position. Valves installed with the stems down will not be accepted.
- E. Prior to flushing of piping systems, place all valves in the full-open position.

### 3.02 SHUT-OFF VALVES

- A. Install shut-off valves at each piece of equipment, at each branch take-off from mains for isolation or repair and elsewhere as indicated.

### 3.03 BALANCING VALVES

- A. Install where indicated on the Drawings and details for balancing of flow in pumped hot water recirculation piping systems.
- B. Upon project completion, adjust each valve and set position stop. Balance system to minimum flow in return piping branches needed to maintain even supply water temperature throughout building.

### 3.04 DRAIN VALVES

- A. Provide drain valves for complete drainage of all systems. Locations of drain valves include low points of piping systems, downstream of riser isolation valves, equipment locations specified or detailed, other locations required for drainage of systems and elsewhere as indicated.

### 3.05 SWING CHECK VALVES

- A. Install swing check valves in recirculation branch lines and elsewhere as indicated. Provide weighted swing check valves at sanitary sump pump discharges.

END OF SECTION

## SECTION 22 05 29

### HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Hangers and supports for Plumbing Piping and Equipment.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within this specification.

##### 1.03 QUALITY ASSURANCE

- A. Quality assurance shall be in accordance with Section 01 45 00–Quality Control.

##### 1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

##### 1.05 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under Section 01 33 00–Submittals.

#### PART 2–PRODUCTS

##### 2.01 MANUFACTURERS

- A. Anvil, B-Line, Pate, G-Strut, Piping Technology, Roof Products & Systems or approved equal.

##### 2.02 STRUCTURAL SUPPORTS

- A. Provide all supporting steel required for the installation of mechanical equipment and materials, including angles, channels, beams, etc. to suspended or floor supported tanks and equipment. All of this steel may not be specifically indicated on the Drawings.

## 2.03 PIPE HANGERS AND SUPPORTS

- A. Hangers for Pipe Sizes 1/2-Inch through 2 Inches:
  - 1. Carbon steel, adjustable swivel ring. B-Line B3170, Anvil 69 or 70.
  - 2. Carbon steel, adjustable clevis, standard. B-Line B3100, Anvil 260.
- B. Hangers for Pipe Sizes 2 Inches and Larger: Carbon steel, adjustable clevis, standard. B-Line B3100, Anvil 260.
- C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- D. Wall Support:
  - 1. Carbon steel welded bracket with hanger. B-Line B3068 Series, Anvil 194 Series.
  - 2. Perforated, epoxy painted finish, 16-12 gauge, minimum, steel channels securely anchored to wall structure, with interlocking, split-type, bolt secured, galvanized pipe/tubing clamps. B-Line type S channel with B-2000 series clamps, Anvil type AS 200 H with AS 1200 clamps. When copper piping is being supported, provide flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the channel or clamp, equal to B-Line B1999 Vibra Cushion or provide manufacturers clamp and cushion assemblies, B-Line BVT series.
- E. Vertical Support: Carbon steel riser clamp. B-Line B3373, Anvil 261 for above floor use.
- F. Floor Support: Carbon steel pipe saddle, stand and bolted floor flange. B-Line B3088T/B3093.

## 2.04 PIPE HANGER RODS

- A. Steel Hanger Rods:
  - 1. Hanger rod shall be continuously threaded, complete with adjusting and lock nuts.
  - 2. Size rods for individual hangers and trapeze support as indicated in the following schedule.
  - 3. Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, shall not exceed the limits indicated.

| Maximum Load<br>(pounds)    | Rod Diameter<br>(inches) |
|-----------------------------|--------------------------|
| (650°F Maximum Temperature) |                          |
| 610                         | 3/8                      |
| 1,130                       | 1/2                      |
| 1,810                       | 5/8                      |

## 2.05 CONCRETE INSERTS

- A. Poured in Place:
  - 1. MSS SP-58 Type 18 wedge type to be constructed of a black carbon steel body with a removable malleable iron nut that accepts threaded rod to 7/8-inch diameter. Wedge design to allow the insert to be held by concrete in compression to maximize the load carrying capacity. B-Line B2505, Anvil 281.
  - 2. MSS SP-58 Type 18 universal type to be constructed of black malleable iron body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter. B-Line B3014N, Anvil 282.

- B. Drilled Fasteners: Carbon steel drop-in type expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Hilti, Rawl, Redhead.

## 2.06 CONTINUOUS CONCRETE INSERT CHANNELS

- A. Steel inserts with an industry standard pre-galvanized finish, nominally 1 5/8-inch wide by 1 3/8-inch deep by length to suit the application, designed to be nailed to concrete forms and provide a linear slot for attaching other support devices. Installed channels to provide a load rating of 2,000 pounds per foot in concrete. Manufacturer's standard brackets, inserts, and accessories designed to be used with the channel inserts may be used. Select insert length to accommodate all pipe in the area.

## 2.07 ANCHORS

- A. Use welding steel shapes, plates, and bars to secure piping to the structure.

## 2.08 EQUIPMENT STANDS

- A. Use structural steel members welded to and supported by pipe supports. Clean, prime and coat with three coat rust inhibiting alkyd paint or one coat epoxy mastic. Where exposed to weather, treat with corrosive atmosphere coatings.

## 2.09 CORROSIVE ATMOSPHERE COATINGS:

- A. Corrosive environments shall be as noted on the Drawings.
- B. Pipe in chemical feed rooms shall be supported with a plastic support system, Aickinstrut, or equal.

# PART 3—EXECUTION

## 3.01 INSTALLATION

- A. Size, apply and install supports and anchors in compliance with manufacturers recommendations.
- B. Install supports to allow free expansion of the piping system. Support all piping from the structure using concrete inserts, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.
- C. Coordinate hanger and support installation to properly group piping of all trades.
- D. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes or continuous insert channels for the supporting steel. Where continuous insert channels are used, pipe supporting devices made specifically for use with the channels may be substituted for the specified supporting devices provided that similar types are used and all data is submitted for prior approval.
- E. Size and install hangers and supports, except for riser clamps, for installation on the exterior of piping insulation. Where a vapor barrier is not required, hangers may be installed either on the exterior of pipe insulation or directly on piping.



- F. Perform welding in accordance with standards of the American Welding Society.

### 3.02 HANGER AND SUPPORT SPACING

- A. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
- B. Place a hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.
- C. Use hangers with 1 1/2-inch minimum vertical adjustment.
- D. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.
- E. Support riser piping independently of connected horizontal piping.
- F. Adjust hangers to obtain the slope specified in the piping section of these specifications.
- G. Space hangers for pipe as follows:

| Pipe Material | Pipe Size             | Maximum Horizontal Spacing | Maximum Vertical Spacing |
|---------------|-----------------------|----------------------------|--------------------------|
| Copper        | 1/2" through 3/4"     | 5'-0"                      | 10'-0"                   |
| Copper        | 1" through 1 1/4"     | 6'-0"                      | 10'-0"                   |
| Copper        | 1 1/2" through 2 1/2" | 8'-0"                      | 10'-0"                   |
| Ductile Iron  | All                   | 5'-0"                      | 15'-0"                   |
| PVC           | All                   | 4'-0"                      | 10'-0"                   |
| CPVC          | All                   | 4'-0"                      | 10'-0"                   |

- H. Any piping materials not explicitly listed above shall have pipe support provided at maximum spacing intervals as noted in the applicable code or manufacturer recommendations, whichever is more restrictive.

### 3.03 RISER CLAMPS

- A. Support vertical piping with clamps secured to the piping and resting on the building structure or secured to the building structure below at each floor.

### 3.04 CONCRETE INSERTS AND CONTINUOUS INSERT CHANNELS

- A. Select size based on the manufacturer's stated load capacity and weight of material that will be supported. Locate continuous insert channels on 6 feet 0 inch maximum centers and 2 feet 0 inch from corners. Furnish inserts to Division 03 for placement in concrete formwork. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4-inch size. Where concrete slabs form finished ceiling, provide inserts that are flush with the slab surface.

### 3.05 ANCHORS

- A. Install where indicated on the Drawings and details. Where not specifically indicated, install anchors at ends of principal pipe runs and at intermediate points in pipe runs between

expansion loops. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

END OF SECTION

## SECTION 22 07 16

### EQUIPMENT INSULATION FOR PLUMBING

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work includes insulation for all equipment provided under Division 22—Plumbing:
  - 1. Flexible Closed Cell Insulation.
  - 2. Adhesives, Mastic, Sealants, and Reinforcing Materials.
  - 3. Jacketing.
  - 4. Accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
  - 1. ASTM B117—Standard Practice for Operating Salt Spray (Fog) Apparatus.
  - 2. ASTM C168—Standard Terminology Relating to Thermal Insulation.
  - 3. ASTM C518—Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - 4. ASTM C591—Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
  - 5. ASTM C1427—Standard Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form.
  - 6. ASTM D1000—Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications.
  - 7. ASTM E84—Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 8. ASTM E96—Standard Test Methods for Water Vapor Transmission of Materials.
  - 9. FED L-P-535E: Plastic Sheet (Sheeting): Plastic Strip: Poly (Vinyl Chloride) And Poly (Vinyl Chloride-Vinyl Acetate), Rigid.
  - 10. EPA Method 8260B—Volatile Organic Compounds By Gas Chromatography/Mass Spectrometry (Gc/Ms).
  - 11. NFPA 262—Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, and fitting materials, along with safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

#### 1.04 QUALITY ASSURANCE

- A. All insulation or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Label all insulating products delivered to the construction site with the manufacturer's name and description of materials.
- C. Insulation systems shall be applied by experienced contractors. Within the past five years, CONTRACTOR shall be able to document the successful completion of a minimum of three projects of at least 50% of the size and similar scope of the work specified in this section.

#### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle materials in accordance with Section 01 60 00–Materials and Equipment.
- B. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage.
- C. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- D. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- E. Use all means necessary to protect insulation before, during, and after installation.
- F. All scratched, dented, and otherwise damaged insulation shall be repaired or replaced without additional cost to OWNER.

#### 1.06 GENERAL REQUIREMENTS

- A. Unless otherwise indicated, all equipment covering, jackets, insulation, vapor barriers, adhesive, and mastics shall have flame spread rating of 25 or less and smoke spread rating of 450 or less when tested in accordance with ASTM E84.

### PART 2–PRODUCTS

#### 2.01 FLEXIBLE CLOSED CELL INSULATION

- A. Acceptable manufacturers are K-flex Insul-tube, Nomaco ArcticFlex, or equal.
- B. Insulation shall be flexible closed cell type conforming to ASTM C1427, Type 1, Grade 1.
- C. Minimum nominal density shall be between 3 to 6 lbs/ft<sup>3</sup>.
- D. K-factor shall not exceed 0.25 (btu-in)/(hr-ft<sup>2</sup>-°F) at 75°F mean.
- E. Insulation shall be rated for service range of -20°F to 220°F on piping or 180°F where adhered to equipment.

## 2.02 ADHESIVES, MASTIC, SEALANTS, AND REINFORCING MATERIALS

- A. Products shall be compatible with surfaces and materials on which they are applied, and shall be suitable for use at operating temperatures of systems to which they are applied.
- B. Vapor Retarding Mastic:
  - 1. Acceptable Manufacturers: Foster 30-65 Vapor Fas, Childers CP-34, and Vimasco 749.
  - 2. For equipment insulation operating below 50°F, mastic water vapor permeance shall be less than 0.03 perms at 45 mils dry film thickness conforming to ASTM E96.
  - 3. Use insulation joint sealant at all joints. Acceptable manufacturers are Foster 95-50 Flextra, Childers CP-76 Chil-Byl, or Pittsburgh Corning CW Sealant.
- C. Weather Barrier Breather Mastic:
  - 1. Acceptable Manufacturers: Foster 46-50 Weatherite, Childers Vi-Cryl CP-10/CP-11, or Vimasco WC-5.
  - 2. For equipment insulation operating at 50°F or above, mastic water vapor permeance shall be greater than 1.0 perms at 1/16-inch dry film thickness conforming to ASTM E96.

## 2.03 ACCESSORIES

- A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.
- B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- C. Insulation bands shall be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness shall be 0.015 inch for aluminum and 0.010 inch for stainless steel.
- D. Staples shall be clinch style.
- E. Tack fasteners shall be stainless steel ring grooved shank tacks.
- F. Joint sealants and metal jacketing sealants shall be non-shrinking and permanently flexible.

## PART 3—EXECUTION

### 3.01 GENERAL

- A. All insulation damaged during construction shall be replaced in accordance with these specifications.
- B. All insulation shall be applied in accordance with the manufacturer's written recommendations. Destructive methods such as sheet metal screws are not acceptable. All insulation shall be installed with joints butted firmly together.
- C. All valves shall be insulated with mitered sections of insulation equal in density and thickness to adjoining insulation or with "Zeston"-type, premolded PVC fittings installed in accordance with the manufacturer's instructions.

- D. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.

### 3.02 VAPOR BARRIER INSTALLATION

- A. For systems operating at 50°F or above, jackets on insulation may be stapled using outward clinch staples spaced 3 inches apart at least 1/4-inch in from the lap edge.
- B. For systems operating below 50°F, laps shall be vapor-sealed using self-sealing lap, lap-seal tape gun, or adhesive.
- C. Install fabric reinforcing without wrinkles. Overlap seams a minimum of 2 inches.
- D. Use full length material (as delivered from manufacturer) wherever possible. Scrap piecing of insulation or pieces cut undersize and stretched to fit will not be accepted.
- E. All insulation ends shall be tapered and sealed regardless of service.
- F. Vapor barrier jackets shall be applied with a continuous, unbroken vapor seal. Vapor barrier jackets shall not be broken at supports.
- G. Vapor retarding jacket shall be maintained continuously through all penetrations.

### 3.03 FLEXIBLE CLOSED CELL INSULATION INSTALLATION

- A. Miter cut fittings allowing sufficient length to prevent stretching. Completely seal seams and joints for vapor tight installation. Apply full bed of adhesive to both surfaces. Cover flexible closed cell insulation on systems operating below 40°F with vapor retarding mastic.

### 3.04 EQUIPMENT INSULATION

- A. Insulation shall not cover equipment access manholes, fittings, nameplates or ASME stamps. Bevel and seal insulation at these locations.
- B. Provide insulation on equipment as outlined in the following schedule:

| Equipment                            | Insulation           | Jacket | Thickness |
|--------------------------------------|----------------------|--------|-----------|
| Water Meters                         | Flexible Closed Cell | N/A    | 0.5"      |
| Reduced Pressure Backflow Preventers | Flexible Closed Cell | N/A    | 0.5"      |

END OF SECTION

## SECTION 22 07 19

### PIPING INSULATION FOR PLUMBING

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work includes insulation for all piping provided under Division 22—Plumbing.
  - 1. Rigid Formed Fiberglass Insulation.
  - 2. Flexible Closed Cell Pipe Insulation.
  - 3. Adhesives, Mastic, Sealants, and Reinforcing Materials.
  - 4. Jacketing.
  - 5. Insulation Inserts and Pipe Shields.
  - 6. Accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
  - 1. ASTM C168—Standard Terminology Relating to Thermal Insulation.
  - 2. ASTM C272—Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions.
  - 3. ASTM C518—Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - 4. ASTM C533—Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
  - 5. ASTM C547—Standard Specification for Mineral Fiber Pipe Insulation.
  - 6. ASTM C591—Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
  - 7. ASTM C612—Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
  - 8. ASTM C871—Standard Test Method for Chemical Analysis of Thermal Insulation Materials.
  - 9. ASTM C1427—Standard Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form.
  - 10. ASTM D1000—Standard Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications.
  - 11. ASTM E84—Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 12. ASTM E96—Standard Test Methods for Water Vapor Transmission of Materials.
  - 13. FED L-P-535E: Plastic Sheet (Sheeting): Plastic Strip: Poly (Vinyl Chloride) And Poly (Vinyl Chloride-Vinyl Acetate), Rigid.
  - 14. NFPA 262—Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, and fitting materials, along with safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

### 1.04 QUALITY ASSURANCE

- A. All insulation or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Label all insulating products delivered to the construction site with the manufacturer's name and description of materials.
- C. Insulation systems shall be applied by experienced contractors. Within the past five years, CONTRACTOR shall be able to document the successful completion of a minimum of three projects of at least 50% of the size and similar scope of the work specified in this section.

### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle materials in accordance with Section 01 60 00–Materials and Equipment.
- B. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage.
- C. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- D. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- E. Use all means necessary to protect insulation before, during, and after installation.
- F. All scratched, dented, and otherwise damaged insulation shall be repaired or replaced as requested by OWNER without additional cost to OWNER.

### 1.06 GENERAL REQUIREMENTS

- A. Unless otherwise indicated, all pipe covering, jackets, insulation, vapor barriers, adhesives, and mastics shall have flame spread rating of 25 or less and smoke spread rating of 450 or less when tested in accordance with ASTM E84.
- B. All insulation and associated materials shall be free of asbestos.



## PART 2–PRODUCTS

### 2.01 RIGID FORMED FIBERGLASS INSULATION

- A. Acceptable manufacturers are Johns Manville Micro-Lok, or equal.
- B. Insulation shall be mineral fiber type conforming to ASTM C547, Type IV.
- C. Minimum nominal density shall be of 3.0 lbs/ft<sup>3</sup>.
- D. K-factor shall not exceed 0.23 (btu-in)/(hr-ft<sup>2</sup>-°F) at 75°F mean.
- E. Insulation shall be rated for service to 850°F.

### 2.02 FLEXIBLE CLOSED CELL PIPE INSULATION

- A. Acceptable manufacturers are K-flex Insul-tube, Armacell AP/Armaflex, or equal.
- B. Insulation shall be flexible closed cell type conforming to ASTM C534, Type 1, Grade 1.
- C. K -factor shall not exceed 0.25 (btu-in)/(hr-ft<sup>2</sup>-°F) at 75°F mean.
- D. Insulation shall be rated for service range of -20°F to 220°F on piping or 180°F where adhered to equipment.

### 2.03 ADHESIVES, MASTIC, SEALANTS, AND REINFORCING MATERIALS

- A. Products shall be compatible with surfaces and materials on which they are applied, and shall be suitable for use at operating temperatures of systems to which they are applied.
- B. Fiberglass Insulation Adhesive—Acceptable Manufacturers: Foster 85-60, Childers CP-127, and Duro Dyne SSG.
- C. PVC Jacket Adhesive—Acceptable Manufacturers: DOWSIL™ 739 Plastic Adhesive by Dow; Zeston Perma-Weld by Johns Manville; and Ceel-Tite® Solvent Welding Adhesive by Ceel-Co.
- D. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

### 2.04 JACKETING

- A. PVC Jackets (PVJ):
  - 1. PVC film, gloss finish one side, semi-gloss other side.
  - 2. In water treatment facilities, PVC film shall conform to FED L-P-535E, Composition A, Type II, Grade NT.
  - 3. Jacket thickness shall be minimum 0.03 inch.
  - 4. Color to be selected by OWNER for various fluid types.
- B. Self-Adhering Jackets (SAJ):
  - 1. Acceptable manufacturers are 3M VentureClad 1577CW, or equal.

2. Jackets shall be 5-ply, self-adhering multiple laminated waterproofing material with reflective aluminum foil, high density polymer films and cold weather acrylic adhesive providing zero (0.0) moisture permeance.
  3. Minimum material thickness shall be 6 mils.
  4. Minimum puncture resistance shall be 25 pounds conforming to ASTM D1000.
- C. ADA Accessible Lavatory Insulation: Provide Truebro, Inc. Lav-Guard, or equal, undersink piping cover. Piping cover shall meet applicable ADA requirements. The P-trap, angle valve assemblies, supply piping, and tailpiece shall be covered with the molded vinyl, antimicrobial pipe cover. Cover shall be secured with flush reusable fasteners; angle stop shall have locking access cover.

## 2.05 INSULATION INSERTS AND PIPE SHIELDS

- A. Acceptable manufacturers are B-Line, Pipe Shields, or Value Engineered Products.
- B. Construct inserts with calcium silicate or polyisocyanurate with minimum 140 psi compressive strength. Provide 16-gauge galvanized steel shield, 12 inches long. Insert and shield shall include minimum 180 degree coverage on bottom supported piping and full 360 degree coverage on clamped piping. On roller mounted piping and piping designed to slide on support, provide additional load distribution stainless steel plate. In corrosive (NEMA 4X) environments, shields, and distribution plates shall be constructed of PVC, Eaton B-Line, or equal.
- C. Where contractor proposes shop/site fabricated inserts and shields, submit schedule of materials, thicknesses, gauges and lengths for each pipe size to demonstrate equivalency to pre-engineered/premanufactured product described above. On low temperature systems, high density rigid polyisocyanurate may be substituted for calcium silicate provided insert and shield length and shield gauge are increased to compensate for lower insulation compressive strength.
- D. Wood blocks will not be accepted.
- E. All pipe shields shall be banded to the jacketing using stainless steel bands. One band is required on each side of the support.

## 2.06 ACCESSORIES

- A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.
- B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- C. Insulation bands shall be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness shall be 0.015 inch for aluminum and 0.010 inch for stainless steel.
- D. Load distributing metal shields shall be constructed of galvanized steel or PVC. Minimum thickness shall be 0.015 inch for aluminum and 0.010 inch for stainless steel.
- E. Staples shall be clinch style.
- F. Tack fasteners shall be stainless steel ring grooved shank tacks.

- G. Joint sealants and metal jacketing sealants shall be non-shrinking and permanently flexible.

## PART 3-EXECUTION

### 3.01 GENERAL

- A. All insulation damaged during construction shall be replaced in accordance with these specifications.
- B. All insulation shall be applied in accordance with the manufacturer's written recommendations. Destructive methods such as sheet metal screws are not acceptable. All pipe insulation shall be installed with joints butted firmly together.
- C. All valves and fittings shall be insulated with mitered sections of insulation equal in density and thickness to adjoining insulation.
- D. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.
- E. All pipe insulation shall be continuous through walls, ceiling or floor openings and through sleeves.
- F. All un-insulated penetrations through the insulation system shall be insulated along their length to a minimum distance of four times the insulation thickness. To prevent moisture migration behind the insulation, these penetrations shall be sealed with a sealant as recommended by the manufacturer and flashed to shed water.

### 3.02 SUPPORT INSTALLATION

- A. For each pipe hanger, provide a hanger block on the bottom half of the pipe in place of the insulation.
- B. Pipe hangers and supports shall be sized large enough to be installed over the outer surface of the insulation.
- C. Load distributing metal shields shall be installed around the lower one-third circumference of the insulation and jacket.
- D. Blocks and shields shall be provided at all supports regardless of orientation, except inserts may be omitted on 3/4 inch and smaller copper piping provided 12-inch long 22 gauge pipe shields are used.

### 3.03 RIGID FORMED FIBERGLASS INSULATION INSTALLATION

- A. Fittings, valves, unions, flanges, couplings and specialties shall be insulated with factory molded insulation of the same thickness as adjoining insulation. Secure insulation sections with two wraps of nylon filament tape 9-inch to 12-inch on center. On single insulation layer systems and on the outer layer of double insulation layer systems, apply a thin coat of flexible closed cell joint sealant rated for system operating temperatures to all longitudinal and butt insulation joints covering entire face of joint. Allow sealant to fully cure before applying protective covering. Where two layers of insulation are used, do not use sealant on the inner

layer or adhere the inner layer to the outer layer. Apply vapor stop bead of joint sealant between pipe and insulation on both sides of valves, expansion/contraction joints, flanges, thermometers/gauges, attached vent and drain lines. Insulate attached non-circulated lines, control lines, vents, etc., for a minimum distance of 6 inches from pipe. Cover insulation with a protective jacket as specified below. Do not penetrate protective covering or insulation with mechanical fasteners.

### 3.04 FLEXIBLE CLOSED CELL INSULATION INSTALLATION

- A. Where practical, slip insulation on piping during pipe installation while pipe ends are open. Miter cut fittings allowing sufficient length to prevent stretching. Completely seal seams and joints for vapor tight installation. Apply full bed of adhesive to both surfaces. Cover flexible closed cell insulation on systems operating below 40°F with vapor retarding mastic.

### 3.05 PROTECTIVE JACKET INSTALLATION

- A. PVC Fitting Covers and Jackets (PVJ): Lap seams and joints a minimum of 2 inches and continuously seal PVC with welding solvent recommended by jacket manufacturer. Lap slip joint ends 4 inches without fasteners where required to absorb expansion and contraction. For sections where vapor retarding jacket is not required and jacket requires routine removal, tack fasteners may be used. Secure PVC fitting covers with tack fasteners. For systems requiring a vapor retarding jacket, apply a 1 1/2-inch band of mastic over ends, throat, seams and penetrations.
- B. Self-Adhering Jackets (SAJ):
  - 1. Install according to manufacturer's recommendations. Cut allowing minimum 4-inch overlap on ends and 6-inch on longitudinal joints. Align parallel to surface. Remove release paper and press flat to surface to avoid wrinkles. Rub entire surface for full adhesion and sealing at joint overlaps. On exterior applications, provide a bead of compatible caulk along exposed edges.
  - 2. Wrap elbows, fittings, valves and butt joints with 2 layers of vapor retarding tape. Vapor retarding tape shall be compatible with the jacket material used.
- C. Protective Metal Jacket (PMJ): Lap seams a minimum of 2 inches. Secure with metal bands for end to end joints, and rivets or sheet metal screws for longitudinal joints. Rivets, screws, and bands shall be constructed of the same material as the jacket. Locate seams on bottom for exterior applications. Seal laps with 1/8-inch bead of metal jacketing sealant to prevent water entry.
- D. Vapor Barriers: On systems operating at 50°F and above, pipe insulation jackets may be stapled using outward clinch staples spaced 3 inches apart at least 1/4 inch in from the lap edge. Mastics used shall be "breather" type allowing passage of water vapor.

### 3.06 PIPING INSULATION

- A. Provide insulation on new piping as indicated in the following schedule:

| SERVICE                                  | INSULATION           | JACKET | INSULATION THICKNESS BY PIPE SIZE |                   |                   |               |                  |
|------------------------------------------|----------------------|--------|-----------------------------------|-------------------|-------------------|---------------|------------------|
|                                          |                      |        | < 1"                              | 1" to<br>< 1 1/2" | 1 1/2"<br>to < 4" | 4" to<br>< 8" | 8" and<br>Larger |
| Piping within Slabs and<br>Masonry Walls | Flexible Closed Cell | N/A    | 1/2"                              | 1/2"              | 1/2"              | -             | -                |

| SERVICE                                                                                         | INSULATION              | JACKET | INSULATION THICKNESS BY PIPE SIZE |                   |                   |               |                  |
|-------------------------------------------------------------------------------------------------|-------------------------|--------|-----------------------------------|-------------------|-------------------|---------------|------------------|
|                                                                                                 |                         |        | < 1"                              | 1" to<br>< 1 1/2" | 1 1/2"<br>to < 4" | 4" to<br>< 8" | 8" and<br>Larger |
| Liquid-Carrying Piping Located in Exterior or Unconditioned Spaces (Unless Specified Elsewhere) | Rigid Formed Fiberglass | PMJ    | 2"                                | 2"                | 2"                | 2"            | 2"               |
| Cooling Coil Condensate Drain                                                                   | Rigid Formed Fiberglass | PVJ    | 1"                                | 1"                | 1"                | 1"            | 1"               |
| Cold Water (Potable/Nonpotable)                                                                 | Rigid Formed Fiberglass | PVJ    | 1"                                | 1"                | 1"                | 1"            | 1"               |
| Hot Water (Potable/Nonpotable)                                                                  | Rigid Formed Fiberglass | PVJ    | 1"                                | 1"                | 1.5"              | 1.5"          | 1.5"             |

- B. For systems with operating fluid temperatures 65°F or less, furnish and install removable flexible closed cell insulation covers, plugs or caps for all mechanical equipment and devices that require access by balancing contractors or service and maintenance personnel. Covers shall be tight fitting to provide a complete vapor retarding barrier. Examples include but are not limited to:
1. Circuit setters.
  2. Drain valves.
  3. Equipment labels.

### 3.07 SPECIAL AREAS

- A. All areas indicated on the Drawings as "Corrosive" or NEMA 4X shall include PVJ or SAJ jackets.

END OF SECTION

## SECTION 22 11 00

### FACILITY WATER DISTRIBUTION PIPING

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: All pipe, fittings, and appurtenances for domestic (hot and cold) potable and non-potable water within and to 5 feet beyond building perimeter.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work under this section.

##### 1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within this specification.

##### 1.03 QUALITY ASSURANCE

- A. Order all pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.
- B. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to OWNER.

##### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. CONTRACTOR shall provide schedule indicating the ASTM, AWWA, or CISPI specification number of the pipe being proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.
- C. CONTRACTOR shall provide statement from manufacturer on their letterhead that pipe furnished meets the ASTM, AWWA, or CISPI specification contained in this section.

##### 1.05 DELIVERY AND STORAGE

- A. CONTRACTOR shall promptly inspect shipments to review that the material is undamaged and complies with specifications.
- B. CONTRACTOR shall cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Materials shall not be stored directly on grade. Pipe, tube, and fitting ends shall be protected so they are not damaged. Where end caps are provided or specified, CONTRACTOR shall take precautions so the caps remain in

place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

- C. Offsite storage agreements will not relieve CONTRACTOR from using proper storage techniques.
- D. Deliver, store, and protect in accordance with Section 01 60 00—Materials and Equipment.

## PART 2—PRODUCTS

### 2.01 DOMESTIC WATER (INCLUDES COLD, HOT, TEMPERED, TEMPERED RECIRCULATED, AND NON-POTABLE)

- A. Copper Piping and Fittings: Piping smaller than 3 inches in diameter shall be Type K copper water tube, H (drawn) temper, ASTM B88; wrought copper pressure fittings, ANSI B16.22; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP. Mechanically formed brazed tee connections may be used in lieu of specified tee fittings for branch takeoffs up to one-half the diameter of the main.
- B. Ductile Iron Piping and Ductile Iron Fittings:
  - 1. Water piping 3 inches in diameter or larger shall be ductile iron conforming to ANSI/AWWA C151/A21.51, with flanged or grooved joints as shown on the Drawings. Unless otherwise shown or specified, all piping shall be minimum special thickness Class 53 with a minimum rated working pressure of 250 psi for flanged pipe. Pipe wall thickness shall be furnished as required by AWWA C115 for flanged piping; AWWA C606 for grooved piping; special thickness Class 53 minimum unless otherwise shown or specified. Manufacturers of flanged pipe and fittings shall be certified to NSF 61 by an ANSI-accredited third-party certification organization.
  - 2. The words "Ductile Iron" and the weight and class of pipe shall be plainly marked on each piece of pipe.
  - 3. All flanged sections of pipe shall be made up in strict accordance with AWWA C115 specifications. No field make-up flanges will be allowed unless strictly conforming to AWWA C115 with facing done after turning pipe through flange.
  - 4. Flanged joints shall conform to AWWA C110, C111, and C115, and shall be compatible with ANSI B16.1 Class 125. Flanges shall be ductile iron. Flanged gaskets shall be minimum 1/8-inch, full-face, rubber-ring, Toruseal, Flange-Tyte, Maloney, or equal, gaskets. Thicker gaskets shall be provided as recommended by the manufacturer to meet joint tolerance. All hot water piping shall have EPDM gaskets designed for a minimum of 225°F service. Flange bolts shall be standard zinc-plated steel with hex head and hex nuts for the rated working pressure and installation conditions specified or shown.
  - 5. Flanged fittings shall be of ductile iron with ductile iron flanges. Flanged fittings shall conform to AWWA C110 and ANSI B16.1, as applicable, with a minimum rated working pressure of 150 psi.
  - 6. All ductile iron fittings shall be American Cast Iron Pipe, Tyler, U.S. Pipe, or equal. No compact fittings are allowed.
  - 7. It is the intent of this specification that all piping, supports, and appurtenances shall be furnished shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.

- C. CPVC Piping:
1. Piping shall be located in NEMA 4X (corrosive) environments and where called out on Drawings.
  2. CPVC material used in manufacturing piping and fittings shall conform to ASTM D1784, Class 23447.
  3. CPVC piping shall be CPVC 4120, Schedule 80, high-impact conforming to ASTM F441. Piping and fittings shall be approved for use by the National Sanitation Foundation. All pipe delivered to the jobsite shall be properly marked for type, grade, and design stress rating. Expansion joints shall be provided as required. In general, all joints shall be solvent weld, except where flanges are shown or called out on the Drawings. All piping shall be supported at spacing not exceeding that recommended by the manufacturer.
  4. Solvent cement for CPVC piping shall be specifically designed for piping systems receiving chemical resistance. Cement shall be Oatey EP42, IPS Weld-On ZZ724, or equal.
  5. CPVC Schedule 80 pressure fittings shall meet requirements of ASTM F437 (threaded type) and ASTM F439 (solvent weld socket type). All internal threads shall be machine-taped to the requirements of ANSI/ASME B1.20.1. The quick burst strength of the fittings shall be equal to or greater than the burst strength of the equivalent Schedule 80 CPVC pipe. Fittings shall be made of CPVC 23447-B, or better.
  6. All CPVC piping and components shall be rated for potable water use.

## 2.02 DIELECTRIC UNIONS AND FLANGES

- A. Watts Regulator Company, Lochinvar, Wilkins or EPCO Sales, Inc., dielectric unions 2 inches and smaller; dielectric flanges 2 inches and larger; with iron female pipe thread to copper solder joint or brass female pipe thread end connections, non-asbestos gaskets, having a pressure rating of not less than 175 psig at 180°F.

## 2.03 UNIONS AND FLANGES

- A. Unions, flanges and gasket materials to have a pressure rating of not less than 150 psig at 180°F. Gasket material for flanges and flanged fittings shall be Teflon type. Treated paper gaskets are not acceptable.
- B. Two and One Half-Inch and Smaller Copper: ANSI B16.18 cast bronze union coupling or ANSI B15.24 Class 150 cast bronze flanges.
- C. Three-Inch and Larger Steel: ASTM A181 or A105, grade 1 hot forged steel flanges of threaded, welding neck, or slip-on pattern on black steel and threaded only on galvanized steel. Use raised face flanges ANSI B16.5 for mating with other raised face flanges or equipment with flat ring or full face gaskets. Use ANSI B16.1 flat face flanges with full face Teflon gaskets for mating with other flat face flanges on equipment. Gaskets shall be Teflon type.

## PART 3-EXECUTION

### 3.01 GENERAL

- A. Install pipe and fittings in accordance with reference standards, manufacturers' recommendations, and recognized industry practices.



### 3.02 PREPARATION

- A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

### 3.03 ERECTION

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
- B. Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.
- C. Maintain piping in clean condition internally during construction.
- D. Provide clearance for installation of insulation, access to valves, and piping specialties.
- E. Provide anchors, expansion joints, swing joints, and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- F. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

### 3.04 THREADED PIPE JOINTS

- A. Use a thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking shall be allowed.

### 3.05 DOMESTIC WATER

- A. Maintain piping system in clean condition during installation. Remove dirt and debris from assembly of piping as work progresses. Cap open pipe ends where left unattended or subject to contamination.
- B. Provide thrust restraints for 3-inch and larger exterior water piping joints, hydrants, caps, plugs, fittings, and bends of 22 1/2 degrees or more. Field apply continuous anti-corrosion coating to rodded restraint components. Protect mechanical joints, nuts and bolts from concrete cover. Cover with 8 mil sheet or tube polyethylene material sleeve.
- C. Install interior water piping with drain valves where indicated and at low points of system to allow complete drainage. Install shutoff valves where indicated and at the base of risers to allow isolation of portions of system for repair. Do not install water piping within exterior walls.

### 3.06 DIELECTRIC UNIONS AND FLANGES

- A. Install dielectric unions or flanges at each point where a copper-to-steel pipe connection is required in domestic water systems.

### 3.07 UNIONS AND FLANGES

- A. Install a union or flange at each connection to each piece of equipment and at other items which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.

### 3.08 TESTING AND CLEANING

#### A. General:

1. All new piping shall be tested. All piping, interior or exposed, shall be subject to test before being covered with insulation or paint. All piping and appurtenances shall be watertight or airtight and free from visible leaks.
2. All piping shall be flushed or blown out after installation and prior to testing. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge and other equipment, materials, and facilities necessary to complete the specified tests, flushing, sterilization. CONTRACTOR shall also provide all temporary sectionalizing devices and vents as required.
3. All new plumbing system piping shall be tested for leaks and defects. Piping being tested shall not leak nor show any loss in test pressure for duration specified.
4. In cases of minor installation and repairs where specified water and/or air test procedures are deemed impractical, CONTRACTOR shall perform alternate testing procedures if acceptable to ENGINEER. Alternate testing procedures for minor installation and repairs may include visual evaluation of installed components by ENGINEER during a simulation of use.
5. The water used for tests shall be obtained from a potable source of supply.
6. Prepare testing reports. If testing is performed in segments, submit separate report for each segment, complete with diagram or clear description of applicable portion of piping. After testing has been accepted for portions thereof, certify in writing the time, date, name, and title of the persons reviewing the test. This shall also include the description of what portion of the system has been accepted. A complete record shall be maintained of all testing that has been accepted and shall be made available at the jobsite. Upon completion of the work, all records and certifications regarding testing shall be submitted to ENGINEER before final payment is made.
7. Verify systems are complete, flushed, and clean prior to testing. Isolate or remove components subject to damage or not rated for test pressure. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. Leave piping uninsulated, uncovered, and unconcealed until it has been tested. Where any portion of piping system must be concealed before completion of entire system, the portion shall be tested separately as specified for the entire system prior to concealment. CONTRACTOR shall expose all untested covered or concealed piping.
8. Gauges used for testing shall have increments as follows:
  - a. Tests requiring a pressure of 10 psi or less shall use a testing gauge having increments of 0.10 psi or less.
  - b. Tests requiring a pressure of greater than 10 psi but less than or equal to 100 psi shall use a testing gauge having increments of 1 psi or less.
  - c. Tests requiring a pressure of greater than 100 psi shall use a testing gauge having increments of 2 psi or less.
9. Separately test above- and belowground piping.
10. Do not introduce test water into piping systems when exposure to freezing temperatures is possible.

11. Do not introduce test water into sections of piping located above existing sensitive areas and/or equipment that may be damaged or contaminated by water leakage. Coordinate with OWNER to determine areas and/or equipment considered as being sensitive.
12. Defective work or material shall be reworked and replaced and test repeated. Repairs shall be made with new materials. Pipe dope, caulking, tape, dresser couplings, etc., shall not be used to correct deficiencies.
13. CONTRACTOR shall be responsible for cleaning up any leakage during flushing, testing, repairing, and disinfecting to the original condition any building parts subjected to spills or leakage.
14. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Backfill underground pressure mains prior to testing with the exception of thrust restrained valves that may be exposed to isolate potential leaks.
15. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.
16. For air or nitrogen tests, gradually increase the pressure to not more than one-half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. System will not be accepted until it can be demonstrated that there is no measurable loss of test pressure during the test period.

B. Domestic Water System:

1. Subject piping system to a hydrostatic pressure of at least 100 pounds per-square-inch gauge, but not less than the operating pressure under which it is to be used. During test period, all pipe, fittings and accessories in the particular piping system that is being tested shall be carefully observed. If leaks are detected, such leaks shall be stopped and the hydrostatic test shall again be applied. This procedure shall be repeated until no leaks are detected. EXCEPTION: Piping located above sensitive areas and/or equipment that may be damaged or become contaminated due to test water leakage shall be tested with oil-free air in lieu of water.
2. After completion of the testing, all new and/or altered water piping systems shall be thoroughly sterilized with a solution containing not less than 50 parts per million of available chlorine. Do not exceed 150 parts per million at any time. Introduce chlorine into the supply stream at a rate sufficient to provide a uniform concentration throughout the system. All outlets shall be opened and closed several times. When the specified level of chlorine is detected at every outlet in the system, close all valves to prevent release of water from the system for 24 hours. At the completion of the 24-hour disinfection period, test every outlet for a minimum chlorine residual of 50 parts per million. This minimum residual must be present to proceed with flushing. Flush the system with clean water at a sufficient velocity until the residual chlorine detected at every outlet is within 0.2 parts per million or the normal water supply's level.
3. Sufficient samples must be taken no sooner than 24 hours after sterilization and flushing to represent the extent and complexity of the affected water system, along with a control sample to indicate municipal water quality at the time of testing. Send water samples to an accredited and/or certified laboratory to perform qualitative and quantitative bacteriological analysis in accordance with AWWA C651 or in accordance with Plumbing Code. CONTRACTOR shall obtain written certification from the independent testing agency stating that the water samples meet federal and state guidelines for safe drinking water. Failure to fully comply with the above procedures will result in a requirement to repeat the procedure until acceptable results are achieved, at no additional cost to OWNER.

4. Isolate or bypass equipment that would be detrimentally affected by disinfecting solution. Isolate all other sections of the domestic water system not being disinfected to prevent migration of chlorine.
5. Prior to injection of chlorine into the piping system, strategically place signs stating "Heavily Chlorinated Water-Do Not Drink," and protect all outlets to prevent use during disinfection and flushing procedures.
6. A bacteria test may not be necessary for small scale work. However, disinfection is required. Examples of small scale work are less than 20 feet of pipe, replacement and/or installation of a sink, drinking fountain, eyewash, backflow preventer, isolation valve, etc. Disinfect individual parts, fixtures, isolation valves, pipes, etc. by swabbing with full strength bleach (5.25%) or soaking for at least 30 minutes in a 500-ppm chlorine solution. Materials should then be thoroughly rinsed before putting into service.

| System                                   | Test Medium | Pressure | Final Test Duration |
|------------------------------------------|-------------|----------|---------------------|
| Belowground Domestic or Nonpotable Water | Water       | 200 psig | 2 hours             |

END OF SECTION

SECTION 22 11 23  
DOMESTIC WATER PUMPS

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included: Domestic water pumps.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within this specification.

1.03 QUALITY ASSURANCE

- A. Field inspection and testing to be performed under provisions of Section 01 45 00—Quality Control.
- B. Inspect completed installation for physical damage.
- C. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as noted on the drawings.
- D. Electrical components shall be UL listed for the service specified.
- E. Electrical components and work shall be in accordance with the National Electrical Code.

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification. Include plans, elevations and sections.
- C. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.
- D. Submittal shall include pump-specific performance curves showing flow, head and motor horsepower.

- E. Submit manufacturer's installation instructions and recommendations.
- F. Submittals must be specific to this project. Generic submittals will not be accepted.
- G. Hanging and support requirements should follow the recommendations in the manufacturer's installation instructions.
- H. Provide detailed control wiring diagrams as well as all external connections.

#### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.
- F. Motors, shafts and bearings shall be protected from weather and dust.

#### 1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule and activities.

#### 1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from Substantial Completion of the project.

### PART 2-PRODUCTS

#### 2.01 IN-LINE CENTRIFUGAL PUMPS

- A. Acceptable manufacturers are Bell and Gossett, or equal.
- B. Type: Horizontal, single stage, oil lubricated in-line pumps, 150 psig maximum working pressure at operating temperature of 203°F continuous. The manufacturer shall certify all pump ratings. All pumps shall operate without excessive noise or vibration.
- C. All products in contact with potable water shall be NSF 61/NSF 372 certified. Documentation of compliance shall be provided in the shop drawing.

- D. Casing: Lead-free brass, 1/2-inch FNPT suction and discharge connection.
- E. Impeller: Noryl/PPO, keyed to the shaft, single suction enclosed type, hydraulically and dynamically balanced.
- F. Bearings shall be Carbon/Alumina Ceramic and lubricated by circulating fluid.
- G. All other wetted parts shall be type 316 stainless steel.
- H. Electrical: Pump shall be suitable for 120V, 60 HZ operation. Pump shall come pre-wired with a 6-foot electrical plug connection. Motor shall include automatic overload protection and low in-rush current.
- I. Control: Pump shall be controlled by adjustable thermostat that is integral to the pump. Thermostat shall be programmed for on/off function and be adjustable from 70°F to 155°F.
- J. Motor: Pump motor shall be spherical permanent magnet electrically commutated motor (ECM). Motor shall be non-overloading and shall have built in overload protection. Motor shall be constant speed.

### PART 3-EXECUTION

#### 3.01 INSTALLATION

- A. Install plumbing equipment where indicated in accordance with manufacturer's recommendations. Coordinate equipment location with piping, conduit, and equipment of other trades to allow sufficient clearances. Locate equipment and arrange plumbing piping to provide access space for servicing all components.
- B. Connect equipment to water piping using unions or flanges and isolation valves. Pump shall be supported separately from piping.
- C. Startup and test equipment adjusting operating and safety controls for proper operation.
- D. Lubricate pumps before startup. Adjust pumps for rated flow. Clean and blowdown strainers after 8 hours of operation.

END OF SECTION

## SECTION 22 13 16

### SANITARY WASTE AND VENT PIPING

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: All plumbing pipe and pipe fittings for this project within and up to 5 feet from the building foundation wall.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work under this section.

##### 1.02 QUALITY ASSURANCE

- A. Quality assurance shall be in accordance with Section 01 45 00—Quality Control.
- B. Order all copper, cast iron, steel, PVC, and polyethylene pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.
- C. Any installed material not meeting the specification shall be replaced with material that meets these specifications without additional cost to OWNER.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. CONTRACTOR shall provide schedule indicating the ASTM or CISPI specification number of the pipe being proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.
- C. CONTRACTOR shall provide statement from manufacturer on manufacturer's letterhead that pipe furnished meets the ASTM or CISPI specification contained in this section.

##### 1.04 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to review that the material is undamaged and complies with specifications.
- B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, aboveground packaging.
- C. Offsite storage agreements will not relieve CONTRACTOR from using proper storage techniques.



- D. Storage and protection methods must allow observation to verify products.

#### 1.05 DESIGN CRITERIA

- A. Use only new material, free of defects, rust, and scale, and meeting the latest revision of ASTM or CISPI specifications as listed in this specification.
- B. Construct all piping for the highest pressures and temperatures in the respective system.
- C. Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in ventilation plenum spaces, including plenum ceilings.
- D. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.

### PART 2-PRODUCTS

#### 2.01 SANITARY WASTE AND VENT

- A. Aboveground PVC shall not be used where smoke generation, noise transmission, or physical abuse/durability are an issue.
- B. Interior Above Ground, Gravity: PVC plastic pipe, Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
- C. Interior Below Ground, Gravity: PVC plastic pipe, Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.

### PART 3-EXECUTION

#### 3.01 GENERAL

- A. Install pipe and fittings in accordance with reference standards, manufacturers recommendations and recognized industry practices.

#### 3.02 PREPARATION

- A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

#### 3.03 ERECTION

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

- B. Where copper or steel piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.
- C. Maintain piping in clean condition internally during construction.
- D. Provide clearance for installation of insulation, access to valves and piping specialties.
- E. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- F. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.
- G. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

#### 3.04 WELDED PIPE JOINTS

- A. Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and State Codes where applicable. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half the diameter of the main.

#### 3.05 THREADED PIPE JOINTS

- A. Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

#### 3.06 SOLVENT WELDED PIPE JOINTS

- A. Install in accordance with ASTM D2855 "Making Solvent Cemented Joints With PVC Pipe and Fittings." Saw cut piping square and smooth. Tube cutters may be used if they are fitted with wheels designed for use with PVC/CPVC pipe that do not leave a raised bead on pipe exterior. Support and restrain pipe during cutting to prevent nicks and scratches. Bevel ends 10-15 degrees and deburr interior. Remove dust, drips, moisture, grease and other superfluous materials from pipe interior and exterior. Check dry fit of pipe and fittings. Reject materials which are out of round or do not fit within close tolerance. Use heavy body solvent cement for large diameter fittings.
- B. Maintain pipe, fittings, primer, and cement between 40 and 100 degrees during application and curing. Apply primer and solvent using separate daubers (3-inch and smaller piping only) or clean natural bristle brushes about half the size of the pipe diameter. Apply primer to the fitting socket and pipe surface with a scrubbing motion. Check for penetration and reapply as needed to dissolve surface to a depth of 4 to 5 thousandths. Apply solvent cement to the fitting socket and pipe in an amount greater than needed to fill any gap. While both surfaces are wet, insert pipe into socket fitting with a quarter turn to the bottom of the socket. Solvent cement application and insertion must be completed in less than 1 minute. Minimum of 2 installers is required on piping 4 inches and larger. Hold joint for 30 seconds or until set. Reference manufacturer recommendations for initial set time before handling and for full

curing time before pressure testing. Cold weather solvent/cement may be utilized only under unusual circumstances and when specifically approved by OWNER.

### 3.07 PUSH-ON GASKETED PIPE CONNECTIONS

- A. Clean pipe end, bell, gasket seat and gasket of dirt or debris. Coat end of pipe and gasket with gasket lubricant. Pipe shall be supported off the ground so lubricant does not pick up dirt. Push spigot end into gasket bell with levered pipe joining tool recommended by pipe manufacturer. Large diameter exterior mains may be joined by pushing end of pipe section with backhoe against wood blocking over pipe end. Insert to fully seated position or to reference mark on pipe.

### 3.08 SANITARY WASTE AND VENT

- A. Verify invert elevations and building elevations prior to installation. Install exterior piping pitched to drain at indicated elevations and slope. Install interior piping pitched to drain at minimum slope of 1/4-inch per foot where possible and in no case less than 1/8-inch per foot for piping 3 inches and larger.
- B. Install exterior piping below predicted frost level and not less than 5-foot bury depth to top of pipe wherever possible. Where piping is located above predicted frost level, provide frost protection in accordance with SPS 382.30(11)(c).
- C. Flush piping inlets (floor drains, hub drains, mop basins, fixtures, etc.) with high flow of water at completion of project to demonstrate full flow capacity. Remove blockages and make necessary repairs where flow is found to be impeded.

### 3.09 PIPING SYSTEM LEAK TESTS

- A. Drainage and Vent System:
  - 1. Subject gravity drainage and vent piping and joints to a test pressure and duration as outlined in the schedule at the end of this section. If, at end of indicated test duration, the level of the water has been lowered by leakage, the leaks must be found and stopped and the water level shall again be raised to the level described and the test repeated until, after another test duration period, there shall be no perceptible lowering of the water level in the system being tested.
  - 2. Piping located above sensitive areas and/or equipment that may be damaged or become contaminated because of test water leakage shall be tested with air. Air test may also be performed when allowed by ENGINEER. Isolate the test section from all other sections and slowly fill pipe with oil-free air until there is a uniform gauge pressure of 5 pounds per square inch. The air pressure shall be regulated to prevent the pressure inside the pipe from exceeding 5.0 psig. This pressure shall be held for a test period of at least 15 minutes. Any adjustments to the test pressure required because of changes in ambient temperature or the seating of gaskets shall be made prior to the beginning of the test period.
  - 3. Should the completion of these tests leave any reasonable question of a doubt relative to the integrity of the installation, additional tests or measures shall be performed to demonstrate the reliability of these systems to ENGINEER.
  - 4. Test plugs must extend outside the end of pipe to provide a visible indication for removal after the test has been completed.

5. Each floor drain P-trap that has successfully passed pressure testing shall be proven clean and free of debris as follows:
    - a. A request shall be submitted to OWNER, identifying the quantity and location of drain(s) to be observed.
    - b. Vacuum out each floor drain P-trap. An observation of the trap shall be performed to verify that the trap is debris free.
    - c. Perform a free-flowing test by pouring two 5-gallon buckets of water down the floor drain.
    - d. After confirming that the floor drain trap is clean and free of debris, review that the trap is filled with water.
    - e. At the discretion of ENGINEER, an observation of the trap using a sewer scope may be required in addition to, or in lieu of, a vacuum procedure.
  6. OWNER may require that any portion of the drainage, waste, and vent systems installed be proven undamaged, clean and free of debris. Verification of the interior condition of piping shall be accomplished using a sewer scope or other method as acceptable to ENGINEER.
- B. Isolate or remove components from system which are not rated for test pressure. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.
  - C. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints.
  - D. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.
  - E. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will not be acceptable.
  - F. Entire test shall be witnessed by OWNER or ENGINEER.

| System                  | Test Medium | Final Test    |          |
|-------------------------|-------------|---------------|----------|
|                         |             | Pressure      | Duration |
| Sanitary Waste and Vent | Water       | 10 feet water | 2 hours  |

END OF SECTION

## SECTION 22 13 19

### SANITARY WASTE PIPING SPECIALTIES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: This section includes specifications for floor drains, cleanouts, and other miscellaneous plumbing specialties.
- B. Related Sections and Divisions: Applicable provisions of Division 01 govern work under this section.

##### 1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references.

##### 1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session. New start-up shall be for the purpose of determining alignment, lubrication, voltage, and amperage readings. New start-up shall confirm all proper electrical connections and discharge and suction gauge readings. A copy of the start-up report shall be made and sent to both CONTRACTOR and to ENGINEER.

##### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.
- C. Submittals for motors associated with equipment specified in this section shall include data sheets from the motor manufacturer. Data sheets from the equipment manufacturer or supplier are not acceptable.
- D. Submit manufacturer's installation instructions.
- E. Submittals must be specific to this project. Generic submittals will not be accepted.

## 1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

## 1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule and activities.
- B. Include replacement and spare parts lists.

## 1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

# PART 2-PRODUCTS

## 2.01 FLOOR DRAINS (FD)

- A. All floor drains shall be furnished and installed with all options and accessories required for a leak-free installation within the particular construction in which they are to be mounted.
- B. FD-1: Floor drains in unfinished areas for piping 4 inches and under shall be Zurn ZN-550, Wade 1100-AX, or Josam 30900-9AD, and for piping larger than 4 inches Zurn ZN-505, Wade W-1240-1, or Josam 32200-1. Provide nickel bronze grate.
- C. FD-2: PP Floor Drain: Provide Floway Series F1000 floor drain with polypropylene body with bottom outlet, polypropylene combination membrane clamp, and sediment bucket. Provide with polypropylene P-trap and 3 feet 0 inch of polypropylene pipe. Transition to building drainage system with coupling system.
- D. Each drain shall be provided with a trap. A minimum of one cleanout shall be provided for each single or common leader.

## 2.02 TRAP GUARDS

- A. Manufacturer: ProSet Systems Trap Guard, Jay R. Smith Quad Close, Sure Seal or approved equal.
- B. Flexible elastomeric PVC construction diaphragm trap guard for installation in new floor drains. Trap guard to prevent trap evaporation and waste backflow. Size as applicable to the drain outlet size, up to 4-inch size.

## 2.03 CLEANOUTS

- A. Manufacturers shall be Zurn, Wade, Jay R. Smith, Josam, or Kusel.
- B. Each cleanout shall be gas- and watertight.
- C. FCO-1 (Interior Concrete Floor Areas): Enameled cast iron body with round or square adjustable scoriated polished nickel bronze cover, tapered threaded ABS closure plug. Zurn ZN-1400.
- D. FCO-2 (Interior Floor Areas): All Type 304 stainless steel cleanout body and plug with O-ring seal. Provide NSF certification with a load classification of Extra Heavy Duty based on ASME A112.36.2M with a load rating of between 7,500 and 10,000 lbs. ZURN Z1745, Kusel KEC Series, or equal.

## PART 3—EXECUTION

### 3.01 INSTALLATION

- A. Coordinate location and setting of plumbing specialties with adjacent construction. Install in accordance with manufacturers recommendations.
- B. Set floor drains and cleanouts level and plumb adjusted to finished floor elevation. Locate where serviceable. Allow a minimum 18-inch clearance around cleanouts for rodding. Lubricate threaded cleanout plugs with graphite and oil, teflon tape, or waterproof grease. Install trap primer connections where indicated.
- C. Trap guards shall be provided as indicated on the Drawings.

END OF SECTION

SECTION 22 30 00  
PLUMBING EQUIPMENT

PART 1–GENERAL

1.01 SCOPE

- A. This section includes specifications for water heaters and other equipment used for plumbing applications.
- B. Related Sections and Division: Applicable provisions of Division 01 shall govern work under this section.

1.02 QUALITY ASSURANCE

- A. Field inspection and testing to be performed under provisions of Section 01 45 00–Quality Control.
- B. Inspect completed installation for physical damage.

1.03 SHOP DRAWINGS

- A. Submit under provisions of Section 01 33 00–Submittals. Included in submittals shall be detailed control wiring diagrams that show logic circuits for the unit, as well as all external connections.

PART 2–PRODUCTS

2.01 WATER HEATERS

- A. Power Vented Gas Fired Water Heater (WH-01):
  - 1. Manufacturers: A.O. Smith, Bradford White, and Lochinvar.
  - 2. Type: Power vented natural gas fired atmospheric storage water heater. Design to be UL listed with 1 year commercial tank and parts warranty.
  - 3. Water heater performance shall be as listed on Drawings.
  - 4. Tank: Steel glass lined tank rated for 160 psig complete with powered anodes, polyurethane foam insulation, drain valve, and temperature and pressure relief valve.
  - 5. Burner: Construct burner of cast iron, aluminized steel (natural gas only) or stainless steel.
  - 6. Controls: 120-volt, single-phase, 60 Hz controls, integral diagnostics, graphic user interface, fault history display, and digital temperature readout.
  - 7. Power Direct Vent: Schedule 40 CPVC with DWV solvent weld fittings with weatherproof screened outlet tee or elbow as recommended by manufacturer. Provide A.O. Smith concentric vent kit, or equal.
- B. Electric Instantaneous Water Heater (IWH-01):
  - 1. Manufacturers: Eemax (E), or equal.
  - 2. Type: Wall-mounted, tankless, UL listed, instantaneous electric water heater with digital microprocessing temperature control capable of maintaining outlet temperature of one



degree accuracy, LED temperature display, 150 psig pressure rating. Model SPEX3208T.

3. Water heater performance shall be as listed on Drawings.
4. Element shall be replaceable cartridge insert nickel chrome material.
5. Accessories:
  - a. Provide Watts LFTWH, or equal, tankless water heater service valve. Pipe service, shutoff, drain, and relief valves in accordance with manufacturer's recommendations. Service valve installation shall include provisions for water heater purge and vinegar wash. Hot side: Watts LFTWH-UT/UTS-H-RV, or equal. Cold side: Watts LFTWH-UT/UTS-C, or equal.
  - b. Set pressure relief valves in accordance with local regulations.

## 2.02 EXPANSION TANKS

- A. Manufacturer: Amtrol, Bell and Gossett, Wessels.
- B. Vertical steel precharged hydro-pneumatic expansion tank, 125 psi construction, complete with replaceable flexible butyl rubber bladder, system connection fitting, Schrader type air charge fitting, steel base ring stand, factory prime and enamel painted exterior finish. Materials exposed to water to be NSF or FDA approved for potable water service.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Install plumbing equipment where indicated in accordance with manufacturer's recommendations. Coordinate equipment location with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. Locate equipment and arrange plumbing piping to provide access space for servicing all components.
- B. Set commercial water heaters, commercial water softeners, and storage tanks on concrete housekeeping pads. Adjust and level equipment.
- C. Connect equipment to water and drain piping using unions or flanges and isolation valves.
- D. Size temperature and relief valves per CSA ratings. Pipe temperature and pressure relief valves to floor drain or floor as indicated.
- E. Startup and test equipment adjusting operating and safety controls for proper operation.
- F. Adjust expansion tank precharge to scheduled minimum operating pressure prior to connecting to system.
- G. Provide isolation valves at plumbing equipment.

END OF SECTION

## SECTION 22 42 00

### COMMERCIAL PLUMBING FIXTURES

#### PART 1—GENERAL

##### 1.01 SCOPE

- A. This section includes specifications for plumbing fixtures, faucets, and trim.

##### 1.02 REFERENCE

- A. Applicable provisions of Division 01 shall govern work under this section.

##### 1.03 QUALITY ASSURANCE

- A. Substitution of Materials: Refer to Section GC—General Conditions of the Contract, Equals and Substitutions.
- B. Plumbing products requiring approval by the State of Wisconsin Department of Safety and Professional Services must be approved or have pending approval at the time of shop drawing submission.

##### 1.04 SHOP DRAWINGS

- A. Include data concerning sizes, utility sizes, rough in-dimensions, capacities, materials of construction, ratings, weights, trim, finishes, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.

##### 1.05 ENERGY EFFICIENCY REQUIREMENTS

- A. Plumbing fixtures must meet the following maximum water usage requirements which are based upon Federal Energy Management Program (FEMP) performance requirements.
  - 1. Lavatory Faucets: Flow of 2 gpm or less and .25 gallon per cycle or less (based on inlet pressure of 60 psi.)
  - 2. Urinal Flush Valves: 1.0 gallon per flush or less.
  - 3. Water Closet Flush Valves: 1.6 gallons per flush or less.

#### PART 2—PRODUCTS

##### 2.01 PLUMBING FIXTURES

- A. Manufacturers: Fixture descriptions establish fixture type, quality, materials, features, and size. Products of the following manufacturers determined to be equal by ENGINEER will be accepted.
  - 1. Water Closets: American Standard, Kohler, Zurn.
  - 2. Water Closet Seats: Bemis, Beneke, Centoco, Olsonite Sperzel.
  - 3. Lavatories: American Standard, Kohler, Zurn.
  - 4. Faucets: Chicago Faucet, Kohler, or Zurn.
  - 5. Service Sinks: American Standard, Crane, Kohler.

6. Emergency Eyewash Fountains and Showers: Bradley, Guardian, or Haws.
  7. WC-1: Floor mount bottom outlet white vitreous china siphon jet water closet with elongated bowl, 1 1/2-inch top spud, 2 1/4-inch passageway, 16 1/2-inch rim height and 1.6-gallon flush. Flush valve handle 13 inches above rim, located to the wide side of the stall and be ADA compliant for activation force.
    - a. Fixture: Kohler Highcliff Ultra K-96057.
    - b. Flush Valve: Sloan UpperCut WES 111.
    - c. Seat: Bemis 1655-SS/C white solid plastic open front seat.
- B. Lavatories (L-1): K-2030 (20-inch by 18-inch), A 0356.015, wall-hung with pop-up drain, supplies, and cast iron hanger. Provide ADA-approved faucets. Faucet: Provide ADA-approved, Chicago Faucet 404-317ABCP, or equal, with 2.2 gpm vandalproof spray and polished chrome-plated solid brass construction.
- C. Service Sinks (SS-1): K 6719 (24-inch by 20-inch), A 7692.023, with Chicago Faucets 835-SFB for supplies from below exposed on wall as in well pump stations, fittings, wall brace, and wall hangers. Faucet shall include cross-connection prevention device.
- D. Emergency Showers:
1. Manufacturers: Bradley (B), Guardian (G), Haws (H), or equal.
  2. Unit shall be hydrostatically tested to meet or exceed ANSI Z358.
  3. All units shall be identified with a high-visibility sign made from rigid polyethylene, Brady B-450, V-style 45-degree, 12-inch by 18-inch Brady 49043/49044, or equal. Provide one sign at each unit.
  4. EEWS-1: Corrosion-resistant safety station with ABS plastic shower head, ABS plastic bowl, cast aluminum powder-coated flag handle, PVC floor flange, 2-inch IPS Schedule 80 PVC pipe and fittings, 1-inch IPS and 1/2-inch IPS U.S.-made PVC-coated brass stay-open ball valve, and polished stainless steel pull rod. Unit shall have two polypropylene "GS" spray heads with integral "flip-top" dust covers, strainer, and 1.8 gpm flow control orifice mounted on chrome stainless steel head assembly, Model No. (B) S19-310PVC, (G) G1992, or (H) 8336.
  5. TMV-1: Thermostatic mixing valve with temperature override protection set for 85°F valve for emergency shower. Unit shall include built-in cold water bypass, thermostatic control valve, rough brass finish, solid bimetal thermostat, limit stop factory set for 90°F, integral check stops, dial thermometer. Unit shall be ASSE 1071 rated. Performance: Unit shall have a flow range of 0.5 gpm to 50 gpm with a maximum pressure loss of 30 psi, Model No. (G) G6040, or equal.

## PART 3—EXECUTION

### 3.01 INSTALLATION

- A. Install plumbing fixtures in accordance with manufacturer's instructions. Set level and plumb. Secure in place to counters, floors and walls providing solid bearing and secure mounting. Bolt fixture carriers to floor and wall. Secure rough-in fixture piping to prevent movement of exposed piping.
- B. Install each fixture with trap easily removable for servicing and cleaning. Install fixture stops in readily accessible location for servicing.
- C. Install barrier free fixtures in compliance with IBC 1108 and 3408, COMM 52, 69 and Federal ADA Accessibility Guidelines. Install barrier free lavatory traps parallel and adjacent

to wall and supplies and stops elevated to 27 inches above floor to avoid contact by wheelchair users.

- D. Each fixture shall have a stop valve installation to control the fixture. Stop valves shall be heavy duty type with brass stems and screwed or sweat inlet connections. Compression type inlets are not acceptable.
- E. Cover pipe penetrations with escutcheons. Exposed traps, stops, piping and escutcheons to be chrome plated brass, same items in concealed locations may be of rough brass finish.
- F. Set floor mounted water closets with full setting bed of flexible non-staining plumber's putty. Cover exposed water closet bolts with bolt covers.
- G. Seal openings between walls, floors and fixtures with mildew-resistant silicone sealant same color as fixture.
- H. Test fixtures to demonstrate proper operation. Replace malfunctioning units or components. Adjust valves for intended water flow rate to fixtures without splashing, noise or overflow.
- I. Protect fixtures during construction. At completion clean plumbing fixtures and trim using manufacturer's recommended cleaning methods and materials.

END OF SECTION

## SECTION 23 05 23

### GENERAL-DUTY VALVES FOR HVAC PIPING

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Valve specifications for all Division 23 systems unless otherwise noted.
- B. Related Section and Divisions: Applicable provisions of Division 01 govern work under this section.

##### 1.02 SUBMITTALS

- A. Submit product data under provisions of Section 01 33 00—Submittals.
- B. CONTRACTOR shall submit a schedule of all valves indicating type of service, dimensions, materials of construction, and pressure/temperature ratings for all valves to be used on the project. Temperature ratings specified are for continuous operation.

##### 1.03 OPERATION AND MAINTENANCE DATA

- A. All operations and maintenance data shall comply with the submission and content requirements specified under Section 01 33 00—Submittals.

##### 1.04 DESIGN CRITERIA

- A. Where valves are specified for individual mechanical services (i.e., hot water heating, steam, etc.) all valves shall be of the same manufacturer.

#### PART 2—PRODUCTS

##### 2.01 GENERAL

- A. Manufacturers: Acceptable manufacturers are Apollo, Bell & Gossett, Crane, Danfoss-Flomatic, DeZurik, Fisher, Grinnell, Jamesbury, Milwaukee, Nibco, Vogt, Watts.

##### 2.02 NATURAL GAS SYSTEM

- A. Interior Shutoff Valves: 2-Inch and Smaller: Ball valve, bronze body, threaded ends, chrome-plated bronze or stainless steel ball, full or conventional port, Teflon seat, blowout-proof stem, two-piece construction, suitable for 150 psig working pressure. U.L. listed for use as natural gas shut-off. Manufacturers Apollo 77G-UL, Nibco T-585-70-UL, Crane 9201.
- B. Exterior Aboveground Shutoff Valves: Black body, brass plug type with square head, top check and lock wing stop lock, threaded ends for 25 psi or less gas pressure requirements, McDonald No. 10687B, or equal.

- C. Pressure Regulators:
1. Manufacturers: Rockwell, Maxitrol, Fischer, or equal.
  2. All pressure regulators shall be designed, manufactured and approved for natural gas service.
  3. Pressure regulators for individual service lines shall be capable of reducing distribution line pressure to pressures required for users. Pressure relief shall be set at a lower pressure than would cause unsafe operation of any connected user. Regulator shall have a single port with orifice diameter no greater than that recommended by manufacturer for the maximum gas pressure at the regulator inlet. Regulator vent valve shall be of resilient materials designed to withstand flow conditions when pressed against valve port. Regulator shall be capable of limiting buildup of pressure under no-flow conditions to 50% or less of the discharge pressure maintained under flow conditions. Provide commercial-grade diaphragm type with internal relief valve, vent valve, cast iron body, and Buna-N diaphragm.
  4. Pressure regulators indicated to be installed on gas piping exceeding 2 psig shall be provided with a tested and approved, integral overpressure protection device (OPD). Pressure regulators and OPD shall comply with ANSI Z21.80 (line regulators) or ANSI Z21.18 (appliance regulators).
  5. Appliance regulators may be provided with a vent limiting device, where entire regulator and vent limiter complies with ANSI Z21.80 as an assembly and is installed in accordance with manufacturer's recommendations and NFPA 54.

## PART 3—EXECUTION

### 3.01 GENERAL

- A. Properly align piping before installation of valves in an upright position; operators installed below the valves will not be accepted.
- B. Install valves in strict accordance with valve manufacturer's installation recommendations. Do not support weight of piping system on valve ends.
- C. Install all valves with the stem in the upright position. Valves may be installed with the stem in the horizontal position only where space limitations do not allow installation in an upright position or where large valves are provided with chain wheel operators. Where valves 2 1/2-inch and larger are located more than 12-foot 0-inch above mechanical room floors, install valve with stem in the horizontal position and provide a chain wheel operator. Valves installed with the stems down, will not be accepted.
- D. Install stem extensions when shipped loose from valve.
- E. Prior to flushing of piping systems, place all valves in the full-open position.
- F. Install all valves, and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.
- G. Install valves for shutoff and to isolate equipment, parts of systems, or vertical risers. All valves shall be located such that servicing and operation is possible with adequate clearance for access. Install line shutoff valve at each branch connection to riser. Branch line shutoff

valves shall be automatic type where shown on Drawings. Install valves with stems upright or horizontal, not inverted unless required otherwise by the valve manufacturer.

- H. Valves, regulators, flanges, unions, and similar appurtenances shall be accessible for operation and servicing and shall not be located within chases, above ceilings, within walls/partitions, or nonaccessible locations.
- I. Identify all gas regulators, including utility-provided regulators, in accordance with Section 20 05 53—Identification for Fire Suppression, Plumbing and HVAC Piping and Equipment.
- J. Locate all valves so that the removal of their bonnets is possible. All flanged valves in horizontal lines with the valve stem in a horizontal position shall be positioned so that the valve stem is inclined one bolt hole above the horizontal position. Screw pattern valves placed in horizontal lines shall be installed with their valve stems at a minimum 30-degree angle above the horizontal position. All valves must be true and straight at the time the system is tested and inspected for final acceptance. Install valves as close as possible to the locations indicated on the Drawings. Any change in valve location must be so indicated on the Record Drawings.
- K. Shut-Off Valves: Install shut-off valves at all equipment, at each branch take-off from mains, and at each automatic valve for isolation or repair.
- L. Balancing Valves: Provide balancing valves for all major equipment, at each major branch takeoff, and at the discharge of each pump as indicated on Drawings and details.
- M. Safety Relief Valves:
  - 1. Gas vent discharge lines as indicated on the Drawings, as detailed, and as specified for each specific valve or piping specialty item. In no event is a termination to occur less than 6 feet above a roof line. Each gas pressure reducing valve vent and relief valve vent shall be run separately to a point outside of the building, terminated with a screened vent cap, and located according to gas utility regulations.
  - 2. Pipe vents from gas pressure reducing valves and pipe casing sleeves to the exterior of the building and terminate with outlet turned down and capped with corrosion resistant insect screen. Vent terminations shall be at least 7 feet abovegrade or pedestrian traffic and a minimum of 3 feet above or 10 feet horizontally from all air intakes or building openings. Provide stainless steel insect screens on vent outlets.
- N. Gas Pressure Regulators: When the gas pressure regulator is equipped with a vent connection, run a connection size vent to outside air in accordance with codes. Use a larger size vent when required by the manufacturer's installation instructions.

END OF SECTION

## SECTION 23 05 29

### HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

#### PART 1—GENERAL

##### 1.01 SCOPE

- A. This section includes specifications for supports of all HVAC piping and equipment and materials as well as piping system anchors.

##### 1.02 RELATED WORK

- A. Section 23 07 13—Ductwork Insulation for Heating, Ventilation, and Air Conditioning.

##### 1.03 REFERENCE

- A. Applicable provisions of Division 01 shall govern work under this section.

##### 1.04 REFERENCE STANDARDS

- A. MSS SP-58—Materials, Design, Manufacture, Selection, Application, and Installation

##### 1.05 DESCRIPTION

- A. Provide all supporting devices as required for the installation of mechanical equipment and materials. All supports and installation procedures are to conform to the latest requirements of the ANSI Code for pressure piping.
- B. Do not hang any mechanical item directly from a metal deck or run piping so it rests on the bottom chord of any truss or joist.
- C. Support apparatus and material under all conditions of operation, variations in installed and operating weight of equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.
- D. Protect insulation at all hanger points; see Related Work above.

##### 1.06 SHOP DRAWINGS

- A. Refer to Division 01, General Conditions, Submittals.
- B. Schedule of all hanger and support devices indicating shields, attachment methods, and type of device for each pipe size and type of service.

##### 1.07 DESIGN CRITERIA

- A. Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58, unless noted otherwise.



- B. Piping connected to base mounted pumps, compressors, or other rotating or reciprocating equipment is to have vibration isolation supports for a distance of one hundred pipe diameters or three supports away from the equipment, whichever is greater. Standard pipe hangers/supports as specified in this section are required beyond the 100 pipe diameter/3 support distance.
- C. Piping flexible connections and vibration isolation supports are required for piping connected to coils that are in a fan assembly where the entire assembly is mounted on vibration supports; the vibration isolation supports are required for a distance of one hundred pipe diameters or three supports away from the equipment, whichever is greater. Piping flexible connection and vibration isolation supports are not required when the fan section is separately and independently isolated by means of vibration supports and duct flexible connections. Standard pipe hangers/supports as specified in this section are required when there are no vibration isolation devices in the piping and beyond the 100 pipe diameter/3 support distance.
- D. Fasteners depending on soft lead for holding power or requiring powder actuation will not be accepted.
- E. Allow sufficient space between adjacent pipes and ducts for insulation, valve operation, routine maintenance, etc.

## PART 2-PRODUCTS

### 2.01 PIPE HANGER AND SUPPORT MANUFACTURERS

- A. Acceptable manufacturers include Anvil, B-Line, G-Strut, Fee and Mason, Kindorf, Michigan Hanger, Unistrut, or approved equal. Anvil figure numbers are listed below; equivalent material by other manufacturers is acceptable.

### 2.02 STRUCTURAL SUPPORTS

- A. Provide all supporting steel required for the installation of mechanical equipment and materials, whether or not it is specifically indicated or sized, including angles, channels, beams, etc. to suspend or floor support tanks and equipment.

### 2.03 PIPE HANGERS AND SUPPORTS

- A. Hangers For Steel Pipe Sizes 1/2-Inch Through 2 Inches: Carbon steel, adjustable, clevis, black finish. Anvil figure 65 or 260.
- B. Adjustable steel yoke, cast iron roll, double hanger. Anvil figure 181.
- C. Wall Support:
  1. Welded steel bracket with hanger. B-Line B3068 Series, Anvil 194 Series.
  2. Perforated epoxy painted finish, 16-12 gauge min., steel channels securely anchored to wall structure with interlocking, split type, bolt secured, galvanized pipe/tubing clamps. B-Line type S channel with B-2000 series clamps, Anvil type AS200 H with AS 1200 clamps. When copper piping is being supported, provide flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the channel or clamp, equal to B-Line B1999 Vibra Cushion or

provide manufacturers clamp and cushion assemblies, B-Line BVT series, Anvil cushion clamp assembly.

- D. Floor Support For Pipe Sizes Through 4 Inches: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.
- E. Steel Hanger Rods:
1. Continuous threaded, black finish.
  2. Size rods for individual hangers and trapeze support as indicated in the following schedule.
  3. Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, are not to exceed the limits indicated.

| Maximum Load<br>(pounds)    | Rod Diameter<br>(inches) |
|-----------------------------|--------------------------|
| (650°F Maximum Temperature) |                          |
| 610                         | 3/8                      |
| 1,130                       | 1/2                      |
| 1,810                       | 5/8                      |

4. Provide rods complete with adjusting and lock nuts.

#### 2.04 CONCRETE INSERTS

- A. Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Hilti, Rawl, Redhead.

#### 2.05 ANCHORS

- A. Use welding steel shapes, plates, and bars to secure piping to the structure.

#### 2.06 CORROSIVE ATMOSPHERE COATINGS

- A. Corrosive environments shall be as noted on the Drawings.
- B. Pipe in chemical feed rooms shall be supported with a plastic support system, Aickinstrut, or equal.

### PART 3-EXECUTION

#### 3.01 INSTALLATION

- A. Install supports to provide for free expansion of the piping system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.
- B. Piping shall be supported independently from ductwork and all other trades.
- C. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes for the supporting steel.

- D. Perform all welding in accordance with standards of the American Welding Society. Clean surfaces of loose scale, rust, paint or other foreign matter and properly align before welding. Use wire brush on welds after welding. Welds shall show uniform section, smoothness of weld metal and freedom from porosity and clinkers. Where necessary to achieve smooth connections, joints shall be dressed smooth.

### 3.02 HANGER AND SUPPORT SPACING

- A. Place a hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.
- B. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers. Provide minimum of 3 inches between piping systems (flanges, insulation, valves, etc.)
- C. Support riser piping independently of connected horizontal piping.
- D. Adjust hangers to obtain the slope specified in the piping section of this specification.
- E. Space hangers for pipe as follows:

| Pipe Material | Pipe Size           | Maximum Spacing |
|---------------|---------------------|-----------------|
| Steel         | 1/2" through 1 1/4" | 6'-6"           |
| Steel         | 1 1/2" through 6"   | 10'-0"          |
| Thermoplastic | All sizes           | 6'-0"           |
| Copper        | 1/2" through 1 1/4" | 5'-0"           |

### 3.03 ANCHORS

- A. Install where indicated on the Drawings and details. Where not specifically indicated, install anchors at ends of principal pipe runs and at intermediate points in pipe runs between expansion loops. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

END OF SECTION

## SECTION 23 05 93

### TESTING, ADJUSTING, AND BALANCING

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Balancing Air Systems.
  - 2. Thermal Performance Testing.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
  - 1. ASHRAE 11—Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air Conditioning, and Refrigeration Systems.
  - 2. SMACNA—HVAC Systems Testing, Adjusting, and Balancing.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Prior to final balancing, submit a preliminary report that includes the following design information for all control modes. Design information shall be from approved shop drawings. Report shall compare design and field tested data.
  - 1. For each supply, return and exhaust register, and ceiling outlet:
    - a. Room number.
    - b. Type of register and outlet and catalog size.
    - c. Air flow factor.
    - d. Design CFM and velocity.
    - e. Actual CFM and velocity.
    - f. Percent of design CFM.
    - g. Room pressure relationship.
  - 2. For each fan:
    - a. Unit number.
    - b. Fan size and wheel type.
    - c. Motor horsepower.
    - d. Motor nameplate voltage and amps.
    - e. Design CFM and static pressure (total pressure).
    - f. Actual CFM and static pressure (total pressure).
    - g. Actual fan RPM.
    - h. Actual motor voltage and amps (each phase).

- C. Provide summary sheet describing mechanical system deficiencies. Where not physically observable, provide pressure and/or flow readings to demonstrate suspected deficiencies. Describe objectionable noise or drafts found during testing, adjusting, and balancing. All deficiencies shall be corrected prior to final balancing.
- D. Upon completion of final balancing, provide updated report indicating thermal performance testing and changes to system during final balancing for all control modes including updated airflows, pressures, velocities, etc. Final report shall be submitted prior to substantial completion.

#### 1.04 QUALITY ASSURANCE

- A. Obtain services of an independent testing organization to perform testing and balancing work. The organization shall have a certified membership in the Associated Air Balance Council (AABC) or certification by the National Environmental Balancing Bureau (NEBB).
- B. Division 23 shall provide a technician and/or controls contractor to observe and assist in balancing the system. Balancing report must include verification of participation, including name and contact information of assisting party.

### PART 2-PRODUCTS

#### 2.01 BALANCING EQUIPMENT

- A. CONTRACTOR shall have the following minimum equipment for balancing systems:
  - 1. Duct air velocities below 1,000 fpm: Pitot tube and Micro-Manometer or Alnor velometer and duct-jet using zero to 1,000 fpm range.
  - 2. Supply Register Velocities: Alnor velometer and applicable jet or Anemotherm.
  - 3. Fan Rotative Speed: Timec tachometer or RPM counter and stop watch (1-minute reading, minimum).
  - 4. Contact pyrometer 0 to 300°F range.
  - 5. Amprobe model RS-3, or equal.
  - 6. Inclined manometer 0 to 30 inches of water.
  - 7. Instruments used for measurements shall be accurate, and calibration shall be calibrated by the manufacturer or an AABC-approved method.
  - 8. Instruments shall be applied in accordance with manufacturer's instructions.
- B. All instruments used for measurements shall be accurate, and calibration histories for each instrument to be available for examination upon request. Calibration and maintenance of all instruments to be in accordance with the requirements of NEBB or AABC Standards.

### PART 3-EXECUTION

#### 3.01 PRELIMINARY BALANCING

- A. Division 23 shall provide an experienced installer to review the air distribution system with the testing and balancing agency for completion to confirm the test openings and volume dampers indicated on the Drawings or called for in the specifications are installed, that dampers are in the open position, that the fans operate properly during all control modes, air filters are clean, and that the system is ready for balancing. Add test openings, volume

dampers, air scoops, deflectrols, turning vanes, etc., as required. Adjust and change fan drives and belts, remove and reinstall ceilings, air terminals, access doors, and air devices as required to balance the system. Maintain the air handling equipment in good operating condition during the testing and balancing procedures.

### 3.02 PRESSURE DIAGRAM

- A. Provide a diagram indicating, at minimum, the static pressure at the following points while system is operating at 100% airflow.
  - 1. EF-1 inlet and outlet.
  - 2. EF-2 inlet and outlet.
  - 3. EF-3 inlet and outlet.
  - 4. EF-4 inlet and outlet.
- B. Diagram shall include all components in an air handling unit and additional pressure points as required in thermal performance testing.
- C. Coordinate with Division 23 and equipment manufacturer to obtain readings where access is difficult or limited. Lack of readings due to inaccessibility will not be accepted.

### 3.03 SCHEDULE OF TOLERANCES

- A. Final air system measurements shall be within the following range of specified cfm:
  - 1. Fans: 0% to +10%.
  - 2. Return/exhaust grilles, registers: 0% to -10%.

### 3.04 GENERAL REQUIREMENTS

- A. Perform testing, balancing, and adjusting procedures in accordance with AABC or NEBB, unless specified below.
- B. Contact the Division 26 contractor for assistance in operation and adjustment of controls during testing, adjusting, and balancing procedures. Cycle controls and verify proper operation and setpoints. Include in report description of temperature control operation for all control modes and any deficiencies found.
- C. Permanently mark equipment settings, including damper and valve positions, control settings, and similar devices allowing settings to be restored. Set and lock memory stops.
- D. Division 23 shall correct any installation deficiencies found by the test and balance agency that were specified and/or shown on the Contract Documents to be performed as part of that division of work, including sheave and pulley replacement or corrections to the controls system. Test and balance agency shall notify CONTRACTOR of these items and instructions will be issued to Division 23 for correction of the deficient work. Testing and balancing reports shall be submitted only after all deficiencies have been corrected and balancing completed upon the corrected system.

END OF SECTION

## SECTION 23 07 13

### DUCTWORK INSULATION FOR HEATING, VENTILATION, AND AIR CONDITIONING

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Includes:
  - 1. Rigid Board Fiberglass Insulation.
  - 2. Adhesives, Mastic, Sealants, and Reinforcing Materials.
  - 3. Jacketing.
  - 4. Accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references:
  - 1. ASTM B117—Standard Practice for Operating Salt Spray (Fog) Apparatus.
  - 2. ASTM C168—Standard Terminology Relating to Thermal Insulation.
  - 3. ASTM C272—Water Absorption of Core Materials for Sandwich Constructions.
  - 4. ASTM C547—Standard Specification for Mineral Fiber Pipe Insulation.
  - 5. ASTM C518—Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - 6. ASTM C591—Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
  - 7. ASTM C612—Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
  - 8. ASTM C871—Standard Test Method for Chemical Analysis of Thermal Insulation Materials.
  - 9. ASTM C916—Standard Specification for Adhesives for Duct Thermal Insulation.
  - 10. ASTM C1071—Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
  - 11. ASTM C1290—Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
  - 12. ASTM C1427—Standard Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form.
  - 13. ASTM D1000—Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications.
  - 14. ASTM E84—Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 15. ASTM E96—Standard Test Methods for Water Vapor Transmission of Materials.
  - 16. FED L-P-535E: Plastic Sheet (Sheeting): Plastic Strip: Poly (Vinyl Chloride) And Poly (Vinyl Chloride-Vinyl Acetate), Rigid.
  - 17. EPA Method 8260B—Volatile Organic Compounds By Gas Chromatography/Mass Spectrometry (Gc/Ms).

18. NFPA 262—Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, and fitting materials, along with safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

- A. All components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect insulation before, during, and after installation.
- E. All scratched, dented, and otherwise damaged insulation shall be repaired or replaced at no additional cost to OWNER.

1.06 GENERAL REQUIREMENTS

- A. Unless otherwise indicated, all duct covering, jackets, insulation, vapor barriers, adhesive, and mastics shall have flame spread rating of 25 or less and smoke spread rating of 50 or less when tested in accordance with ASTM E84.

PART 2—PRODUCTS

2.01 RIGID BOARD FIBERGLASS INSULATION

- A. Acceptable manufacturers are Johns Manville Spin-Glas Series 814, Owens Corning Type 703, or Knauf Insulation Board.
- B. Insulation shall be mineral fiber type conforming to ASTM C612.
- C. Minimum nominal density shall be 3 lbs/ft<sup>3</sup>.
- D. K-factor shall not exceed 0.23 (btu-in)/(hr-ft<sup>2</sup>-°F) at 75°F mean.



- E. Insulation shall be rated for service to 450°F.

## 2.02 ADHESIVES, MASTIC, SEALANTS, AND REINFORCING MATERIALS

- A. Products shall be compatible with surfaces and materials on which they are applied and shall be suitable for use at operating temperatures of systems to which they are applied.
- B. All adhesives used for ductwork insulation shall conform to ASTM C916, Type II.
- C. Fiberglass Insulation Adhesive—Acceptable Manufacturers: Foster 85-60; Childers CP-127; and Duro Dyne SSG.
- D. Acoustical Ductwork Adhesive—Acceptable Manufacturers: Foster 81-10, or equal.
- E. Vapor Retarding Mastic:
  - 1. Acceptable Manufacturers: Foster 30-65 Vapor Fas, Childers CP-34, and Vimasco 749.
  - 2. For ductwork insulation operating below 50°F, mastic water vapor permeance shall be less than 0.03 perms at 45 mils dry film thickness conforming to ASTM E96.
  - 3. Use insulation joint sealant at all joints. Acceptable manufacturers are Foster 95-50 Flextra, Childers CP-76 Chil-Byl, or Pittsburgh Corning CW Sealant.
- F. Weather Barrier Breather Mastic:
  - 1. Acceptable Manufacturers: Foster 46-50 Weatherite, Childers Vi-Cryl CP-10/CP-11, or Vimasco WC-5.
  - 2. For ductwork insulation operating at 50°F or above, mastic water vapor permeance shall be greater than 1.0 perms at 1/16-inch dry film thickness conforming to ASTM E96.
- G. PVC Jacket Adhesive—Acceptable Manufacturers: DOWSIL™ 739 Plastic Adhesive by Dow; Zeston Perma-Weld by Johns Manville; and Ceel-Tite® Solvent Welding Adhesive by Ceel-Co.
- H. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.03 JACKETING

- A. Foil Scrim Jackets (FSJ): Glass fiber reinforced foil kraft laminate, factory applied to insulation. Maximum permeance of .02 perms and minimum beach puncture resistance of 25 units.
- B. PVC Jackets (PVJ):
  - 1. PVC film, gloss finish one side, semi-gloss other side.
  - 2. In water treatment facilities, PVC film shall conform to FED L-P-535E, Composition A, Type II, Grade NT.
  - 3. Jacket thickness shall be minimum 0.03 inch.
- C. Self-Adhering Jackets (SAJ):
  - 1. Acceptable manufacturers are 3M VentureClad 1577CW, or equal.
  - 2. Jackets shall be 5-ply, self-adhering multiple laminated waterproofing material with reflective aluminum foil, high density polymer films and cold weather acrylic adhesive providing zero (0.0) moisture permeance.

3. Jackets in corrosive (NEMA 4X) areas shall be 3M VentureClad 1577CW-WM, 4-ply poly vinyl fluoride, self-adhering multiple laminated waterproofing material with reflective aluminum foil, high density polymer films and cold weather acrylic adhesive providing zero (0.0) moisture permeance.
4. Minimum material thickness shall be 6 mils.
5. Minimum puncture resistance shall be 25 lbs conforming to ASTM D1000.

#### 2.04 ACCESSORIES

- A. All products shall be compatible with surfaces and materials on which they are applied and be suitable for use at operating temperatures of the systems to which they are applied.
- B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- C. Insulation bands shall be 3/4-inch wide, constructed of aluminum or stainless steel. Minimum thickness shall be 0.015 inch for aluminum and 0.010 inch for stainless steel.
- D. Staples shall be clinch style.
- E. Tack fasteners shall be stainless steel ring grooved shank tacks.
- F. Joint sealants and metal jacketing sealants shall be non-shrinking and permanently flexible.

### PART 3-EXECUTION

#### 3.01 GENERAL

- A. All insulation damaged during construction shall be replaced in accordance with these specifications.
- B. All insulation shall be applied in accordance with the manufacturer's written recommendations. Destructive methods such as sheet metal screws are not acceptable.
- C. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.
- D. All duct insulation shall be continuous through walls, ceiling or floor openings and through sleeves, except where firestop or firesafing materials are required.

#### 3.02 RIGID BOARD FIBERGLASS INSULATION INSTALLATION

- A. Provide finished edges at all access doors and ends of insulation.
- B. Provide additional insulation trim pieces over flanged ductwork joints to completely insulate and seal to the thickness specified.
- C. For exterior ductwork, insulate duct such that minimum thickness is maintained and is sloped/peaked to shed water.
- D. Flexible connections from ducts to HVAC equipment shall not be insulated.

### 3.03 PROTECTIVE JACKET INSTALLATION

- A. Foil Scrim Jackets (FSJ): Install according to manufacturer's recommendations using factory supplied lap seals and butt strip seals.
- B. PVC Fitting Covers and Jackets (PVJ): Lap seams and joints a minimum of 2 inches and continuously seal PVC with welding solvent recommended by jacket manufacturer. Lap slip joint ends 4 inches without fasteners where required to absorb expansion and contraction. For sections where jacket requires routine removal, tack fasteners may be used. Secure PVC fitting covers with tack fasteners. For all other systems, apply a 1 1/2-inch band of mastic over ends, throat, seams and penetrations.
- C. Self-Adhering Jackets (SAJ):
1. Install according to manufacturer's recommendations. Cut allowing minimum 4-inch overlap on ends and 6 inches on longitudinal joints. Align parallel to surface. Remove release paper and press flat to surface to avoid wrinkles. Rub entire surface for full adhesion and sealing at joint overlaps. On exterior applications, provide a bead of compatible caulk along exposed edges.
  2. Wrap elbows, fittings, valves and butt joints with two layers of vapor retarding tape. Vapor retarding tape shall be compatible with the jacket material used.

### 3.04 DUCTWORK INSULATION

- A. Provide insulation on new ductwork as indicated in the following schedule:

| Service                                                       | Insulation             | Jacket           | Thickness |
|---------------------------------------------------------------|------------------------|------------------|-----------|
| Exhaust/Relief Ducts from Exterior to 12 Inches Beyond Damper | Rigid Board Fiberglass | FSJ or SAJ       | 2.0"      |
| Intake and Exhaust Damper Frames                              | Rigid Board Fiberglass | FSJ              | 2.0"      |
| Generator Radiator Outlet to Damper Frame                     | Rigid Board Fiberglass | FSJ, PVJ, or SAJ | 2.0"      |

### 3.05 SPECIAL AREAS

- A. All areas indicated on the Drawings as "Corrosive" or NEMA 4X shall include PVJ or SAJ jackets.

END OF SECTION

## SECTION 23 07 16

### EQUIPMENT INSULATION FOR HVAC

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work includes insulation for all equipment provided under Division 23—HVAC:
  - 1. Formed calcium silicate insulation.
  - 2. Adhesives, mastic, sealants, and reinforcing materials.
  - 3. Jacketing.
  - 4. Accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
  - 1. ASTM B117—Standard Practice for Operating Salt Spray (Fog) Apparatus.
  - 2. ASTM C168—Standard Terminology Relating to Thermal Insulation.
  - 3. ASTM C272—Water Absorption of Core Materials for Sandwich Constructions.
  - 4. ASTM C533—Calcium Silicate Block and Pipe Thermal Insulation.
  - 5. ASTM C547—Standard Specification for Mineral Fiber Pipe Insulation.
  - 6. ASTM C518—Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - 7. ASTM C591—Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
  - 8. ASTM C612—Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
  - 9. ASTM C916—Standard Specification for Adhesives for Duct Thermal Insulation.
  - 10. ASTM C1071—Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
  - 11. ASTM C1290—Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
  - 12. ASTM C1427—Standard Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form.
  - 13. ASTM D1000—Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications.
  - 14. ASTM E84—Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 15. ASTM E96—Standard Test Methods for Water Vapor Transmission of Materials.
  - 16. FED L-P-535E: Plastic Sheet (Sheeting): Plastic Strip: Poly (Vinyl Chloride) And Poly (Vinyl Chloride-Vinyl Acetate), Rigid.
  - 17. EPA Method 8260B—Volatile Organic Compounds By Gas Chromatography/Mass Spectrometry (Gc/Ms).

18. NFPA 262—Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, and fitting materials, along with safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

- A. All insulation or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Label all insulating products delivered to the construction site with the manufacturer's name and description of materials.
- C. Insulation systems shall be applied by experienced contractors. Within the past five years, CONTRACTOR shall be able to document the successful completion of a minimum of three projects of at least 50% of the size and similar scope of the work specified in this section.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle materials in accordance with Section 01 60 00—Materials and Equipment.
- B. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage.
- C. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- D. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- E. Use all means necessary to protect insulation before, during, and after installation.
- F. All scratched, dented, and otherwise damaged insulation shall be repaired or replaced without additional cost to OWNER.

1.06 GENERAL REQUIREMENTS

- A. Unless otherwise indicated, all equipment covering, jackets, insulation, vapor barriers, adhesive, and mastics shall have flame spread rating of 25 or less and smoke spread rating of 450 or less when tested in accordance with ASTM E84.

## PART 2-PRODUCTS

### 2.01 FORMED CALCIUM SILICATE INSULATION

- A. Acceptable manufacturers are Johns Manville Thermo-1200, or equal.
- B. Insulation shall be water resistant, Type 1 rigid hydrous calcium silicate conforming to ASTM C533, Type I.
- C. Dry density shall be between 12 and 14 lbs/ft<sup>3</sup>.
- D. K-factor shall not exceed 0.44 (btu-in)/(hr-ft<sup>2</sup>-°F) at 300°F.
- E. Insulation shall be rated for service range of 0°F to 1,200°F.
- F. Material shall be visually coded or marked to indicate it is asbestos free.

### 2.02 ADHESIVES, MASTIC, SEALANTS, AND REINFORCING MATERIALS

- A. Products shall be compatible with surfaces and materials on which they are applied, and shall be suitable for use at operating temperatures of systems to which they are applied.
- B. Fiberglass Insulation Adhesive. Acceptable Manufacturers: Foster 85-60, Childers CP-127, and Duro Dyne SSG.
- C. Vapor Retarding Mastic:
  - 1. Acceptable Manufacturers: Foster 30-65 Vapor Fas, Childers CP-34, and Vimasco 749.
  - 2. For equipment insulation operating below 50°F, mastic water vapor permeance shall be less than 0.03 perms at 45 mils dry film thickness conforming to ASTM E96.
  - 3. Use insulation joint sealant at all joints. Acceptable manufacturers are Foster 95-50 Flextra, Childers CP-76 Chil-Byl, or Pittsburgh Corning CW Sealant.
- D. Weather Barrier Breather Mastic:
  - 1. Acceptable Manufacturers: Foster 46-50 Weatherite, Childers Vi-Cryl CP-10/CP-11, or Vimasco WC-5.
  - 2. For equipment insulation operating at 50°F or above, mastic water vapor permeance shall be greater than 1.0 perms at 1/16-inch dry film thickness conforming to ASTM E96.
- E. Sealant for Metal Jacketing. Acceptable Manufacturers: Foster 95-44 Elastolar, Childers CP-76 Chil-Byl, Pittsburgh Corning 727.

### 2.03 JACKETING

- A. Protective Metal Jackets (PMJ):
  - 1. Acceptable manufacturers are Metal-Clad, or equal.
  - 2. All metal jackets shall include safety edges.
  - 3. Indoor installations: 0.010-inch-thick 304 stainless steel with safety edge.

### 2.04 ACCESSORIES

- A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.

- B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- C. Insulation bands shall be 3/4-inch wide, constructed of aluminum or stainless steel. Minimum thickness shall be 0.015-inch for aluminum and 0.010-inch for stainless steel.
- D. Staples shall be clinch style.
- E. Tack fasteners shall be stainless steel ring grooved shank tacks.
- F. Joint sealants and metal jacketing sealants shall be non-shrinking and permanently flexible.

### PART 3-EXECUTION

#### 3.01 GENERAL

- A. All insulation damaged during construction shall be replaced in accordance with these specifications.
- B. All insulation shall be applied in accordance with the manufacturer's written recommendations. Destructive methods such as sheet metal screws are not acceptable. All insulation shall be installed with joints butted firmly together.
- C. All valves shall be insulated with mitered sections of insulation equal in density and thickness to adjoining insulation or with "Zeston"-type, premolded PVC fittings installed in accordance with the manufacturer's instructions.
- D. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.

#### 3.02 VAPOR BARRIER INSTALLATION

- A. For systems operating at 50°F or above, jackets on insulation may be stapled using outward clinch staples spaced 3 inches apart at least 1/4-inch in from the lap edge.
- B. Install fabric reinforcing without wrinkles. Overlap seams a minimum of 2 inches.
- C. Use full length material (as delivered from manufacturer) wherever possible. Scrap piecing of insulation or pieces cut undersize and stretched to fit will not be accepted.
- D. All insulation ends shall be tapered and sealed regardless of service.
- E. Vapor barrier jackets shall be applied with a continuous, unbroken vapor seal. Vapor barrier jackets shall not be broken at supports.
- F. Vapor retarding jacket shall be maintained continuously through all penetrations.

### 3.03 CALCIUM SILICATE INSULATION INSTALLATION

- A. Tightly butt insulation with staggered joints and secure with metal bands or wire.

### 3.04 PROTECTIVE JACKET INSTALLATION

- A. Protective Metal Jacket (PMJ): Lap seams a minimum of 2 inches. Secure with metal bands for end to end joints, and rivets or sheet metal screws for longitudinal joints. Rivets, screws, and bands shall be constructed of the same material as the jacket. Locate seams on bottom for exterior applications. Seal laps with 1/8-inch bead of metal jacketing sealant to prevent water entry.

### 3.05 EQUIPMENT INSULATION

- A. Insulation shall not cover equipment access manholes, fittings, nameplates or ASME stamps. Bevel and seal insulation at these locations.
- B. Provide insulation on equipment as outlined in the schedule below:

| Equipment                                     | Insulation       | Jacket | Thickness |
|-----------------------------------------------|------------------|--------|-----------|
| Generator Exhaust Pipe and Muffler (Silencer) | Calcium Silicate | PMJ    | 4.0"      |
| Breeching From Equipment Outlet to Stack      | Calcium Silicate | PMJ    | 2.0"      |

END OF SECTION



## SECTION 23 07 19

### PIPING INSULATION FOR HVAC

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work includes insulation for all piping provided under Division 23—HVAC.
  - 1. Flexible Closed Cell Pipe Insulation.
  - 2. Adhesives, Mastic, Sealants, and Reinforcing Materials.
  - 3. Jacketing.
  - 4. Insulation Inserts and Pipe Shields.
  - 5. Accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
  - 1. ASTM C168—Standard Terminology Relating to Thermal Insulation.
  - 2. ASTM C272—Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions.
  - 3. ASTM C518—Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
  - 4. ASTM C533—Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
  - 5. ASTM C547—Standard Specification for Mineral Fiber Pipe Insulation.
  - 6. ASTM C591—Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
  - 7. ASTM C612—Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
  - 8. ASTM C871—Standard Test Method for Chemical Analysis of Thermal Insulation Materials.
  - 9. ASTM C1427—Standard Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form.
  - 10. ASTM D1000—Standard Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications.
  - 11. ASTM E84—Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 12. ASTM E96—Standard Test Methods for Water Vapor Transmission of Materials.
  - 13. FED L-P-535E: Plastic Sheet (Sheeting): Plastic Strip: Poly (Vinyl Chloride) And Poly (Vinyl Chloride-Vinyl Acetate), Rigid.
  - 14. NFPA 262—Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00–Submittals.
- B. Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, and fitting materials, along with safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

### 1.04 QUALITY ASSURANCE

- A. All insulation or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Label all insulating products delivered to the construction site with the manufacturer's name and description of materials.
- C. Insulation systems shall be applied by experienced contractors. Within the past five years, CONTRACTOR shall be able to document the successful completion of a minimum of three projects of at least 50% of the size and similar scope of the work specified in this section.

### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle materials in accordance with Section 01 60 00–Materials and Equipment.
- B. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage.
- C. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- D. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- E. Use all means necessary to protect insulation before, during, and after installation.
- F. All scratched, dented, and otherwise damaged insulation shall be repaired or replaced as requested by OWNER without additional cost to OWNER.

### 1.06 GENERAL REQUIREMENTS

- A. Unless otherwise indicated, all pipe covering, jackets, insulation, vapor barriers, adhesives, and mastics shall have flame spread rating of 25 or less and smoke spread rating of 450 or less when tested in accordance with ASTM E84.
- B. All insulation and associated materials shall be free of asbestos.

## PART 2-PRODUCTS

### 2.01 FLEXIBLE CLOSED CELL PIPE INSULATION

- A. Acceptable manufacturers are K-flex Insul-tube, Armacell AP/Armaflex, or equal.
- B. Insulation shall be flexible closed cell type conforming to ASTM C534, Type 1, Grade 1.
- C. K -factor shall not exceed 0.25 (btu-in)/(hr-ft<sup>2</sup>-°F) at 75°F mean.
- D. Insulation shall be rated for service range of -20°F to 220°F on piping or 180°F where adhered to equipment.

### 2.02 ADHESIVES, MASTIC, SEALANTS, AND REINFORCING MATERIALS

- A. Products shall be compatible with surfaces and materials on which they are applied, and shall be suitable for use at operating temperatures of systems to which they are applied.
- B. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

### 2.03 JACKETING

- A. Self-Adhering Jackets (SAJ):
  - 1. Acceptable manufacturers are 3M VentureClad 1577CW, or equal.
  - 2. Jackets shall be 5-ply, self-adhering multiple laminated waterproofing material with reflective aluminum foil, high density polymer films and cold weather acrylic adhesive providing zero (0.0) moisture permeance.
  - 3. Minimum material thickness shall be 6 mils.
  - 4. Minimum puncture resistance shall be 25 lbs conforming to ASTM D1000.
- B. Protective Metal Jackets (PMJ):
  - 1. Acceptable manufacturers are Metal-Clad, or equal.
  - 2. All metal jackets shall include safety edges.
  - 3. Indoor installations: 0.016-inch-thick aluminum or 0.010-inch-thick 304 stainless steel with safety edge.
  - 4. Outdoor installations: 0.024-inch-thick aluminum or 0.016-inch-thick 304 stainless steel with safety edge.

### 2.04 INSULATION INSERTS AND PIPE SHIELDS

- A. Acceptable manufacturers are B-Line, Pipe Shields, or Value Engineered Products.
- B. Construct inserts with calcium silicate or polyisocyanurate with minimum 140 psi compressive strength. Piping 12 inches and larger shall be supplemented with high density 600 psi structural calcium silicate insert. Provide 16-gauge galvanized steel shield, 12 inches long. Insert and shield shall include minimum 180-degree coverage on bottom supported piping and full 360-degree coverage on clamped piping. On roller mounted piping and piping designed to slide on support, provide additional load distribution stainless steel plate.

- C. Where CONTRACTOR proposes shop/site fabricated inserts and shields, submit schedule of materials, thicknesses, gauges and lengths for each pipe size to demonstrate equivalency to pre-engineered/premanufactured product described above. On low temperature systems, high density rigid polyisocyanurate may be substituted for calcium silicate provided insert and shield length and shield gauge are increased to compensate for lower insulation compressive strength.
- D. Wood blocks will not be accepted.
- E. All pipe shields shall be banded to the jacketing using stainless steel bands. One band is required on each side of the support.

## 2.05 ACCESSORIES

- A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.
- B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.
- C. Insulation bands shall be 3/4 inch wide, constructed of aluminum or stainless steel. Where metal jackets are used, band material shall match jacket material. Minimum thickness shall be 0.015-inch for aluminum and 0.010-inch for stainless steel.
- D. Load distributing metal shields shall be constructed of aluminum or stainless steel. Where metal jackets are used, shield material shall match jacket material. Minimum thickness shall be 0.015-inch for aluminum and 0.010-inch for stainless steel.
- E. Staples shall be clinch style.
- F. Tack fasteners shall be stainless steel ring grooved shank tacks.
- G. Joint sealants and metal jacketing sealants shall be non-shrinking and permanently flexible.

## PART 3—EXECUTION

### 3.01 GENERAL

- A. All insulation damaged during construction shall be replaced in accordance with these specifications.
- B. All insulation shall be applied in accordance with the manufacturer's written recommendations. Destructive methods such as sheet metal screws are not acceptable. All pipe insulation shall be installed with joints butted firmly together.
- C. All valves and fittings shall be insulated with mitered sections of insulation equal in density and thickness to adjoining insulation.
- D. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.

- E. All pipe insulation shall be continuous through walls, ceiling or floor openings and through sleeves except where firestop or firesafing materials are required.
- F. All uninsulated penetrations through the insulation system shall be insulated along their length to a minimum distance of four times the insulation thickness. To prevent moisture migration behind the insulation, these penetrations shall be sealed with a sealant as recommended by the manufacturer and flashed to shed water.

### 3.02 SUPPORT INSTALLATION

- A. For each pipe hanger, provide a hanger block on the bottom half of the pipe in place of the insulation.
- B. Pipe hangers and supports shall be sized large enough to be installed over the outer surface of the insulation.
- C. Load distributing metal shields shall be installed around the lower one-third circumference of the insulation and jacket.
- D. Blocks and shields shall be provided at all supports regardless of orientation, except inserts may be omitted on 3/4 inch and smaller copper piping provided 12-inch long 22 gauge pipe shields are used.

### 3.03 FLEXIBLE CLOSED CELL INSULATION INSTALLATION

- A. Where practical, slip insulation on piping during pipe installation while pipe ends are open. Miter cut fittings allowing sufficient length to prevent stretching. Completely seal seams and joints for vapor tight installation. Apply full bed of adhesive to both surfaces. Cover flexible closed cell insulation on systems operating below 40°F with vapor retarding mastic.

### 3.04 PROTECTIVE JACKET INSTALLATION

- A. Self-Adhering Jacket (SAJ):
  - 1. Install according to manufacturer's recommendations. Cut allowing minimum 4-inch overlap on ends and 6-inch on longitudinal joints. Align parallel to surface. Remove release paper and press flat to surface to avoid wrinkles. Rub entire surface for full adhesion and sealing at joint overlaps. On exterior applications, provide a bead of compatible caulk along exposed edges.
  - 2. Wrap elbows, fittings, valves and butt joints with 2 layers of vapor retarding tape. Vapor retarding tape shall be compatible with the jacket material used.
- B. Protective Metal Jacket (PMJ): Lap seams a minimum of 2 inches. Secure with metal bands for end to end joints, and rivets or sheet metal screws for longitudinal joints. Rivets, screws, and bands shall be constructed of the same material as the jacket. Locate seams on bottom for exterior applications. Seal laps with 1/8-inch bead of metal jacketing sealant to prevent water entry.

### 3.05 PIPING INSULATION

- A. Provide insulation and jacketing on new piping as indicated in the following schedule:

| SERVICE             | INSULATION           | JACKET | INSULATION THICKNESS BY PIPE SIZE |                   |                   |               |                  |
|---------------------|----------------------|--------|-----------------------------------|-------------------|-------------------|---------------|------------------|
|                     |                      |        | < 1"                              | 1" to<br>< 1 1/2" | 1 1/2"<br>to < 4" | 4" to<br>< 8" | 8" and<br>Larger |
| Refrigerant Suction | Flexible Closed Cell | N/A    | 1.0"                              | 1.0"              | 1.5"              | 1.5"          | 1.5"             |

B. All piping exterior to buildings shall be provided with a PMJ or SAJ jacket.

END OF SECTION

## SECTION 23 09 13

### TEMPERATURE CONTROLS AND INSTRUMENTATION

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Electrical Components.
  - 2. Dampers and Actuators.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Submit under provision of Section 01 33 00—Submittals.
- B. Submittal shall include control schematics with wiring and logic diagrams in addition to equipment information. All wiring shall be color coded and labeled at each end with corresponding numbers in accordance with Section 20 05 53—Identification for Fire Suppression, Plumbing, and HVAC Piping and Equipment. This numbering shall be shown on the shop and record drawings. Wiring diagrams shall be job-specific and indicate all point-to-point wiring connections. Manufacturer's standard wiring diagrams are not acceptable.

##### 1.03 QUALITY ASSURANCE

- A. Temperature control equipment including panels and other standard marketed apparatus shall bear the nameplate of the manufacturer. The entire system including temperature control wiring shall be installed by mechanics employed by or under contract to the temperature control provider, a factory-licensed distributor, or factory-licensed dealer. The provider shall be responsible for the quality and satisfactory operation of all materials.
- B. All control panels shall bear a serialized UL label.
- C. Comply with the National Electrical Code (NFPA 70) and any and all local codes as applicable to construction of electrical wiring devices, material, and equipment herein specified.

#### PART 2—PRODUCTS

##### 2.01 ELECTRICAL COMPONENTS

- A. Provide electrical work in accordance with Division 26. All line voltage wiring and conduit shall be provided by Division 26 contractor. All low voltage wiring (100 volts and below) shall be provided by temperature controls contractor and be installed in raceways provided by Division 26 contractor.

- B. Provide all components necessary to complete the work of this section including, but not limited to relays, transformers, motors, solenoid valves, starters, switches, override controls, operator linkages, and associated low voltage wiring. Outdoor wiring and equipment shall be NEMA 4X, or as indicated.
- C. All relays, time clocks, transformers, motors, operator linkages, wiring, etc., not specifically mentioned herein but necessary to make the control system complete and operative in accordance with the sequence of operation shall be provided as part of this section.
- D. All boxes for thermostats shall be provided by Division 26 contractor.
- E. All control and auxiliary relays shall have indicating LEDs.
- F. Pushbuttons shall be heavy-duty, oil-tight, 30 mm, flush head style.
- G. Indicating lights shall be heavy-duty, oil-tight, 30 mm, push-to-test type.
- H. Selector switches shall be heavy-duty, oil-tight, 30 mm.
- I. Temperature control contractor shall utilize a licensed electrician for installation of all wiring. TCC shall submit name and license number of electrician with shop drawings.

## 2.02 DAMPERS AND ACTUATORS

- A. Outside Air Intake and Exhaust Outlet:
  - 1. Dampers shall be TAMCO Series 9000 BF, Alumavent Series 3900SS, or Arrow AFDTI-25LT, thermally insulated control damper with aluminum construction. Dampers for corrosive environments shall be TAMCO Series 9000 SW provided with an anodized coating and stainless steel linkage.
  - 2. Dampers shall be parallel blade.
  - 3. Extruded aluminum (6063T5) damper frame shall be thermally broken, minimum 0.080 inch thickness. Damper frame to be 4 inches deep and shall be insulated with polystyrene on four sides. Damper shall be rated at a leakage of less than 8.0 cfm per square foot at 4.0 inches of water column pressure differential at 20°F.
  - 4. Blades to be extruded aluminum (6063T5), internally insulated with non-CFC, expanded polyurethane foam and shall be thermally broken. Complete blade shall have an insulating factor of R-2.29 and a temperature index of 55 as tested in accordance with AMCA Standard 511.
  - 5. Blade gaskets shall be extruded EPDM; blade seals shall be silicone.
  - 6. Shaft to actuator shall be hex type, material to match damper construction.
  - 7. Side seals shall be silicone.
  - 8. Dampers shall be flanged to duct type. Clear opening in damper shall be same size as ductwork.
- B. Actuators:
  - 1. Actuators shall be Belimo NFBUP, Honeywell MS4110, or Siemens GCA, maintenance-free actuator rated at minimum 88 in-lb. of torque. Dampers shall be power-to-open, spring-closed unless otherwise specified. Provide auxiliary switch where noted on Drawings. Actuator shall be capable of accepting 120-volt power for operation and control.
  - 2. Actuators shall include electronic overload protection and visual position indication throughout range of motion.



3. Actuators shall include a manual override via a manufacturer-supplied hex crank.
4. Generator associated intake and exhaust dampers and dampers on standby power shall be power-to-close and spring-to-open on power fail.
5. Provide Greenheck, or equal, NEMA 4X plastic enclosure for actuators in the following areas:
  - a. Fluoride Rooms.
  - b. Chlorine Rooms.
6. All actuators shall be direct-coupled to damper and mounted outside the air stream utilizing TAMCO motor mounting bracket model AL-0001, or equal unless otherwise noted. CONTRACTOR shall verify suitability of mounting bracket prior to ordering.
7. If auxiliary switch is not used, terminate cord in nearest junction box.
8. All actuators shall be of the same manufacturer. Manufacturer shall be responsible for furnishing quantity of actuators required to meet minimum damper torque rating, plus an additional 10% torque.

### PART 3-EXECUTION

#### 3.01 INSTALLATION

- A. Install all equipment in accordance with manufacturer's recommendations and Division 26.
- B. Coordinate location of exposed devices prior to rough-in. Thermostats shall be mounted where shown on the Drawings. Thermostats on exterior walls shall have insulated bases.
- C. Temperature controls to be installed in or on insulated ductwork shall be installed after the insulation has been applied.
- D. Thermostats, humidistats, etc. shall be installed 48 inches above floor (top of box), unless otherwise noted. Notify ENGINEER of conflicts.
- E. Install all dampers in accessible locations with ample space to install direct-coupled actuator, housing and accessories.

#### 3.02 SEQUENCE OF OPERATION

- A. Electric wall heaters (EWH) shall be controlled by an integral thermostat.
- B. Controls for electric unit heaters (EUH) shall be provided by Division 26 contractor. Thermostats shall be suitable to meet room electrical rating. Control power shall be from control power transformer at unit.
- C. Devices and control logic for the following fans shall be provided by the Division 26 contractor: EF 04. Refer to Section 26 09 00-Controls and Instrumentation.
- D. The following fans shall run continuously. No means of shut off shall be provided except at the equipment disconnect or lighting panel circuit breaker. The motor-operated damper at the fan and the associated dampers shall be open when the fan is running and closed when the fan is off.
  1. EF-01.
  2. EF-02.

- E. The following fans shall be controlled by a room occupancy sensor: EF-03. Provide all required interfaces with the switch and coordinate switch type. Speed control for fans shall be for balancing only and shall be inaccessible to room occupants.

END OF SECTION

## SECTION 23 11 23

### FACILITY FUEL GAS PIPING

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: All facility fuel gas pipe and fittings unless otherwise noted.
- B. Related Sections and Divisions: Applicable provisions of Division 01 govern work under this section.

##### 1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
  - 1. Wisconsin Administrative Code SPS 365—Fuel Gas Appliances and applicable standard(s).
  - 2. NFPA 54—National Fuel Gas Code (Current Edition).
  - 3. ANSI B16.3—Malleable Iron Threaded Fittings.
  - 4. ASTM A53—Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.
  - 5. ASTM A234—Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
  - 6. 2015 International Fuel Gas Code.

##### 1.03 QUALITY ASSURANCE

- A. All materials, equipment and Work shall meet or exceed all applicable federal, state and local requirements and conform to codes and ordinances of authorities having jurisdiction.
- B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- C. Order all Type E and Type S steel pipe with heat numbers rolled, stamped, or stenciled to each length or each bundle, depending on the size of the pipe, and in accordance with the appropriate ASTM specification.

##### 1.04 SUBMITTALS

- A. Submittals shall be in accordance with provisions of Section 01 33 00—Submittals.

##### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Accept piping on-site in shipping containers with labeling in place, inspect for damage and store with a minimum of handling. Store plastic piping under cover out of direct sunlight. Do not store materials directly on the ground.

- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping systems from entry of foreign materials by installing temporary covers, completing sections of the work and isolating parts of completed system.
- D. Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place.

#### 1.06 DESIGN CRITERIA

- A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed in this specification.
- B. Construct all piping for the highest pressures and temperatures in the respective system in accordance with ANSI B31, but not less than 125 psig unless specifically indicated otherwise.
- C. Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in occupied spaces and ventilation plenum spaces, including plenum ceilings.
- D. Use only long radius elbows having a centerline radius of 1.5 pipe diameters.
- E. Where ASTM A53 grade A pipe is specified, ASTM A53 grade B pipe may be substituted at CONTRACTOR's option. Where the grade or type is not specified, CONTRACTOR may choose from those commercially available.

#### 1.07 WELDER QUALIFICATIONS

- A. Before any metallic welding is performed, CONTRACTOR to submit their Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section IX of the ASME Boiler and Pressure Vessel Code and/or the National Certified Pipe Welding Bureau.
- B. Before any polyethylene fusion welding is performed, CONTRACTOR to submit certification that the welders to be used on this project have successfully demonstrated proper welding procedures in accordance with the Code of Federal Regulations, Title 49, Part 192, Section 192.285.
- C. ENGINEER and OWNER reserves the right to test the work of any welder employed on the project, at CONTRACTOR's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project.

### PART 2—PRODUCTS

#### 2.01 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state, and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

- B. Natural gas pressures shall not exceed 5 psig on customer side of the meter.
- C. Buried natural gas shall be in accordance with Section 33 52 16–Fuel Gas Distribution Utilities.

## 2.02 NATURAL GAS

- A. 2-Inch and Smaller: ASTM A53, type E or S, standard weight (Schedule 40) black steel pipe with ASTM A197/ANSI B16.3 class 150 black malleable iron threaded fittings or ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.
- B. Exposed piping shall be painted in accordance with Section 09 91 00–Painting. All aboveground piping shall be labeled in accordance with Section 20 05 53–Identification for Fire Suppression, Plumbing, and HVAC Piping and Equipment. Where not labeled on manufacturer nameplate, regulator tags shall indicate inlet pressure, outlet pressure, and flow. Appliance regulators provided by equipment manufacturer as part of a manufacturer's gas train are not required to be tagged.

## 2.03 VENTS AND RELIEF VALVE DISCHARGE PIPING

- A. Use pipe and pipe fittings as specified for the system to which the relief valve or vent is connected.

## 2.04 UNIONS AND FLANGES

- A. 2-Inch and Smaller: ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping. Use unions of a pressure class equal to or higher than that specified for the fittings of the respective piping service but not less than 250 psi.
- B. Provide ASTM A 193 B7 grade bolts and A 194 2H grade nuts and hardened washers for connections (star washers for grounding).

## 2.05 GASKETS

- A. Fuel Oil and Natural Gas Systems: Branded, compressed, non-asbestos sheet gaskets. Klingsil C4401, Garlock 3000, or JM Clipper 978-C.

# PART 3–EXECUTION

## 3.01 PREPARATION

- A. Remove all foreign material from interior and exterior of pipe and fittings.

## 3.02 INSTALLATION

- A. Support:
  - 1. All interior or exposed pipelines shall be securely supported by adjustable metal saddles, brackets, or adjustable hangers supported directly by concrete, masonry work, or tile.
  - 2. Strap hangers, tin clips, or U-hooks will not be acceptable.

3. In general, the maximum spacing of supports shall not exceed 10 feet on centers.
4. Insulation saddles shall be used. CONTRACTOR shall furnish and place hangers, supports, wall pipes, sleeves, and floor boxes in the forms before concrete is poured wherever needed or shown on the Drawings.
5. The weight of the piping shall be supported independently of connected equipment.
6. All supports and parts shall conform to the latest requirements of ASME B31 and shall have a structural safety factor of 5. Accurate weight balance calculation shall be made by CONTRACTOR to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection. CONTRACTOR shall be responsible for the installation and application of the supports. Pipe hangers shall be capable of supporting the pipe weight load in all conditions of operation. The hangers shall allow free expansion and contraction of the piping to prevent excessive stress in the piping. Hangers and supports shall be spaced in accordance with ASME B31 and as indicated in this specification. Pipe supports shall be placed before and after a valve, expansion joint, or equipment so that stress will not be transferred to them.
7. CONTRACTOR shall provide calculations of pipe supports if requested by ENGINEER.
8. The following maximum spacings shall be provided for supports:

**MAXIMUM HORIZONTAL PIPE  
HANGER AND SUPPORT SPACING**

| Nominal Pipe or<br>Tube Size | Black Steel<br>(See Note 1)<br>ft |
|------------------------------|-----------------------------------|
| 3/4                          | 8                                 |
| 1                            | 8                                 |
| 1 1/4                        | 8                                 |
| 1 1/2                        | 8                                 |
| 2                            | 10                                |

Note 1: Provide at least one hanger per pipe length located as close to the flange or joint on barrel as possible.

9. The length of hanger span and support spacing in the above table refers to straight lengths of pipe. When there are changes of direction in pipe, two supports shall be placed less than three-fourths the full span in the table. When practical, a hanger shall be located immediately adjacent to a change in direction of piping. Where there are concentrated loads between supports such as valves, spacing shall be based on load calculations rather than this table.
  10. Provide saddles or shields under piping hanger and supports for all insulated piping to prevent crushing of insulation. Provide stainless steel pipe shields under stainless steel piping to prevent indentation of piping from the support or clamp.
  11. Vertical piping shall be supported at each floor level and at intervals as specified for horizontal piping.
- B. Penetrations:**
1. Where pipes pass through concrete members without wall fittings shown, CONTRACTOR shall provide sleeves in the forms for the piping.
  2. The sleeve diameter shall not exceed the pipe O.D. (or flange O.D. where applicable) plus 2 inches, unless otherwise shown on Drawings.
  3. If the concrete members are to be watertight, the annular space around the pipe shall be sealed with an approved mechanical seal.

4. Where pipes pass through a roof, they shall be run through an approved roof penetration with flashing and counter-flashing.
5. Where pipes pass through nonwatertight walls, the annular space shall be grouted full.
6. Where pipes pass through nonwatertight floors, the sleeve shall extend 1-inch above the finished floor elevation, and the annular space shall remain open.
7. Space between wall sleeve or wall pipe and concrete shall be filled with nonshrinking mortar.
8. The annular space between the wall sleeve and pipe shall be sealed with an approved mechanical seal.
9. Where new pipes go through existing nonwatertight concrete or masonry members, holes shall be cored and grouted full (walls), remain open (floors).
10. Plug abandoned pipes and wall pipes, after pipe and fitting removal, flush to the concrete surface with nonshrinking mortar, or as otherwise acceptable, to achieve a watertight seal.
11. No chases or recesses shall be made in poured concrete for pipe installation, and no pipe shall run in poured concrete unless called for in the Drawings or Specifications or permitted by ENGINEER. The cutting or core drilling of concrete for pipe shall be avoided wherever possible, and in no case, where such cutting or core drilling is necessary, shall reinforcing rods be cut or disturbed without prior consultation with ENGINEER.
12. All openings for pipe work shall be neatly patched in a workmanlike manner.

C. Layout:

1. Install all piping parallel to building walls and ceilings and at heights that do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult Drawings for location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.
2. Exposed piping shall run straight, in neat parallel lines, and shall be located far enough from walls, ceilings and floors, to permit access for covering of pipe and painting work.
3. Care shall be taken in laying out piping that there is no interference with the proper location of piping for other purposes or other equipment, and shall be run with regard to the requirements of each service.
4. Piping shall not interfere with headroom or clear floor space.
5. Plates shall be provided on all uncovered pipes passing through floors, walls, and ceilings, constructed of materials other than poured concrete. Plates shall be on exposed sides and shall be chrome-plated, spring and snap type.
6. An ample number of unions shall be provided in all threaded, soldered, and glued pipelines and at all equipment to facilitate removal and replacement. Install a shutoff valve at each appliance.
7. In joining two dissimilar types of pipe, standard fittings shall be used when available. The proposed joint shall be submitted by CONTRACTOR to ENGINEER for review prior to installation.

### 3.03 ERECTION

- A. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.
- B. Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not acceptable.

- C. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half the diameter of the main.
- D. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

### 3.04 WELDED PIPE JOINTS

- A. Welding of pipe in normally occupied buildings is prohibited. Off-site welding is acceptable.
- B. If welding is required in a normally occupied building for connecting to an existing welded system, written approval from OWNER shall be obtained and shall comply with building's fire and life safety, as well as hot work requirements.
- C. Piping and fittings shall be welded and fabricated in accordance with ASME/ANSI latest editions of B31 for all systems from the Code for Pressure Piping. Machine beveling in CONTRACTOR's shop is preferred. Field beveling may be done by flame cutting to recognized standards.
- D. Provide complete penetration of deposited metal with base metal. Provide filler metal suitable for use with base metal. Maintain inside of fittings free from globules of weld metal.
- E. All welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process. All pipes shall have the ends beveled 37 1/2 degrees and all joints shall be aligned true before welding. Except as specified otherwise, all changes in direction, intersection of lines, reduction in pipe size and the like shall be made with factory-fabricated welding fittings. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction shall not be permitted.
- F. Align piping and equipment so that no part is offset more than 1/16 inch. Set all fittings and joints square and true and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.
- G. CONTRACTOR shall not permit any weld to project within the pipe so as to restrict it. Tack welds, if used, must be of the same procedure as the completed weld. Otherwise, remove tack weld during welding operation.
- H. Do not split, bend, flatten or otherwise damage piping before, during or after installation.
- I. Remove dirt, scale or other foreign matter from the inside of the piping, by swabbing or flushing, prior to the connection of other piping sections, fittings, valves or equipment.
- J. Schedule 40 pipe shall in no case be welded with less than three passes including one stringer/root, one filler and one lacer. Schedule 80 shall be welded with no less than four passes, including one stringer/root, two filler and one lacer. In all cases, the weld must be filled before the cap weld is added.
- K. Weld Testing:
  - 1. All welds are subject to inspection, visual and/or x-ray, for compliance with Specifications. OWNER will at OWNER's option, provide employees or employ a testing laboratory for the purposes of performing said inspections and/or x-ray testing. Initial



visual and x-ray inspections will be provided by OWNER. CONTRACTOR shall be responsible for all labor, material and travel expenses involved in the reinspection and retesting of any welds found to be unacceptable. In addition, CONTRACTOR shall be responsible for the costs involved in any and all additional testing required or recommended by ASME/ANSI Standards B31.1 and B31.3 because of the discovery of poor, unacceptable or rejected welds.

2. Welds lacking penetration, containing excessive porosity or cracks, or are found to be unacceptable for any reason, must be removed and replaced with an original quality weld as specified herein. All qualifying tests, welding and stress relieving procedures shall, moreover, be in accordance with Standard Qualification for Welding Procedures, Welders and Welding Operators, Appendix A, Section 6 of the Code, current edition.

### 3.05 THREADED PIPE JOINTS

- A. Use a Teflon based thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

### 3.06 NATURAL GAS

- A. Pitch horizontal piping down 1-inch in 60 feet in the direction of flow. Install a 4-inch minimum depth dirt leg at the bottom of each vertical run and at each appliance. When installing mains and branches, cap gas tight each tee or pipe end which will not be immediately extended. All branch connections to the main shall be from the top or side of the main.
- B. Do not install gas pipe in a ventilation air plenum.
- C. If an above ground vent terminates in an area subject to snow accumulation, terminate the line at least five feet above grade.
- D. Piping through a roof shall be run through an approved roof penetration with flashing and counter flashing.
- E. Each gas pressure reducing valve vent and relief valve vent shall be run separately to a point outside of the building, terminated with a screened vent cap, and located according to gas utility regulations.
- F. Clean all welded piping before all regulators and control valves. Test by placing target cloth over piping and blow with compressed air. Clean piping until target cloth is clean and free of debris.

### 3.07 VENTS AND RELIEF VALVE DISCHARGE PIPING

- A. Install vent and relief valve discharge lines as indicated on the Drawings, as detailed, and as specified for each specific valve or piping specialty item. In no event is a termination to occur less than 6 feet above a roof line. Each gas pressure reducing valve vent and relief valve vent shall be run separately to a point outside of the building, terminated with a screened vent cap, and located according to gas utility regulations.
- B. Pipe vents from gas pressure reducing valves and pipe casing sleeves to the exterior of the building and terminate with outlet turned down and capped with corrosion resistant insect screen. Vent terminations shall be at least 7 feet above grade or pedestrian traffic and a

minimum of 3 feet above or 10 feet horizontally from all air intakes or building openings. Provide stainless steel insect screens on vent outlets.

### 3.08 UNIONS AND FLANGES

- A. Install a union or flange, as required, at each automatic control valve and at each piping specialty or piece of equipment which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.
- B. Provide dielectric isolation device where nonferrous lines connect to ferrous lines or equipment, such as dielectric union, coupling, or dielectric flange fitting.

### 3.09 PIPING SYSTEM LEAK TESTS

- A. Piping system shall be tested as a complete unit or in sections. Under no circumstances shall a valve in a line be used as a bulkhead between gas in one section and test medium in an adjacent section, unless two valves in series are installed with a valved "telltale" located between these valves.
- B. Verify that the piping system being tested is fully connected to all components and that all equipment is properly installed, wired, and ready for operation. If required for the additional pressure load under test, provide temporary restraints at expansion joints or isolate them during the test. Verify that hangers can withstand any additional weight load that may be imposed by the test.
- C. All natural gas systems shall be inspected, tested, purged and placed into operation in accordance with NFPA 54 and as required by local code. Tester shall submit pneumatic tests to ENGINEER.
- D. Conduct pressure test with air. Test time and pressure shall be as indicated in the table below; additional time may be necessary to conduct an examination for leakage. Each test must be witnessed by ENGINEER. If leaks are found, repair the area with new materials and repeat the test; caulking will not be acceptable.

| System      | Pressure                                                                                                                                                                                                                  | Medium                                       | Duration                                                                                                                                                                                                                                                                                                                                                       |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Natural Gas | Test pressure shall be no less than 1.5 times the proposed maximum working pressure, but not less than 3 psi. Where the test pressure exceeds 125 psi, test pressure shall not exceed 50% minimum yield strength of pipe. | Air, carbon dioxide, nitrogen, or inert gas. | 1/2 hour per 500 cubic feet pipe volume not to exceed 24 hours. Test duration shall be not less than 1/2 hour for each 500 cubic feet of pipe volume or fraction thereof. When testing a system having a volume less than 10 cubic feet the test duration shall be a minimum of 60 minutes. The duration of the test shall not be required to exceed 24 hours. |

- E. Gradually increase the pressure to not more than one half of the test pressure; then increase pressure in steps of approximately one-tenth of the test pressure until the required test

pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. After testing is complete, slowly release the pressure in a safe manner.

- F. All necessary piping, fittings, blind flanges, and apparatus for conducting tests shall be furnished by CONTRACTOR and shall comply with the requirements of NFPA 54 and as required by local codes.
- G. All new rough-in distribution piping and affected portions of existing systems connected to, shall be subjected to a pneumatic test pressure utilizing clean, dry air and must be demonstrated to be absolutely tight when subjected to the pressures and time durations listed in table above. All equipment and components designed for operating pressures of less than the test pressure shall not be connected to the piping system during test.
- H. Test pressure shall be measured with a manometer or with a pressure-measuring device designed and calibrated to read, record or indicate a pressure loss caused by leakage during the pressure test period.
- I. Piping system shall withstand test pressure specified without showing any evidence of leakage or other defects. Any reduction of test pressures as indicated by pressure gauges shall be deemed to indicate a leak unless can be attributed to some other cause.
- J. Leakage shall then be located by means of a gas detector, a noncorrosive leak detection fluid, or other leak detection method. Matches, candles, open flames or other methods that provide a source of ignition shall not be used.
- K. When placing system into operation, appliances and equipment shall not be placed into operation until piping system has been checked for leakage with above requirements.

END OF SECTION

## SECTION 23 23 00

### REFRIGERANT PIPING

#### PART 1—GENERAL

##### 1.01 SCOPE

- A. This section contains specifications for all refrigerant piping for this project. Included are the following topics:
  - 1. Refrigerant Piping.
  - 2. Refrigerant Piping Accessories.
  - 3. Refrigerant.

##### 1.02 REFERENCE

- A. Applicable provisions of Division 01 govern work under this section.

##### 1.03 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
  - 1. ANSI B16.22—Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings.
  - 2. ASHRAE 15—Safety Standard for Refrigeration Systems.
  - 3. ASHRAE 32—Sustainable, High-Performance Operations and Maintenance.
  - 4. ASHRAE 34—Designation and Safety Classification of Refrigerants.
  - 5. ASME B31.5—Refrigeration Piping and Heat Transfer Components.
  - 6. ASTM B280—Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
  - 7. NFPA 70—National Electrical Code.

##### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. CONTRACTOR shall submit schedule indicating the ASTM specification number of the pipe being proposed along with its type and grade and sufficient information to indicate the type and rating of fittings for each service.

##### 1.05 COPPER TUBE

- A. Statement from manufacturer on their letterhead that the pipe furnished meets the ASTM specification contained in this section.

## 1.06 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Order all copper refrigeration tube with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier; with soft straight lengths or coils identified with a tag indicating that the product was manufactured in accordance with ASTM B280; and with each hard temper straight length identified throughout its length by a blue colored marking not less than 3/16 inch in height and a legend at intervals of not greater than three feet that includes the designation "ACR" and pipe outside diameter.
- C. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to OWNER.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Promptly inspect shipments to review that the material is undamaged and complies with specifications.
- B. Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. If end caps are not present on tube bearing the "ACR" designation, clean and re-cap in accordance with ASTM B280. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
- C. Offsite storage agreements will not relieve CONTRACTOR from using proper storage techniques.
- D. Storage and protection methods must allow observation to verify products.

## 1.08 DESIGN CRITERIA

- A. Use only new material, free of defects and scale, and meeting the latest revision of ASTM specifications as listed in this specification.

## PART 2-PRODUCTS

### 2.01 REFRIGERANT PIPING

- A. Acceptable manufacturer is Streamline ACR Copper Tube, or equal.
- B. Piping shall be hard drawn copper tube, cleaned and capped in accordance with ASTM B280, and marked "ACR", with ANSI B16.22 wrought copper solder-type fittings. The piping shall have an operating pressure of 700 psi at 250°F.
- C. Precharged tubing line sets may be used on systems 3 1/2 tons and less in size.

## 2.02 REFRIGERANT PIPING ACCESSORIES

- A. Acceptable manufacturers are Sporlan, Alco, or equal.
- B. Provide all refrigerant piping specialties with a maximum working pressure of full vacuum to no less than the pressure vessel.
- C. Flexible Pipe Connectors: Double braided bronze hose flexible pipe connectors with solder end connections.
- D. Filter Dryers: For circuits 15 tons and over provide angle pattern filter dryers with replaceable core. For circuits below 15 tons provide straight pattern filter dryers without replaceable core.
- E. Sight Glasses: Two piece brass construction with solder end connections. Include color indicator for sensing moisture.
- F. Solenoid Valves: Two-way, normally closed with two piece brass body, full port, stainless steel plug, stainless steel spring, teflon diaphragm and solder end connections. Provide replaceable coil assembly.
- G. Hot Gas Bypass Valves: Provide with integral solenoid valve, external equalizer connection and adjustable pilot assembly.
- H. Thermostatic Expansion Valves: Brass body, bronze disc, neoprene seat, bronze bonnet, stainless steel spring and solder end connections.
- I. Charging Valves: Provide 1/4-inch SAE brass male flare access ports with finger tight, quick seal caps. Provide 2-inch long copper extension sections.
- J. Check Valves: Spring loaded type with bronze body, bronze disc, neoprene seat, bronze bonnet, stainless steel spring and solder end connections.

## 2.03 REFRIGERANT

- A. Refrigerant shall be R-32: Difluoromethane mixture in accordance with ASHRAE 34.

## PART 3-EXECUTION

### 3.01 PREPARATION

- A. Remove all foreign material from interior and exterior of pipe and fittings.

### 3.02 ERECTION

- A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult Drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

- B. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment
- C. Do not install piping running through any elevator shaft, public stairway, stair landing, or means of egress.
- D. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.

### 3.03 REFRIGERANT PIPING

- A. Refrigeration piping to be installed by firms who are experienced in installation of such piping and in accordance with the requirements of the International Mechanical Code and the Wisconsin Administrative Code Chapter SPS 345.
- B. All brazing filler metals shall have a melting temperature above 1,400°F and contain a minimum of 6 percent silver.
- C. Tubing to be new and delivered to the job site with the original mill end caps in place. Clean and polish all joints before brazing. Avoid prolonged heating and burning during brazing. Purge all lines with nitrogen during brazing. Provide manual shut-off and check valves as required.
- D. No refrigerant is to be vented directly to the atmosphere except that which may escape through leaks in the system during leak testing. During evacuation procedures, use equipment designed to recover and allow recycling of the refrigerant.
- E. Systems erected on site which use A1 refrigerants and no piping larger than 0.62 inch in diameter shall be leak tested with refrigerant in accordance with ASHRAE 15 as follows. All other systems shall be leak tested with dry nitrogen or nonflammable, nonreactive, dried gas in accordance with ASHRAE 15. Leak test the system by charging the system to a pressure of 10 psig with an HFC refrigerant, with the compressor suction and discharge valves closed and with all other system valves open. Increase pressure to 300 psig with dry nitrogen. Rap all joints with a mallet and check for leaks with an electric leak detector having a certified sensitivity of at least one ounce per year. Seal any leaks that may be found and retest.
- F. After completion of the leak test, evacuate the system with a vacuum pump to an absolute pressure not exceeding 1500 microns while the system ambient temperature is above 60°F. Break the vacuum to 2 psig with the refrigerant to be used in the system. Repeat the evacuation process, again breaking the vacuum with refrigerant. Install a drier of the required size in the liquid line, open the compressor suction and discharge valves, and evacuate to an absolute pressure not exceeding 500 microns. Leave the vacuum pump running for not less than two hours without interruption. Raise the system pressure to 2 psig with refrigerant and remove the vacuum pump.
- G. Charge refrigerant directly from original drums through a combination filter-drier. Each drier may be used for a maximum of three cylinders of refrigerant and then must be replaced with a fresh drier. Charge the system by means of a charging fitting in the liquid line. Weigh the refrigerant drum before charging so that an accurate record can be kept of the weight of

refrigerant put in the system. If refrigerant is added to the system through the suction side of the compressor, charge in vapor form only.

### 3.04 REFRIGERANT PIPING ACCESSORIES

- A. Install accessories in accordance with the manufacturer's written instructions and recommendations.

END OF SECTION



## SECTION 23 31 00

### DUCTWORK AND DUCTWORK SUPPORTS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Duct Pressure/System Class.
  - 2. Duct Materials.
  - 3. Fasteners, Hangers and Supports.
  - 4. Duct Sealants and Gaskets.
  - 5. Ductwork Fabrication.

##### 1.02 REFERENCES

- A. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Provide layout drawing for review prior to ductwork fabrication. Layout drawings shall be coordinated between all other trades prior to review.

##### 1.04 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 77 00—Contract Closeout.
- B. Record actual locations and sizes of ducts and duct fittings. Record changes in fitting location sizes and types. Show additional fittings used.

##### 1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with SMACNA—HVAC Duct Construction Standards—Metal and Flexible.

##### 1.06 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A standards.

##### 1.07 ENVIRONMENTAL REQUIREMENTS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain recommended minimum temperatures during and after installation of duct sealants.
- C. Ductwork shall be stored indoors or in durable, waterproof, abovegrade packing.

## 1.08 DUCTWORK DESIGN

- A. Duct layout and design shown on the Drawings are based on design of supply, return and exhaust system components. Any changes to the design for installation shall be submitted to and approved by OWNER and ENGINEER. Proposed changes shall be submitted with layout and pressure drop calculations. CONTRACTOR shall be responsible for the cost of any changes to the duct system or any system components.

## 1.09 DELIVERY, STORAGE AND HANDLING

- A. Store products inside and protect from weather.

## PART 2-PRODUCTS

### 2.01 DUCT PRESSURE/SYSTEM CLASS (METAL DUCTWORK)

- A. Ductwork shall be constructed to the static pressure class as shown below, unless otherwise noted: Exhaust Air Ductwork: 2-inch negative pressure class.

### 2.02 DUCT MATERIALS

- A. All sheet metal used for construction of duct shall be 24 gauge, or heavier, except for round ductwork 12 inches and smaller, which shall be 26 gauge where allowed by SMACNA.
- B. Galvanized steel ducts shall be ASTM A653 galvanized steel sheet, lock-forming quality, having G90 zinc coating of 1.25 ounces per square foot in conformance with ASTM A90. Sheet metal for ductwork noted or specified to be painted shall include "Paint Grip" finish.
- C. PVC Ducts:
  - 1. PVC piping (round duct) material less than 22 inches in diameter shall conform to ASTM D1784, Class 12454. PVC piping and fittings shall be PVC 1120, Schedule 80, high impact pipe conforming to ASTM D1785 with bells conforming to ASTM D2672. Solvent weld fittings shall conform to ASTM D2467, and for threaded, ASTM D2464. PVC round duct and fittings greater than or equal to 22 inches in diameter shall be of PVC conforming to ASTM D1784, Class 16444-D.
  - 2. All rectangular ductwork material shall conform to ASTM D1784, Class 16444-D. Ductwork shall be shop fabricated in accordance with SMACNA Thermoplastic Duct (PVC) Construction Manual. Duct shall be joined by hot gas fusion welding or solvent welding per manufacturer's instructions. PVC welders shall be DVS certified.
  - 3. All duct delivered to the job site shall be properly marked for type, grade, and design stress rating. Expansion joints shall be provided where needed. In general, all joints shall be solvent weld, except where flanges are required or as shown on the Drawings or where transition to another material is required.
  - 4. All exterior exposed duct shall be formulated with sufficient ultraviolet-light screeners to provide for long-term outdoor exposure with no deleterious effects.
  - 5. Entire duct shall be of PVC construction. PVC-coated materials are not acceptable.
  - 6. All PVC shall have a flame-spread rating of 25 or less in accordance with ULC S102.2.
- D. All ductwork within corrosive areas shall be PVC. Material proposed shall be compatible with corrosive vapors present in environment.

## 2.03 FASTENERS, HANGERS, AND SUPPORTS

- A. Ductwork shall be supported in accordance with SMACNA–HVAC Duct Construction Standards–Metal and Flexible. Secure wire method of support is not acceptable.
- B. Inserts and Fasteners:
  - 1. Concrete inserts installed prior to pouring shall be manufactured inserts. Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Acceptable manufacturers include Hilti, Rawl, and Redhead.
  - 2. Concrete fasteners installed after pouring shall be epoxy-type.
  - 3. Fasteners to ductwork shall be 316 stainless steel, unless otherwise indicated.
- C. Hangers:
  - 1. Strip hangers shall be only used in concealed areas and shall be galvanized steel.
  - 2. Hanger rod shall be ASTM A36 galvanized steel for galvanized ducts or 316 stainless steel for ducts other than galvanized, unless noted otherwise. Rods shall be continuously threaded.
- D. Supports:
  - 1. Duct support material shall be galvanized steel for galvanized duct. Material for supports in corrosive spaces shall be as noted below.
  - 2. Acceptable supports for trapeze hangers are steel angles or uni-strut. Exposed ductwork shall be supported by steel angle supports painted to match duct.
  - 3. Riser supports shall be angles or channels secured to the sides of the duct with welds or fasteners.
  - 4. Provide all supporting steel required for the installation of ductwork and materials, whether or not it is specifically indicated or sized, including angles, channels, beams, etc. to suspend or floor support.
- E. Corrosive Atmosphere Coatings:
  - 1. Corrosive environments shall be as noted on the Drawings.
  - 2. Ductwork in chemical feed rooms shall be supported with a plastic support system, Aickinstrut, or equal.

## 2.04 DUCT SEALANTS AND GASKETS

- A. Duct sealant shall be United McGill–United Duct Sealer, or equal for indoor applications and United McGill–Uni-Weather Duct Sealer, or equal for outdoor applications. Sealant shall be UL classified for flame and smoke development and shall be suitable for mating materials.
- B. Gaskets at flanged joints shall be butyl rubber or EPDM.

## 2.05 DUCTWORK FABRICATION

- A. Rectangular Field and Shop Fabricated Ductwork:
  - 1. Fabricate and support in accordance with SMACNA–Duct Construction Standards–Metal and Flexible. Duct material, gauges, reinforcing, joint types and sealing shall be in accordance with required pressure class in the standard.
  - 2. Construct tees, bends, and elbows with radius of not less than 1 1/2 times width of duct on centerline. Where not possible, rectangular elbows may be used with turning vanes in accordance with Section 23 33 00–Air Duct Accessories.

3. Increase duct sizes gradually, not exceeding 15-degree divergence wherever possible; maximum 30-degree divergence upstream of equipment and 45-degree convergence downstream.
4. Provide 45 degree expanded entry takeoffs unless otherwise indicated. Flange ductwork for attachment to grille registers and outlets, unless otherwise noted.
5. Provide reinforcement and rigidity required for pressure class.
6. Provide cross breaking or cross beading on duct sides larger than 18 inches.
7. Seal all joints airtight with gaskets and sealants.

## PART 3–EXECUTION

### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards–Metal and Flexible.
- C. Duct sizes are inside clear dimensions.
- D. Provide openings in ductwork to accommodate testing equipment and controllers. Where openings are provided in insulated ductwork, install a metal insulation sleeve of same material as ductwork.
- E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities. Make all necessary incidental changes in cross-section, offsets, etc., to avoid interference with other equipment and supports.
- F. Supports:
  1. Use double nuts and lock washers on threaded rod supports.
  2. Inserts shall be coordinated with general contractor for installation in concrete.
  3. The weight of the ductwork shall be supported independently of connected equipment.
  4. Roof Mounted Supports: Use for all ductwork on roof. Secure bottom of support flat on roof deck. Apply two coats of zinc rich paint to cut edges of all galvanized steel elements. Flashing and counter flashing by the Division 07 Contractor.
  5. Secure ducts to supports with metal straps over ductwork and insulation and jacketing, if applicable.
- G. Duct Penetration Through Roof: Install at points where ducts penetrate roof. Install as shown on the Drawings, as detailed and according to the manufacturer's installation instructions. Fill the entire void space with compressible fiberglass insulation. Flashing and counterflashing by the Division 07 Contractor.
- H. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- I. Provide an experienced installer to go through the air distribution system with the balancer.
- J. Any modifications to the ductwork shown on the Drawings must be reviewed by ENGINEER prior to installation.

- K. Where ducts pass through non-fire rated partitions in interior or exterior walls, provide stainless steel flange on four sides on both sides of partition concealing opening. Flange shall overlap opening all around by 2 inches. Fill space with insulation if duct is insulated on either side of partition.
- L. Where ducts pass through fire rated partitions in interior or exterior walls, install fire damper sleeve in accordance with manufacturer's recommendations.

### 3.02 CLEANING AND PROTECTION

- A. Temporary Closure: At ends of ducts which are not connected to equipment or distribution devices at time of ductwork installation, cover with polyethylene film or other covering which will keep the system clean until installation is completed.

END OF SECTION

## SECTION 23 33 00

### AIR DUCT ACCESSORIES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Air Turning Devices.
  - 2. Duct Access Doors.
  - 3. Duct Test Holes.
  - 4. Fire Dampers.
  - 5. Flexible Duct Connections.
  - 6. Duct Screens.
  - 7. Control Dampers.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
  - 1. NFPA 90A—Installation of Air Conditioning and Ventilating Systems.
  - 2. SMACNA—HVAC Duct Construction Standards—Metal and Flexible.
  - 3. UL 33—Heat Responsive Links for Fire-Protection Service.
  - 4. UL 555—Fire Dampers and Ceiling Dampers.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Damper submittals shall include actual pressure drop, free area, and torque requirements for each type of damper provided.

##### 1.04 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 77 00—Contract Closeout.
- B. Record actual locations of access doors, fire dampers, flexible duct connections, dampers, and screens.

##### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and handle products in accordance with manufacturers recommendations and Section 01 60 00—Materials and Equipment.

## 1.06 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

## PART 2—PRODUCTS

### 2.01 AIR TURNING DEVICES

- A. Provide factory-fabricated metal air turning vanes in all square elbows and bends according to SMACNA Standards. Turning vanes shall be constructed of the same material specified for the ductwork.

### 2.02 DUCT ACCESS DOORS

- A. Provide Ductmate Model FD&H, or equal, access doors for ductwork. Access door hinge and cover shall be constructed of material similar to that specified for ductwork. Provide insulated access doors where ductwork is insulated. All access doors shall be gasketed.
- B. Provide Chicago Plastics Systems PVC gasketed duct access doors with hinges and plastic knobs in all PVC ductwork, or equal.

### 2.03 DUCT TEST HOLES

- A. Provide Ventfabrics, Inc. No. 699 Instrument Test Holes, or equal, complete with gaskets and screw caps. Coordinate test hole height with insulation thickness.
- B. On uninsulated ductwork only, plastic pull-tab centered tapered plugs may be used. Plugs shall be Caplugs CPT-3, or equal, with minimum diameter of 0.36 inch.

### 2.04 FIRE DAMPERS

- A. Provide fire dampers equal to Greenheck Model DFD-150, Type B or Type C, or Model DFD-350, of sizes and locations as indicated on the Drawings. Dampers shall have a 1 1/2-hour fire rating unless indicated on the Drawings to have a 3-hour rating. Fire dampers shall meet NFPA 90A and shall be UL555 listed and labeled. Blades shall be located out of the airstream. Dampers shall be of stainless steel construction where indicated.

### 2.05 FLEXIBLE DUCT CONNECTIONS

- A. Flexible duct connections in unrated spaces shall be Ventfabrics, Inc. "Ventglas®", or equal, neoprene-coated glass fabric. Fabric shall be suitable for continuous operation up to 200°F. Fabric shall have zero leakage at ±10 inches water column.
- B. Flexible duct connections in rated spaces shall be Ventfabrics, Inc. "Ventel™", or equal, Teflon fluorocarbon resin-coated glass fabric. Fabric shall be suitable for continuous operation up to 500°F. Fabric shall have zero leakage at ±8 inches water column.

## 2.06 DUCT SCREENS

- A. Provide screens equal to Ryerson Ryex Standard, 3/4-inch, 12-gauge sheet metal with border frame for protection on open duct inlets and outlets, and as indicated on the Drawings. Frame and screen shall be of similar material to ductwork.
- B. In PVC ductwork, provide screen equal to Harrison Machine and Plastic, 3/4-inch with border frame for protection, in lieu of metal. Install screen at sufficient angle to provide 60% of duct-free area through screen.

## 2.07 BALANCING DAMPERS

- A. All balancing dampers shall be provided with locking devices to hold the dampers in a fixed position without vibration. Single blade dampers shall be stiffened to operate in a stable manner.
  - 1. Balancing dampers for rectangular metal ductwork 12 inches high or less and for round metal ductwork shall be single blade manual balancing dampers of same material as specified for the ductwork. Dampers shall conform to SMACNA standards for single blade-type volume dampers.
  - 2. Balancing dampers for rectangular ductwork over 12 inches high shall be Greenheck VCD-20, or equal, multi-blade volume dampers of same material as specified for the ductwork. Damper blades shall be 3V type of 16-gauge construction. Bushings shall be nylon. Axles shall be 1/2-inch diameter. Blade operation shall be opposed. Damper shall include an indicator to show position of the blades. Where dampers are installed in vertical ductwork, provide dampers with jamb seals designed for vertical duct installation.
- B. Dampers for PVC ductwork shall be Chicago Plastics Systems Blastgate or quadrant damper, or equal. Dampers shall be PVC with lockable blades for balancing.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards—Metal and Flexible. Refer to Section 23 31 00—Ductwork and Ductwork Supports for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts where indicated.
- C. Provide duct access doors for inspection and cleaning before and after intake louver screens, filters, coils, fans, automatic dampers, at fire dampers, underneath duct smoke detectors, and elsewhere as indicated. Provide minimum 8-inch by 8-inch size for hand access, 18-inch by 18-inch size for shoulder access, and as indicated.
- D. Division 23 shall be responsible for coordinating with testing and balancing agency and providing test holes in all locations required for testing and balancing agency to complete their scope of work.



- E. Provide fire dampers at locations indicated and where ducts and outlets pass through fire-rated components. Install with perimeter mounting angles, sleeves, breakaway duct connections, corrosion-resistant springs, bearings, bushings, and hinges.
- F. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment. Metal-to-metal gap shall be approximately 4 inches.
- G. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts for air balancing and where indicated on the Drawings. Install minimum two duct widths from duct takeoff.
- H. Provide balancing dampers on duct takeoff to diffusers, grilles, and registers regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

## SECTION 23 34 16

### CENTRIFUGAL HVAC FANS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Ceiling or Cabinet Fans.
  - 2. Centrifugal Inline Fans.
  - 3. Centrifugal Blowers.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
  - 1. AMCA 99—Standards Handbook.
  - 2. AMCA 210—Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
  - 3. AMCA 300—Reverberant Room Method for Sound Testing of Fans.
  - 4. AMCA 301—Method for Calculating Fan Sound Ratings from Laboratory Test Data.
  - 5. ASTM B117—Standard Practice for Operating Salt Spray (Fog) Apparatus.
  - 6. NFPA 70—National Electrical Code.
  - 7. NEMA MG 1—Motors and Generators.

##### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification. Include plans, elevations, sections, and details.
- C. Submittal shall include fan-specific performance curves showing airflow, head, and motor horsepower.
- D. Submit manufacturer's installation instructions and recommendations.
- E. Submittals must be specific to this project. Generic submittals will not be accepted.
- F. Hanging and support requirements shall follow the recommendations in the manufacturer's installation instructions.

#### 1.04 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Fans shall bear AMCA-certified rating seals.
- C. Electrical components shall be UL listed for the service specified.
- D. Electrical components and work shall be in accordance with the National Electrical Code.

#### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.
- F. Motors, shafts, and bearings shall be protected from weather and dust.

#### 1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule, and activities.
- B. Include replacement and spare parts lists.

#### 1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

### PART 2—PRODUCTS

#### 2.01 CEILING FANS OR CABINET FANS

- A. Acceptable manufacturers are Greenheck, Cook, or Twin City Fans.

- B. Fans shall have acoustically insulated housings and shall have maximum sound level rating not to exceed 4.0 sones in accordance with AMCA Bulletin 300-74. Fans shall bear the AMCA-certified ratings and seal for air capacity, sound, and UL label.
- C. Unit shall be equipped with integral chatter proof backdraft damper.
- D. Fans shall have centrifugal wheel with inlet perpendicular to grille. Ceiling grille shall be aerodynamically designed and shall provide 80% free area.
- E. Terminal box shall be furnished with cord, plug, and receptacle inside housing. Entire fan, motor, and wheel assembly shall be removable without disturbing the housing. Motor speed shall not exceed 1,100 rpm.
- F. Fan shall be mounted on vibration isolators furnished by fan manufacturer.
- G. Manufacturer shall furnish line voltage internally-mounted and wired variable speed controller for fan. Controller shall be used for balancing only and shall be inaccessible to room occupants unless otherwise indicated on the Drawings. The fan motor shall be open drip proof as indicated on Drawings. Starters and disconnects shall be provided as noted on equipment schedules. Where indicated on equipment schedules, provide electronically commutated motor (ECM).

## 2.02 CENTRIFUGAL INLINE FANS

- A. Acceptable manufacturers are Greenheck, Cook, or Twin City Fans.
- B. Centrifugal inline fans shall be of drive type indicated on drawing schedules. Fan performance shall be as indicated on equipment schedules. Fans shall be UL listed.
- C. The fan wheel shall be centrifugal with backward-inclined blades. The fan wheel shall be statically and dynamically balanced.
- D. The fan shall be quiet-operating and vibration-free. Fan performance shall include AMCA-certified air and sound ratings and AMCA seal. Furnish and install spring-type vibration isolators provided by fan manufacturer.
- E. The fan shaft shall be mounted in prelubricated ball bearing pillow blocks. Bearings shall be sealed and have a minimum L<sub>10</sub> life of 100,000 hours.
- F. The fan housing shall be all aluminum construction with square inlet and discharge collars. Provide access panels for servicing drives and motors. All fasteners shall be either stainless steel or aluminum.
- G. Fans shall be mounted on vibration isolators furnished by fan manufacturer.
- H. The motor shall be mounted out of the airstream. The fan motor shall be as noted on the equipment schedule and NEMA-approved ball-bearing type. Starters and disconnects shall be provided as noted on equipment schedules. Motors shall be provided with a 1.15 service factor. Motors 1 hp and higher shall have a NEMA premium efficiency rating. Where indicated on drawing schedules, provide electronically commutated motor.

- I. Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure. The motor furnished with the fan shall not operate into the motor service factor when operating under these conditions.

## 2.03 CENTRIFUGAL BLOWERS

- A. Blowers, as shown on the Drawings, shall be manufactured Plastec Ventilation, or equal.
- B. Blower housing shall be single-piece, seamless, UV-resistant polypropylene. Split-molded housings are not acceptable. All supporting hardware shall be stainless steel.
- C. The blower wheel shall be constructed of polypropylene and be forward-curved type. Blower wheel shall be statically and dynamically balanced. Blower wheel shall be provided with a motor shaft bushing and hubcap made of polypropylene.
- D. The blower motor shall be UL listed for continuous-duty. Motor shall be as noted on the equipment schedule and provided with a motor junction box. Fabricate motor stand out of aickinstrut. Starters and disconnects shall be provided as noted on equipment schedules.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install in accordance with manufacturer's instructions and approved submittals. Test for proper operation and adjust until satisfactory results are obtained.
- C. Install units with vibration isolators as recommended or supplied by manufacturer.
- D. Provide flexible duct connections on all duct connections to unit in accordance with Section 23 33 00-Air Duct Accessories.
- E. Provide lubrication line extenders as required to allow regreasing of bearings without removal of equipment components.
- F. Provide all mounting hardware and accessories necessary for complete installation.
- G. Touch-up, repair or replace damaged products at no additional cost to OWNER.
- H. Installation of all equipment furnished under this Contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation, and plant operators/building maintenance personnel shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.
- I. Drawings and Specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or

alternates of other manufacturers or model numbers including but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of Drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

END OF SECTION

## SECTION 23 37 08

### LOUVERS AND VENTS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Louvers.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
  - 1. ADC 1062—Certification Rating and Test Manual.
  - 2. AMCA 500—Test Method for Louvers, Dampers, and Shutters.
  - 3. ARI 650—Air Outlets and Inlets.
  - 4. ASHRAE 70—Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
  - 5. NFPA 90A—Installation of Air Conditioning and Ventilating Systems.

##### 1.03 QUALITY ASSURANCE

- A. Performance of air terminals shall be in accordance with ADC 1062.
- B. Louvers shall be tested and certified in accordance with AMCA 500 and shall bear the AMCA seal.

##### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Include a louver schedule that includes louver model, screen type, screen location, louver size, finish type, free areas, face velocity, and pressure drop for each louver.
- C. Submit manufacturer's installation instructions and recommendations.
- D. Submit color selection chart with submittal for selection by OWNER.

##### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage.

- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. Scratched, dented, and otherwise damaged units shall be repaired or replaced with no additional cost to OWNER.

## PART 2—PRODUCTS

### 2.01 LOUVERS (EXTRUDED ALUMINUM)

- A. Acceptable louvers are Greenheck ESD 635, or equal. See Drawings for sizes and locations.
- B. Blades and frame shall be extruded aluminum 6063-T5 alloy and 0.08-inch thickness.
- C. Blades shall be 35-degree drainable type spaced at 4 inches on center. Louver shall be capable of a velocity of 1,077 fpm with no water penetration. Performance shall include AMCA-certified air and moisture penetration data and louver shall bear the AMCA seal. Vertical and horizontal mullions and connections between panels shall not be exposed.
- D. Provide channel frame unless noted otherwise on the Drawings.
- E. Provide aluminum screen on louver (type and location) in accordance with louver schedule and detail on the Drawings. All fastenings shall be stainless steel or aluminum. Screen frame shall be painted to match louver. Paint shall be by manufacturer or per Section 09 91 00—Painting.
- F. Louver free area shall be equal to or greater than attached ductwork and damper free area.
- G. Louvers shall be furnished with 3 coats of 70% Kynar 500 finish with custom color selected by OWNER. Submit manufacturer's standard color chart with shop drawings.

## PART 3—EXECUTION

### 3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify ENGINEER of unsatisfactory preparation before proceeding.

### 3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.



- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.03 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install in accordance with manufacturer's instructions, drawing details, and approved submittals.
- C. Clean surface of louvers after installation.

END OF SECTION

## SECTION 23 37 23

### HVAC GRAVITY VENTILATORS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Gravity roof ventilators.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references: NFPA 90A—Installation of Air Conditioning and Ventilating Systems.

##### 1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Performance of air terminals shall be in accordance with ADC 1062.

##### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification. Include plans, elevations, sections, and details.
- C. Submittal shall include a ventilator schedule that includes ventilator model, screen type, ventilator size, finish type, free area, face velocity, and pressure drop for each ventilator.
- D. For product requiring color selection, provide a hard copy color chart to OWNER for color selection.

##### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.

- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

## PART 2-PRODUCTS

### 2.01 GRAVITY ROOF VENTILATORS

- A. Acceptable manufacturers are Greenheck, Carnes, or equal.
- B. Gravity roof ventilator shall be heavy gauge aluminum construction and provided with roof curb and bird screen.
- C. Manufacturer shall furnish, and CONTRACTOR shall install, a prefabricated insulated aluminum roof curb with wood blocking to match roof pitch to allow for a level curb on roof. Curb shall be sized for 1/4-inch clearance on all sides between curb and ventilator mounting flange. Curb insulation shall be 1-inch thick, 3 pounds per cubic foot rigid fiberglass board. Curb height for low side of curb shall be 12 inches unless otherwise indicated. For roof ventilators on pitched roof, manufacturer shall furnish a pitched crickets roof curb. Roof curb shall be provided with a foam seal and an aluminum liner.
- D. All surfaces of the gravity roof ventilators including curb liner shall be coated with 2 to 3 mils of Hi-Pro Polyester powder coating. Color shall be selected by OWNER. Submit color chart with shop drawings.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install in accordance with manufacturer's instructions and approved submittals.
- C. Provide all mounting hardware and accessories necessary for complete installation.
- D. Drawings and Specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

END OF SECTION

## SECTION 23 51 00

### BREECHINGS, CHIMNEYS, AND STACKS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Breechings/Connector Vents.
  - 2. Engine Exhaust Vent.
  - 3. Terminations.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following reference.
  - 1. ASTM A167—Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
  - 2. ASTM A525—Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, General Requirements.
  - 3. ASTM A527—Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality.
  - 4. ASTM D1784—Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
  - 5. NFPA 54 (ANSI Z223.1)—The National Fuel Gas Code.
  - 6. NFPA 211—Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances.
  - 7. SMACNA—HVAC Duct Construction Standards—Metal and Flexible.
  - 8. UL 103—Standard for Factory Built Low Heat Chimneys.
  - 9. UL 441—Standard for Gas Vents.
  - 10. UL 641—Standard for Low Temperature Venting Systems.
  - 11. UL 959 (ANSI Z181.1)—Medium Heat Appliance Factory Built Chimneys.

##### 1.03 QUALITY ASSURANCE

- A. Factory-built vents and chimneys used for venting natural draft appliances shall comply with NFPA 211 and be UL listed and labeled.

##### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Engineered generator exhaust systems shall be submitted with layout and section drawings by the manufacturer.

## 1.05 REGULATORY REQUIREMENTS

- A. Conform to NFPA 54 and local codes for installation of natural gas appliances and equipment.

## 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and handle products in accordance with manufacturers' recommendations and Section 01 60 00—Materials and Equipment.

## 1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

# PART 2—PRODUCTS

## 2.01 GENERAL

- A. For each fuel-fired appliance, provide venting of category recommended by manufacturer.
- B. Size vents in accordance with manufacturer's recommendations.

## 2.02 BREECHINGS/CONNECTOR VENTS

- A. Fabricate breechings of lock forming quality galvanized steel with ANSI/ASTM A525 G90 zinc coating. Fabricate with groove seams (pipe lock or flat lock), end joints beaded and crimped. Breechings shall be of 16-gauge galvanized steel or heavier, in accordance with SMACNA HVAC Duct Construction Standards—Metal and Flexible.
- B. Where indicated on Drawings, provide cleanout doors. Doors shall be same gauge as breeching.
- C. Weld longitudinal seams. Fabricate joints by welding, lapping and bolting, or with companion flanges. Provide groove seam with end joints beaded and crimped.
- D. Fabricate breeching fittings to match adjoining breechings. Fabricate elbows with center line radius equal to 1.5 times breeching diameter. Limit angular tapers to 20 degrees maximum.

## 2.03 ENGINE EXHAUST VENT

- A. ASTM A53, schedule 40, black steel pipe with ASTM A234 150-lb butt welded fittings. Provide drain, roof flashing, counter-flashing and necessary supports.
- B. Size pipe in accordance with manufacturer's recommendations.
- C. Provide thimble for penetration through building wall/roof. Thimble shall be GT Systems Model 20, or equal.

## 2.04 TERMINATIONS

- A. Small (<500 MBH) gas appliance vent terminations shall be as allowed by the appliance and vent system manufacturers.

## PART 3—EXECUTION

### 3.01 INSTALLATION

- A. Install stack, breeching, and accessories in accordance with the manufacturer's recommendations, maintaining minimum clearances from combustibles specified in UL listing, NFPA 54, and local codes.
- B. Level and plumb chimney and stacks.
- C. Install breechings with as few joints as possible. Align connections accurately and maintain smooth internal surfaces. All joints of positively pressurized exhaust vents shall be leak tight.
- D. Clean breeching, chimneys, and stacks internally during and after installation to remove dust and debris. Clean external surfaces to remove welding slag and mill film.
- E. At appliances, provide slip joints permitting removal of appliances without removal or dismantling of breechings, breeching insulation, chimneys, or stacks.
- F. Provide minimum 2-foot length of breeching to connect appliance to chimney.
- G. Insulate breechings in accordance with Section 23 07 13—Ductwork Insulation for Heating, Air Conditioning, and Ventilation.
- H. Pitch breechings with 1/4 inch per foot slope up from fuel-fired equipment to chimney or stack.
- I. At ends of breeching and chimneys which are not completed or connected to equipment, provide temporary closure which will prevent entrance of dust and debris until final connections are made.
- J. Support breechings from building structure, rigidly with suitable ties, braces, hangers, and anchors to hold to shape and prevent buckling. Support per manufacturer's recommendations and refer to SMACNA HVAC Duct Construction Standards—Metal and Flexible for equivalent duct support configuration and size. At minimum, support vertical sections at each floor penetration. Support from floor structure, roof structure, or adjacent structural surfaces. Verify load bearing capacity of support points with ENGINEER.
- K. Locate exhaust termination and combustion air intake in accordance with appliance manufacturer's recommendations to prevent re-entry of products of combustion.
- L. Termination of exhaust within 10 feet of operable windows, other building openings, or air intakes will not be accepted.
- M. Locate terminations with respect to normal wind direction so that the products of combustion are not likely to enter the building, regardless of the distance from the vent to the building

openings or air intakes. Provide adequate termination height to avoid contamination of building recirculation zones in accordance with guidelines of ASHRAE Fundamentals.

- N. Seal all joints of positive pressure stacks and breeching in accordance with manufacturer's recommendations, using only sealants recommended by stack manufacturer.
- O. Provide drain points as indicated and per the manufacturer's recommendation to allow proper draining of condensate. Provide Flue Gas Condensate pH Neutralization at each drain piping termination point.
- P. Pitch engine exhaust vents as shown on the Drawings.
- Q. Install engine exhaust vibration isolation and muffler furnished by Division 26. Install vent pipe with proper pitch for drain.
- R. Generator Stack Drains: Provide threaded pipe connection to allow drainage at all low points and drain connections in stack and breeching systems. Slope piping system to drain. Pipe size shall be 1 inch minimum.

### 3.02 AIR INLETS AND VENT TERMINATIONS

- A. Coordinate air intakes with other vent terminations, plumbing vents, and HVAC exhaust openings.
- B. Terminations shall not be within 10 feet horizontally or less than 3 feet above openings for HVAC intakes or combustion air inlets.

END OF SECTION

## SECTION 23 81 26

### SPLIT-SYSTEM AIR CONDITIONERS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Split systems (SS).
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
  - 1. ASHRAE 15—Safety Code for Mechanical Refrigeration.
  - 2. ASHRAE 62—Ventilation for Acceptable Indoor Air Quality.
  - 3. ASHRAE 90A—Energy Conservation in New Building Design.
  - 4. NFPA 70—National Electrical Code.
  - 5. NFPA 90A—Installation of Air Conditioning and Ventilating Systems.
  - 6. UL900—Test Performance for Air Filter Units.

##### 1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session.
- C. Electrical components shall be UL listed for the service specified.
- D. Electrical components and work shall be in accordance with the National Electrical Code.
- E. Insulation and insulation adhesive shall comply with NFPA 90A requirements for flame spread and smoke generation.
- F. Direct expansion coils shall be designed and tested in accordance with ASHRAE 15 Safety Code for Mechanical Refrigeration, latest edition.

##### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's



performance limitations, and appropriate identification. Include plans, elevations, sections, and details.

- C. Project specific wiring diagrams for power, signal, and control.
- D. Submit manufacturer's installation instructions and recommendations.
- E. Submittals must be specific to this project. Generic submittals will not be accepted.
- F. Hanging and support requirements shall follow the recommendations in the manufacturer's installation instructions.

#### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

#### 1.06 OPERATION AND MAINTENANCE DATA

- A. Include installation instructions, assembly views, lubrication instructions, recommended maintenance schedule and activities.

#### 1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

### PART 2-PRODUCTS

#### 2.01 SPLIT SYSTEM (SS)

- A. Acceptable manufacturers are Sanyo, Mitsubishi, or Daikin.
- B. General:
  - 1. Split system unit shall be an indoor wall-mounted evaporator/blower section and matching outdoor condensing section.

2. Systems shall bear the ARI label showing that the system is ARI 210 or 240. Systems shall be listed by a Nationally Recognized Testing Laboratory and bear the NRTL label. Matching systems shall meet or exceed a Seasonal Energy Efficiency Rating (SEER2) of 21, as certified by the ARI testing programs.
  3. Matching indoor and outdoor sections shall be connected by deoxidized, annealed refrigerant copper tubing, type "L" cleaned and capped. All systems shall have flared refrigeration connections on both indoor and outdoor sections.
  4. Systems indoor and outdoor sections shall be completely factory assembled and wired with a precharge of refrigerant. A single power source shall provide voltage to both the outdoor and indoor units. Electrical wire and connections to outdoor section and between indoor and outdoor sections shall be sized, installed and grounded by the installer in conformance with the National Electrical Code (NEC), local codes, as well as manufacturer's instructions.
  5. System shall be equipped with a microprocessor control system with a wired remote controller with LCD display, that provides access to all system functions, and transmits room conditions and programs to the indoor microprocessor every 3 minutes. Wired remote controller shall be capable of operating system mounted up to 26 feet from the indoor section according to manufacturer's recommendations and instructions. System shall have the capability of continuous operation in the case of a damaged remote controller, utilizing a factory-installed integral manual switch in conjunction with the system microprocessor.
- C. System Remote Controller: Controller shall include system mode selection, programmable temperature control, 24-hour programmable timer, automatic three-speed indoor fan speed control, constant fan speed selection, night setback mode, user selectable room temperature sensor located on indoor unit multiple system control using a single wired controller. Provide lockable remote controller bracket. Controller model shall be Daikin One Like Smart Thermostat (DTST-LTE-LA-A), or equal.
- D. Outdoor Condensing Section:
1. Outdoor condensing section shall be factory assembled, wired, piped, and precharged with a start-up amount of R-32 refrigerant.
  2. Unit shall be constructed of rust-proofed mild steel panels coated with a baked enamel finish. The unit shall be completely weatherproof and corrosion-resistant.
  3. Unit shall be furnished with a high-efficiency, variable speed, swing inverter-driven compressor. Unit shall have an accumulator and four-way reducing valve. The compressor shall have internal thermal overload protection.
  4. Condenser coil heat exchanger shall be of nonferrous construction with corrugated fin tube. The fins are to be covered with an anti-corrosion acrylic resin and hydrophilic film, rated for up to 500 hours salt spray. Refrigerant flow from the condenser shall be controlled via a metering device.
  5. Fan motor shall be direct drive with internal overload protection, permanent lubrication. Fans shall be propeller type, mounted for horizontal air discharge. A fan guard shall be provided on the outdoor unit to prevent contact with fan operation.
  6. Brass valves with refrigeration flare connections and flare nuts and service ports shall be factory mounted prior to shipment for installation.
  7. Low ambient outdoor section shall contain a microprocessor, factory mounted and wired, to assist in control of low ambient operation. Unit shall be factory provided with internal thermal overload protector.
  8. Cooling Only Models: Unit shall be able to operate in the A/C mode down to -4°F outdoor temperature.

E. Indoor Evaporator Section:

1. Indoor section shall be wall mount type with single direction airflow, factory assembled and wired.
2. Unit evaporator coil shall be a nonferrous, aluminum fin on copper tube heat exchanger. All tube joints shall be brazed with silver alloy or phoscopper. Coil shall be factory pressure tested. The fins shall be covered with an anti-corrosion acrylic resin and hydrophilic film, rated for up to 500 hours salt spray.
3. Fan motor shall be direct drive. The fan shall be statically and dynamically balanced and operate on a motor with permanent lubricated bearings. The fan shall have three speeds, plus quiet and auto settings. The fan shall be removable without the need to detach the evaporator coil or blower.
4. Unit shall contain microprocessor, factory mounted and wired, that receives and processes all commands and transmissions from the wired system controller. Indoor unit shall also contain an Operation Switch with visible lamps for operation, standby and timer functions, as well as a system test switch and manual ON/OFF switch.
5. Unit shall have refrigeration line connections with flare nuts.
6. Indoor section shall be provided with factory assembled supply and return air grille with a motorized louver/flap on the supply air opening. The motorized louver/flap, controlled by the wired remote controller, shall provide automatic, full-oscillating supply airflow, as well as being capable of being placed in a set, stationary position.
7. Unit shall also contain adjustable horizontal air louvers to provide user defined directional airflow.
8. Unit shall be provided with a removable, washable air filter. In addition, unit shall have two permanent titanium apatite air-purifying filters.

### PART 3-EXECUTION

#### 3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify ENGINEER of unsatisfactory preparation before proceeding.

#### 3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

#### 3.03 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install in accordance with manufacturer's instructions and approved submittals. Test for proper operation and adjust until satisfactory results are obtained.
- C. Pipe and trap condensate to grade in accordance with Section 22 13 16-Sanitary Waste and Vent Piping and as shown on Drawings.

- D. Protect installed products until completion of project.
- E. Touch-up, repair or replace damaged products at no additional cost to OWNER.
- F. Installation of all equipment furnished under this Contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation, and plant operators/building maintenance personnel shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.
- G. Drawings and Specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

#### 3.04 CLEANING

- A. Unit and filters shall be cleaned prior to final acceptance by OWNER.

END OF SECTION

## SECTION 23 82 39

### UNIT HEATERS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Electric unit heaters.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
  - 1. ARI 410—Forced Circulation Air-Cooling and Air-Heating Coils.
  - 2. NFPA 70—National Electrical Code.

##### 1.03 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- B. Electrical components shall be UL listed for the service specified.
- C. Electrical components and work shall be in accordance with the National Electrical Code.
- D. Coil performance shall be certified in accordance with ARI 410.

##### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00—Submittals.
- B. Include data concerning dimensions, required clearances, capacities, materials of construction, ratings, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification. Include plans, elevations, sections, and details.

##### 1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs, if required for handling.
- B. Materials that could be damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.

- C. Store materials in a clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- D. Use all means necessary to protect equipment before, during, and after installation.
- E. All scratched, dented, and otherwise damaged units shall be repaired or replaced at no additional cost to OWNER.

## 1.06 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

## PART 2-PRODUCTS

### 2.01 ELECTRIC UNIT HEATERS

- A. CONTRACTOR shall provide electric heaters of the type, size, capacity, and accessories as listed on the equipment schedule. All units shall be UL listed.
- B. All electric unit heaters shall be factory-assembled and tested.
- C. Electric Unit Heaters (Standard) (EUH):
  1. Acceptable manufacturers are Chromalox, QMark, Indeeco, or equal.
  2. The cabinet shall be constructed of heavy gauge, die-formed steel with baked enamel coating. Manufacturer shall provide mounting bracket.
  3. Provide a propeller fan with direct-drive, totally enclosed motor.
  4. Provide an aluminum-finned copper-clad steel sheath heating element.
  5. Provide an automatic reset thermal cutout to protect the element.
  6. Unit-mounted equipment disconnect shall be ABB OT Series, or equal, provided by manufacturer and meet the requirements of Division 26.
  7. Mount units to provide 8 feet 0 inch clearance below, unless otherwise shown on the Drawings.
  8. Unit shall include a thermal fan delay to dissipate heat when coil deenergizes, and prevent cold air drafts when it starts.
  9. Unit control voltage shall be 120 V. Line voltage (120 V) thermostat shall be provided by Division 26.
- D. Electric Unit Heaters (Corrosion-Resistant) (EUH):
  1. Acceptable manufacturers are:
    - a. QMark Model QWD.
    - b. Berko Model BWD.
    - c. Chromalox Model HD3D.
    - d. INDEECO Model TRIAD.
  2. The cabinet shall be constructed of heavy gauge stainless steel with stainless steel adjustable air deflectors and stainless steel wall-mounting bracket. Heating elements shall be 316 stainless steel sheathed with 316 stainless steel fins.

3. Unit shall include a direct-drive totally enclosed epoxy coated motor, wired to a NEMA 4X enclosure.
  4. Unit shall include an automatic reset thermal cutout to protect the element and a thermal fan delay.
  5. Unit control voltage shall be 120 V. Line voltage (120 V) thermostat shall be provided by Division 26.
  6. Unit-mounted equipment disconnect shall be ABB OT Series provided by manufacturer suitable for corrosive locations and meet the requirements of Division 26.
  7. Mount bottom of units 8 feet 0 inch above finished floor, unless otherwise shown on Drawings.
- E. Electric Wall Heaters (EWH):
1. Acceptable manufacturer is QMark, or equal.
  2. Furnish and install a steel cabinet for surface mounting on a standard block wall as shown on Drawings. Provide a cabinet with 16 gauge steel grille bars and finished in baked enamel.
  3. Provide a direct-drive propeller fan and permanently lubricated totally enclosed motor.
  4. Provide steel-finned metal sheath electric heating elements.
  5. Provide manual reset thermal overhear protection to disconnect power in the event of overheating. Provide an integral, tamper-resistant thermostat. Provide integral contactors and disconnects.

## PART 3—EXECUTION

### 3.01 INSTALLATION

- A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.
- B. Install in accordance with manufacturer's instructions and approved submittals. Test for proper operation and adjust until satisfactory results are obtained.
- C. Provide all mounting hardware and accessories necessary for complete installation.
- D. Installation of all equipment furnished under this Contract shall be supervised by a qualified representative of the equipment manufacturer. All equipment shall be placed in operation, and plant operators/building maintenance personnel shall be trained to the satisfaction of OWNER by a qualified representative of the equipment manufacturer. OWNER may videotape training presentations given by manufacturer's representatives. Final payment for various items of equipment will not be made by OWNER until the equipment is operating to their satisfaction.
- E. Drawings and Specifications are based on the scheduled manufacturer and model number. CONTRACTOR shall be responsible for the cost of any changes because of substitutions or alternates of other manufacturers or model numbers including but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall pay all costs for revisions of drawings by ENGINEER. Any changes shall be coordinated and provided at no additional cost to OWNER.

END OF SECTION

## SECTION 26 05 00

### GENERAL ELECTRICAL REQUIREMENTS

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work includes general requirements for all electrical work.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern Work in this section.

##### 1.02 REFERENCES

- A. ANSI/NFPA 70—National Electrical Code (NEC).
- B. ANSI/IEEE C2—National Electrical Safety Code.

##### 1.03 CONTRACT DOCUMENTS

- A. Any equipment roughed in improperly and/or not positioned on implied centerlines or as dictated by good practice shall be repositioned at no cost to OWNER.
- B. The Drawings are generally diagrammatic, and CONTRACTOR shall coordinate the Work so that interferences are avoided. Provide all offsets in conduit, fittings, etc., necessary to properly install the work. All offsets, fittings, etc., shall be provided without additional expense to OWNER.

##### 1.04 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 70.
- B. Conform to ANSI/IEEE C2.
- C. The rules and regulations of the federal, state, local, and civil authorities and utility companies in force at the time of execution of the Contract shall become a part of this specification.
- D. Obtain electrical permits and inspections from authority having jurisdiction. Costs for permits and inspections shall be paid by CONTRACTOR.

##### 1.05 CODES AND ORDINANCES

- A. CONTRACTOR is expected to know or to ascertain, in general and in detail, the requirements of all codes and ordinances applicable to the construction and operation of systems covered by this Contract. CONTRACTOR shall know or ascertain the rulings and interpretations of code requirements being made by all authorities having jurisdiction over the work to be performed by them.



- B. In preparing a Bid, CONTRACTOR shall include the cost of all items and procedures necessary to satisfy the requirements of all applicable codes, ordinances, and authorities, whether or not these are specifically covered by the Drawings and Specifications. All cases of apparent conflicts between the Drawings, Specifications, and codes shall be brought to ENGINEER's attention, as herein before specified. CONTRACTOR shall carry out work and complete construction as required by applicable codes and ordinances and in such a manner as to obtain approval of all authorities whose approval is required.
- C. When requested by ENGINEER, CONTRACTOR shall provide written calculations to show compliance with applicable codes or the Contract Documents. This shall include, but not be limited to, conduit and wire sizing, junction and pull box fill and sizing, conductor derating, and voltage drop. CONTRACTOR shall indicate calculation method used as well as compliance with applicable code, drawing, or specification.

#### 1.06 EQUIPMENT PROVIDED UNDER OTHER DIVISIONS

- A. Included in this Contract are electrical connections to equipment provided under other divisions. CONTRACTOR shall refer to final shop drawings for equipment being furnished under other divisions, for exact location of electrical equipment, and the various connections required.

#### 1.07 ELECTRICAL DISTRIBUTION SYSTEM

- A. Provide a complete electrical distribution system consisting of components indicated on the Drawings or specified herein including, but not limited to:
  - 1. All miscellaneous equipment coordination and related appurtenances required by power company.
  - 2. 480-volt, three-phase, 4-wire service entrance conductors.
  - 3. Feeders, branch wiring, and electrical distribution equipment.
  - 4. All control wiring.
  - 5. Access panels and access doors for access to equipment installed by Division 26.
  - 6. Wiring between system components if equipment is not prewired.
  - 7. Lighting fixtures, lighting controls, and associated wiring.
  - 8. Support system design and supports for electrical raceways.
  - 9. Code-required disconnects.
- B. Provide a standby power system consisting of components indicated on the Drawings (see Section 26 32 13–Standby Power System and Section 26 36 24–Service Entrance-Rated Automatic Transfer Switches).
- C. CONTRACTOR shall connect all equipment furnished by other Divisions consisting of components indicated on the Drawings or specified herein.
- D. Provide balancing and adjusting of electrical loads.
- E. CONTRACTOR shall instruct OWNER's representative in the operation and maintenance of all equipment. The instruction shall include a complete operating cycle on all apparatus.
- F. Provide miscellaneous items for a complete and functioning system as indicated on the Drawings and specified herein.

- G. A partial list of work not included in Division 26 is as follows: Painting (except as otherwise specified herein).

#### 1.08 NOISE

- A. Eliminate any abnormal noises that are not considered by ENGINEER to be an inherent part of the systems as designed. Abnormal buzzing in equipment components will not be acceptable.

#### 1.09 DRAWINGS

- A. The Drawings indicate approximate locations of the various items of the electrical systems. These items are shown approximately to scale and attempt to show how these items should be integrated with building construction. Locate all the various items by on-the-job measurements in conformance with Contract Documents and cooperation with other trades.
- B. Prior to locating equipment, confer with ENGINEER as to desired location in the various areas. In no case should equipment locations be determined by scaling drawings. Relocate equipment and bear cost of redoing work or other trades' work necessitated by failure to comply with this requirement.
- C. In certain instances, receptacles, switches, light fixtures, or other electrical devices and equipment, etc., may be relocated. Where relocation is within 10 feet of location shown on the Drawings, and when CONTRACTOR is informed of necessary relocation before work is begun on this portion of the job, the relocation shall be at CONTRACTOR's expense.
- D. The Drawings are schematic in nature and are not intended to show exact locations of conduit, but rather to indicate distribution, circuitry, and control.

#### 1.10 EXISTING UNDERGROUND UTILITIES

- A. Record drawings of existing underground utilities are not available for this facility. CONTRACTOR shall excavate and verify the location of all underground utilities prior to installing new electrical equipment and prior to making modifications to existing electrical. This shall include, but not be limited to, feeders to structures and equipment, branch circuit wiring, phone and communication cabling, instrument wiring, and control wiring. CONTRACTOR shall temporarily relocate existing underground utilities to keep the existing facility in operation and for any new construction, and all costs for relocating existing electrical shall be included in the Bid.

#### 1.11 SUBMITTALS

- A. CONTRACTOR shall submit to ENGINEER for approval prior to beginning work, shop drawings on the equipment and materials proposed to be furnished and installed. See Section 01 33 00–Submittals for requirements.
- B. CONTRACTOR shall, in addition, submit drawings and/or diagrams for review and for job coordination in all cases where deviation from the Contract Drawings are contemplated because of job conditions, interference or substitution of equipment, or when requested by ENGINEER for purposes of clarification of CONTRACTOR's intent. CONTRACTOR shall also submit detailed drawings, rough-in sheets, etc., for all special or custom-built items or

equipment. Drawings and details under this section shall include, but not be limited to, the following, where applicable to this project:

1. Electrical interconnection wiring diagrams; see Section 26 09 00—Controls and Instrumentation and Section 26 24 19—Motor Control.
  2. Major feeder routing in plan and elevation, including service entrance raceways and cable.
  3. Equipment room layouts showing exact locations and arrangements of equipment, conduit, wiring, etc., and clearances.
- C. These drawings and diagrams shall show applicable electrical switch and breaker sizes as well as the manufacturer's name and catalog number for each piece of equipment used.
- D. Equipment and material submittals must show sufficient data to indicate complete compliance with Contract Documents as follows:
1. Proper sizes and capacities.
  2. That the item will fit in available space in the manner that will allow proper service.
  3. Construction materials and finishes.
- E. When the manufacturer's reference numbers are different from those specified, provide correct cross-reference number for each item. The shop drawings shall be clearly marked and noted accordingly.
- F. When equipment and items specified include accessories, parts, and additional items under one designation, shop drawings shall be complete and include all components.
- G. See additional requirements of shop drawings under Division 01—General Requirements.

## PART 2—PRODUCTS

### 2.01 STANDARD PRODUCTS

- A. All equipment and products shall be of new manufacture per applicable specifications.
- B. All equipment shall be UL and NEMA approved.
- C. Unless specified otherwise, major distribution equipment such as panelboards, motor control centers, motor starters, VFDs, SPD, transformers, etc., shall each be by the same manufacturer.
- D. All equipment and wiring shall be selected and installed for conditions in which it will perform (e.g., general purpose, weatherproof, raintight, dustproof, or any other special type).

### 2.02 SUBSTITUTION OF MATERIALS AND EQUIPMENT

- A. While it is not the intention of OWNER to discriminate against any manufacturer of equipment which may be equivalent to specified equipment, a strict interpretation of such equivalency will be exercised in considering any equipment offered as a substitute for specified equipment. CONTRACTOR shall submit with each request for approval of substitute material or equipment sufficient data to show conclusively that it is equivalent to that specified in the following respects:

1. Performance:
    - a. Capacity at conditions and operating speeds scheduled shall be equal to or greater than that of the specified equipment.
    - b. Energy consumption at the point of rating shall not exceed that of the specified equipment.
    - c. Vibration and noise production at the point of rating shall not exceed that of the specified equipment.
  2. Materials of construction.
  3. Gauges, weights, and sizes of all portions and component parts.
  4. Design arrangements, methods of construction, and workmanship.
  5. Coatings, finishes, and durability of wearing parts.
  6. National reputation of the manufacturer as a producer of first quality equipment of the type under consideration.
  7. Availability of prompt, reliable, and efficient service facilities franchised by or affiliated with the equipment manufacturer. This shall include the maintenance of local stocks of critical replacement parts equal to those maintained for the specified equipment.
- B. Requests for substitution shall include CONTRACTOR's reason for the request.
- C. If ENGINEER does not consider the items equivalent to those specified, CONTRACTOR shall provide those specified.
- D. See General Conditions for additional requirements.

#### 2.03 LOW-VOLTAGE WIRING (LESS THAN 100 VOLTS)

- A. Low-voltage wiring specified in this section shall be applicable to all systems installed that utilize low-voltage wiring where such wiring is not specified in other technical sections.
- B. All wiring shall have copper conductors with 300-volt insulation rating and meet the requirements of NEC Article 725.
- C. All conductors must be suitable for the application intended. Conductors 16 AWG and larger shall be stranded. Conductors 18 AWG and smaller may be solid or stranded.
- D. Control Cable for Class 1 Remote Control and Signal Circuits: Individual conductors twisted together, shielded, and covered with an overall PVC jacket. Cable shall be UL listed, temperature rated, and plenum or nonplenum rated for the application as required in the National Electrical Code.
- E. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits shall be constructed, UL listed, temperature rated, and plenum or nonplenum rated for the application as required in the NEC Article 725.

### PART 3—EXECUTION

#### 3.01 UTILITY SERVICES

- A. Utility connection requirements shall be determined. All costs for coordinating utility service shall be included in the price bid as described in Section 26 21 00—Electrical Service System of these specifications.

- B. All costs for temporary service, temporary routing of piping, or any other requirements of a temporary nature associated with the utility service shall be included in the Base Bid.
- C. It is the intent that in the latter stages of construction, the permanent electrical service will be used and the temporary construction service discontinued. The following requirements shall govern the use of the permanent services:
  - 1. No permanent service shall be available until structure is enclosed, watertight, and heated.
  - 2. Only permanently connected and protected circuits and outlets shall be available.
  - 3. Temporary wiring shall not be connected to permanent distribution equipment.
  - 4. Under the above conditions, the use of permanent service equipment shall in no way affect the Contract conditions of the guarantee.
- D. It shall be CONTRACTOR's responsibility to police this situation and protect its equipment.

### 3.02 CONTINUITY OF SERVICE

- A. CONTRACTOR shall provide and maintain continuous services (power, controls, alarms, etc.) during the entire construction period.
- B. No service shall be interrupted or changed without permission from OWNER. Written permission shall be obtained before any work is started.
- C. When interruption of service is required, all persons concerned shall be notified and a prearranged time agreed upon. Notice shall be a minimum of 72 hours prior to the interruption.

### 3.03 CLEANUP AND REMOVAL OF RUBBISH

- A. All lighting and appliance panelboards, MCCs, VFD enclosures, motor starter and disconnect switch enclosures, junction boxes, and pullboxes shall be cleaned of debris and wires neatly arranged with surplus length cut off before installation of covers.
- B. Where louvers are provided in MCCs, or transformer enclosures, louvers shall be vacuumed free of all dust and dirt. Where air filters are provided in equipment such as control panels, motor control centers and transformers, CONTRACTOR shall replace all filters with new at the time of final completion.
- C. All lighting fixture lenses (interior and exterior fixtures) shall be cleaned at the time of installation, and all lens exteriors shall be cleaned just prior to final inspection.
- D. Equipment shall be thoroughly cleaned of all stains, paint spots, dirt, and dust. All temporary labels not used for instruction or operation shall be removed.

### 3.04 CONCRETE WORK

- A. All cast-in-place concrete for new electrical equipment bases shown on the Drawings shall be provided by CONTRACTOR, except where specifically noted to be provided by others. All new equipment shall be set on 3 1/2-inch minimum leveling slabs including MCCs, free-standing enclosures, etc. Pads shall be 3 inches larger than equipment being supported.

- B. Concrete shall comply with Section 03 30 00—Cast-In-Place Concrete.
- C. Provide all anchor bolts, metal shapes, and templates to be cast in concrete or used to form concrete for support of electrical equipment.

### 3.05 PAINTING

- A. All painting of electrical equipment shall be done by CONTRACTOR unless equipment is specified to be furnished with factory-applied finish coats.
- B. All electrical equipment shall be provided with factory-applied prime finish, unless otherwise specified.
- C. If the factory finish on any equipment furnished by CONTRACTOR is damaged in shipment or during construction, the equipment shall be refinished by CONTRACTOR.
- D. One can of touch-up paint shall be provided for each different color factory finish which is to be the final finished surface of the product.

### 3.06 CAULKING

- A. Caulk with a caulking sealant where indicated on the electrical drawings or hereinafter specified.
- B. Caulking sealant shall be silicone construction sealant as manufactured by General Electric or two-part polysulfide conforming to the requirements and bearing the seal of the Thiokol Chemical Corporation.
- C. Caulking sealant shall contain no acid or ingredients that will stain stone, corrode metal, or have injurious effect on painting. It shall be colored to match adjacent surroundings.

### 3.07 BUILDING ACCESS

- A. CONTRACTOR shall arrange for the necessary openings in the building to allow for admittance of all apparatus.

### 3.08 COORDINATION

- A. Provide wiring for all motors and all electrically powered or electrically controlled equipment.
- B. All starters, VFDs, disconnects, relays, wire, conduit, push buttons, pilot lights, and other devices for the power and control of motors or electrical equipment shall be provided by CONTRACTOR except as specifically noted elsewhere in these specifications or on the Drawings.
- C. Where devices are provided by others, they shall be connected and wired by CONTRACTOR.
- D. CONTRACTOR's drawings and specifications shall show number and horsepower rating of all motors furnished, together with their actuating devices. Should any change in size, horsepower rating, or means of control be made to any motor or other electrical equipment

after the Contract is awarded, any additional costs because of these changes shall be the responsibility of CONTRACTOR.

- E. All motors shall be provided for starting in accordance with local utility requirements and shall be compatible with starters or VFDs as specified herein or under the various trades' sections of these specifications.
- F. CONTRACTOR shall provide all line voltage power and control wiring (100 volts and above), including temperature control wiring for operation, control, and supervision of all motorized equipment, including wiring between motor starters, VFDs, and control devices as specified herein and as shown on the Drawings. Low-voltage control wiring (below 100 volts) shall be provided by CONTRACTOR supplying the equipment that has low-voltage wiring, unless otherwise noted. CONTRACTOR shall provide raceways for all low-voltage wiring.
- G. CONTRACTOR shall connect and wire all apparatus according to approved wiring diagrams furnished by the various trades.
- H. Motors 1/2 hp and larger shall be NEMA rated 460 volts, three-phase, 60 Hz, unless otherwise shown. Motors 1/3 hp and below shall be 115 volts, single-phase, 60 Hz, unless otherwise shown.

### 3.09 EXCAVATION AND BACKFILL

- A. Backfilling of all trenches beneath concrete floor slabs within building shall be accomplished with gravel fill and shall be specially compacted to same density as surrounding area. Backfill of exterior trenches shall be compacted granular fill, unless otherwise noted. Compaction shall meet the requirements of Section 31 23 00—Excavation, Fill, Backfill, and Grading. Refer to Section 26 05 33—Conduit for additional requirements associated with PVC conduit installed in earth.
- B. Lines passing under foundation walls shall have a minimum of 1 1/2-inch clearance.
- C. Care shall be taken so that there is no disturbance of bearing soil under foundations.
- D. CONTRACTOR shall follow underground pipe runs where possible to avoid additional rock excavation. See Division 31 for rock excavation requirements.

### 3.10 EQUIPMENT ACCESS AND LOCATION

- A. CONTRACTOR shall coordinate work of this division with that of other divisions so that all systems, equipment, and other components of the building will be installed at the proper time, will fit the available space, and will allow proper service access to those items requiring maintenance. This means adequate access to all equipment not just that installed under this division. Any components for the electrical systems that are installed without regard to the above shall be removed and relocated as required to provide adequate access at CONTRACTOR's expense.
- B. Where various items of equipment and materials are specified and scheduled, the purpose is to define the general type and quality level, not to set forth the exact trim to fit the various types of ceiling, wall, or floor finishes. Provide materials that will fit properly the types of finishes actually installed.

- C. All equipment, junction and pull boxes, and accessories shall be installed to permit access to equipment for maintenance. Any relocation of conduits, equipment, or accessories to provide maintenance access shall be accomplished by CONTRACTOR at no additional cost.
- D. Electrical equipment, devices, instruments, hardware, etc., shall be installed with ample space allowed for removal, repair, calibration or changes to the equipment. Ready accessibility to equipment and wiring shall be provided without moving other equipment that is to be installed or that is already in place.
- E. Locate electrical outlets and equipment to fit the details, panels, decorating, or finish of the space. ENGINEER shall reserve the right to make minor position changes of the outlets before the work has been installed. Verify door swings before installing room lighting switch boxes, and install boxes on the latch side of door unless noted otherwise.

### 3.11 WORKMANSHIP

- A. All work shall be performed in compliance with the NEC.
- B. Install work using procedures defined in NECA Standard of Installation.
- C. Location of process equipment as shown on the Drawings is approximate.
- D. Utilization equipment and control devices required under these specifications shall be mounted in a code-approved manner.
- E. Locations of utilization equipment and control devices as shown on the Drawings are within 10 feet of actual positions. Any mounting of this equipment within this 10-foot distance shall be performed at no additional cost to OWNER.
- F. Unless otherwise noted, conduit shall be fastened to building structure or equipment framework and not placed on the floor.
- G. Where materials, equipment apparatus, or other products are specified by manufacturer, brand name, and type or catalog number, such designation is to establish standards of desired quality and style and shall be the basis of the Bid.
- H. Materials and equipment of the types for which there are National Board of Fire Underwriters Laboratories (UL) listings shall be so labeled and shall be used by CONTRACTOR.

### 3.12 AREA CLASSIFICATION

- A. As noted on the Drawings.
- B. Where referenced herein, damp and wet locations shall include, but not be limited to, all NEMA 4X areas, structures and areas below grade, and exterior locations.

END OF SECTION



## SECTION 26 05 19

### WIRE

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Wire.
  - 2. Wiring Connections and Terminations.
  - 3. Terminal Blocks and Accessories.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 QUALITY ASSURANCE

- A. Manufacturers of Wire: Firms regularly engaged in the manufacture of electrical wire products of the types and ratings needed whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical material, which has been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

##### 1.03 SUBMITTALS

- A. Submit shop drawings and product data under the provisions of Section 01 33 00—Submittals.
- B. Submit shop drawings for wiring system including layout of distribution devices, branch circuit conduit and cables, circuiting arrangement, and outlet devices.
- C. Submit manufacturer's instructions.

##### 1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Provide factory-wrapped, waterproof, flexible-barrier material for covering wire on wood reels, where applicable, and weather-resistant fiberboard containers for factory-packaging of wire, connectors, outlets, boxes, lamps, fuses, etc., to protect against physical damage in transit. Do not install damaged wire or other material; remove from project site.

- B. Store wire and other material in factory-installed coverings in a clean, dry, indoor space which provides protection against the weather.

## PART 2–PRODUCTS

### 2.01 WIRE

- A. All wire for permanent installation shall be new stranded copper delivered to project in unopened cartons or reels, except where specifically noted and be UL listed for the use intended. No wire smaller than 12 AWG shall be used unless specifically noted. The use of multiconductor cable is not allowed.
- B. Motor circuit branch wiring and associated control wiring:
  - 1. Insulation type shall be THHN (indoors, nonVFD application).
  - 2. Minimum size for motor control wiring shall be 14 AWG.
  - 3. Control wiring for supervisory equipment shall be shielded, sized per equipment manufacturer's recommendations, or as shown on Drawings.
- C. All power wiring to motors utilizing Variable Frequency Drives (VFDs) shall be type XHHW-2, unless otherwise noted.
- D. All wiring within control panels, supervisory control centers, and motor control centers that does not extend outside of the enclosure or the motor control center bucket shall be insulation-type MTW, minimum size 16 AWG.
- E. Wiring in dry locations shall be THHN. Wiring in damp and wet locations shall be XHHW-2.
- F. Refer to Section 26 05 53–Electrical Identification for required wire insulation color coding and conductor labeling requirements. Initial phase color shall be used throughout the run, even for switch legs. Colors must meet code requirements for each class voltage. Do not duplicate colors, including neutral, on different voltages.
- G. Branch circuit wiring for exit lights, emergency lights, and exterior lights in excess of 75 feet shall be minimum 10 AWG. Circuits 150 feet or over shall be sized for a maximum 2% voltage drop.

### 2.02 WIRING CONNECTIONS AND TERMINATIONS

- A. Provide crimp type UL or ETL listed terminations for 6 AWG and smaller stranded conductor connections to electrical devices and equipment such as receptacles, switches, and terminal strips. Crimp devices shall be Sta-kon, or equal.
- B. Provide insulated, silicone-filled spring wire connectors with plastic caps for 8 AWG conductors and smaller. Connectors shall be King Silicone-Filled Safety Connectors, or equal. Spring wire connectors shall only be allowed in junction, outlet, or switch boxes. Spring wire connectors are not allowed for terminating motor conductors.
- C. All feeder cable connections to motor leads up to 600 volts shall be insulated and sealed with factory-engineered kits. Motor connection kits shall consist of one-hole copper compression lugs for 6 AWG and larger, split-bolt connector for 8 AWG and smaller, and motor-lead pigtail splice kit. Individual components shall be as follows:

1. Split-bolt connectors shall be for use with copper conductors only.
  2. One-hole copper compression lugs shall be as manufactured by 3M, or equal, 30000 series. Lug size shall be selected based on motor and feeder wire sizes installed.
  3. Pigtail splice kit shall consist of one-hole lug cover, silicone grease, and mastic sealing strip. Pigtail splice kit shall have locking pins for conductors 2 AWG and larger. Kit shall be as manufactured by 3M, or equal, 5300 series, and be selected based on motor, feeder, and lug sizes installed.
- D. No splices will be allowed unless reviewed by ENGINEER. Where allowed, provide in-line splices for all conductor connections, 6 AWG and larger. Splice compression connectors for installation above grade shall be UL listed in-line copper barrel-type as manufactured by Burndy Type YS-TC, or equal, with heat shrink tubing to match the conductor size. Splice compression connectors for installation below grade shall be UL listed in-line copper barrel-type as manufactured by Burndy Type YS, or equal, with heat shrink tubing to match the conductor size. Splice compression shall be made with a manufacturer-recommended crimp tool.
- E. Heat shrink tubing for splices shall be UL listed, heavy wall type as manufactured by Burndy Type HS-H-PF, or equal, to match the conductor size.

## 2.03 TERMINAL BLOCKS AND ACCESSORIES

- A. Terminal Blocks: ANSI/NEMA ICS 4: UL listed or UL recognized under UL 467, UL 486E, UL1059, and UL 1953 (power terminals only).
- B. Power Terminal Blocks: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts as manufactured by Allen-Bradley 1492-PDL, or equal.
- C. 600-Volt Fuse Holders: Fuse holders for circuits rated up to 30 amps and 600 volts AC shall be finger safe, UL Listed, DIN-rail mountable, and shall include blown-fuse indicating lights. Fuse holders shall be as manufactured by Allen-Bradley Bulletin 1492-FB, or equal.
- D. Signal and Control Terminal Blocks:
1. General-Purpose Terminal Blocks:
    - a. Terminal blocks shall be rated up to 600 volts AC/DC.
    - b. Terminal blocks shall accept center-mounted jumper bars without increasing the installed space.
    - c. Terminal blocks shall be Allen-Bradley Bulletin 1492-J, or equal.
    - d. Terminal block color shall be gray.
  2. Grounding Terminal Blocks:
    - a. Terminal blocks shall be Allen-Bradley Bulletin 1492-JG, or equal.
    - b. Terminal block color shall be green/yellow.
  3. Disconnect-type Terminal Blocks (300-Volt Class):
    - a. Terminal blocks shall be feed-through type with a knife-blade disconnect.
    - b. Terminal blocks shall be Allen-Bradley Bulletin 1492-JKD, or equal, depending on the application.
    - c. Terminal block color shall be gray.
  4. Fuse-type Terminal Blocks with Indicator (300-Volt Class):
    - a. Terminal blocks for applications from 100 to 300 volts AC shall be Allen-Bradley Bulletin 1492-H4, or equal, with neon blown-fuse indicator.
    - b. Terminal blocks for applications from 10 to 50 volts AC/DC shall be Allen-Bradley Bulletin 1492-H5, or equal, with LED blown-fuse indicator.

- c. Terminal block color shall be black.
  - 5. Terminal Blocks for Power Meters and Current Transformers: Provide test-disconnect terminal blocks for disconnecting, shorting, and testing current transformers and for disconnecting and testing voltage sensing inputs. Provide test-disconnect terminals for individual current transformer or voltage sensing installations, and provide a group of terminals for all current transformer and voltage sensing inputs for each power meter installation.
    - a. Provide a pair of terminal blocks for each current transformer including one feed-through terminal block, one sliding disconnect terminal block with a cross-connection short-circuit slider. The pair of terminal blocks shall include the following:
      - (1) Feed-through terminal block shall be Weidmüller Model WTD 6/1 EN, or equal.
      - (2) Sliding disconnect terminal block shall be Weidmüller Model WTL 6/1 EN, or equal.
      - (3) Short-circuit slider shall be Weidmüller Model WKS 2/2, or equal. The short-circuit slider shall cover the terminal block conductor screws on the meter-side of the terminal blocks when in the non-shorting position, and expose the terminal block conductor screws when slid into the shorting position.
      - (4) Provide two cross-connection sliders Weidmüller Model STB, or equal, with connecting sleeves Weidmüller Model VH, or equal. Provide one slider fixing screw Weidmüller Model BS, or equal. Connecting sleeves and fixing screws shall be color coded for each current transformer.
    - b. Provide disconnecting terminal blocks for each voltage sensing and neutral connection. The terminal blocks shall include the following:
      - (1) Sliding disconnect terminal block shall be Weidmüller Model WTL 6/1 EN, or equal.
      - (2) Provide one cross-connection slider Weidmüller Model STB, or equal, with connecting sleeve Weidmüller Model VH, or equal, for each voltage sensing and neutral connection terminal block. Provide one slider fixing screw Weidmüller Model BS, or equal. The neutral connecting sleeve shall be a different color than the voltage sensing connecting sleeves.
    - c. Terminal block colors shall be gray. Provide end plates and end brackets as required to complete the test-disconnect terminal block assembly.
  - 6. Terminal blocks shall have self-locking screw compression clamps rated for the size of conductors being terminated and upstream overcurrent protection for each application.
  - 7. The same manufacturer and style of terminal block shall be used throughout the entire project for all applications.
  - 8. Terminal blocks shall have tin-plated copper current bars and tin-plated steel screws. Terminal housings shall be completely finger safe from all live circuits and be constructed of self-extinguishing material with minimum UL 94-V0 flammability rating.
  - 9. Terminal blocks shall accept pre-printed, snap-in labeling cards on both sides without increasing the installed space. Provide terminal block manufacturer's end barriers and screw-type retainers for all terminal block groupings.
  - 10. Terminal blocks shall mount on standard DIN rail and shall be able to be removed without removing adjacent terminal blocks.
  - 11. Multi-level terminal blocks and stacked, single-level terminal block installations are not acceptable.
- E. Refer to Section 26 05 53—Electrical Identification for terminal block labeling requirements.

## PART 3-EXECUTION

### 3.01 GENERAL WIRING METHODS

- A. Install electrical wire and connectors in accordance with the manufacturer's written instructions, applicable requirements of the NEC, the National Electrical Contractors Association's "Standard of Installation," and in accordance with recognized industry practices so that products serve the intended functions. Use appropriate wiring methods and materials for the equipment or environment.
- B. Stranded conductors shall be terminated using crimp-type devices specified herein. Conductors may not be wrapped around a terminal screw.
- C. Place an equal number of conductors for each phase of a circuit in the same raceway.
- D. Torque conductor connections and terminations with calibrated torque wrench to manufacturer's recommended values. Provide permanent marking on lug, bolt, nut, or connection for conductors larger than 4 AWG.
- E. Splice only in junction or outlet boxes. Splicing is not allowed in disconnects, manholes, motor control centers, panelboards, control panels, equipment, etc. Avoid splices between terminals of interconnecting power and control wiring.
- F. Spring wire connectors shall only be used in junction, outlet, or switch boxes. Equipment wireways (e.g., motor control centers, panelboards, disconnects, switchgear, etc.), and control panels shall not have any spring-wire connectors installed; all terminations shall be on terminal strips.
- G. Neatly train, lace, and tie wrap all wiring inside boxes, equipment, control panels, MCCs, and panelboards.
- H. Make conductor lengths for parallel circuits equal.
- I. The same color shall be used for each numbered wire throughout its entire length.
- J. Terminate all wiring on terminal blocks in control panels, VFD enclosures, starter cubicles, and similar equipment. This shall include all spare or unused wires.
- K. Provide a dedicated neutral for each branch circuit or feeder requiring a neutral. Ampacity of neutral conductor shall match that of the branch circuit or feeder.
- L. Do not use a pulling means that can damage the raceway.
- M. Signal wiring (below 100 volts) must be in a conduit separate from power and/or control wiring (over 100 volts). Signal wire shall include, but not be limited to, loop-powered devices, voice and data communications, and communication wiring (i.e., Ethernet, serial, etc.). Analog wiring shall be in a conduit separate from all other wiring.
- N. Control wiring (e.g., internal thermal overloads, lockout stops, etc.) to motors utilizing VFDs shall be in a conduit separate from motor power wiring.

- O. Provide junction or pull boxes to facilitate the “pulling in” of wires or to make necessary connections. All raceways and apparatus shall be thoroughly blown out and cleaned of foreign matter prior to pulling in wires.
- P. Thoroughly clean wires before installing lugs and connectors.
- Q. Make splices, taps, and terminations to carry full capacity of conductors without perceptible temperature rise.
- R. Terminate spare conductors within equipment, MCCs, control panels, etc., on terminal strips and label as “SPARE.” Spare wiring in pull or junction boxes may be terminated with electrical tape and labeled as “SPARE.” All spare conductor labels shall indicate where the conductors terminate. Refer to Section 26 05 53—Electrical Identification, for additional requirements.
- S. Feeder connections to motors shall be installed within the motor junction box utilizing factory engineered kits as specified herein. Spring wire connectors are not allowed for connections to motors.

### 3.02 GENERAL LOW-VOLTAGE WIRING METHODS (LESS THAN 100 VOLTS)

- A. Low-voltage wiring installation requirements specified herein shall be applicable to all systems installed that utilize low-voltage wiring where such wiring installation is not specified in other technical sections.
- B. Low-voltage wiring shall be installed in conduit.
- C. Do not use wire smaller than 14 AWG for control wiring greater than 60 volts, or 18 AWG for voltages less than 60 volts. All sizes subject to NEC 725 requirements.
- D. Low-voltage cable splices shall only be allowed in junction boxes.

### 3.03 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use UL-listed wire-pulling lubricant for pulling 4 AWG and larger wires. Wax-based pulling lubricant is not allowed unless it includes a Teflon additive.
- B. Install wire in raceway after interior of building is enclosed, watertight, and dry, and all mechanical work likely to injure conductors has been completed.
- C. Completely and thoroughly swab raceway system before installing conductors.
- D. Conductors No. 6 AWG and larger shall be pulled into conduits by hand or by utilizing a tugger with built-in tension meter. Other motorized machines of any type are not allowed for any wire pulling. CONTRACTOR shall provide a report to ENGINEER for each pull indicating maximum tension reached during the pull along with manufacturer’s maximum pulling tension.
- E. Conductors shall be installed in conduit system in such a manner that insulation is not damaged, conductors are not overstressed in pulling, and walls are not damaged. No splices are permitted except in junction boxes or outlet boxes.

- F. CONTRACTOR shall observe code limitation on the number and size of wires in an outlet box. CONTRACTOR shall either lay out work so that the wires do not exceed the particular box limitation or provide larger boxes approved for additional capacity.
- G. Panel riser feeder conductors shall be identified with colored tape at panel lugs. The same phase relation shall be maintained throughout.
- H. Circuiting is indicated diagrammatically on the Drawings.

#### 3.04 TERMINAL BLOCK INSTALLATION

- A. A maximum of one conductor shall be installed on the field-wired side of each terminal block. If rated to accept more than one conductor, a maximum of two conductors shall be installed on the enclosure-wired side of each terminal block. Provide additional terminal blocks and shorting jumpers as required.
- B. Provide a separate ground-type terminal block for each shielded-cable drain conductor.
- C. Provide ten percent spare terminal blocks for each type of connected terminal block, minimum five spare terminal blocks total. For each grouping of terminal blocks, provide 25% spare DIN rail space.
- D. Maintain a minimum of 1 1/2 inches between terminal blocks and adjacent devices and enclosure wireways.
- E. For current transformer shorting terminal blocks, the short-circuit slider shall cover the terminal block conductor screws on the meter-side of the terminal blocks when in the non-shortening position, and expose the terminal block conductor screws when slid into the shortening position.

#### 3.05 FIELD QUALITY CONTROL

- A. Inspect wire for physical damage and proper connection.
- B. Prior to energizing, check conduit, raceways, outlet boxes, and wire for continuity of circuitry and for short circuits. Correct malfunction when detected.
- C. Subsequent to wire hookups, energize circuitry and demonstrate functionality in accordance with these specifications.
- D. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.
- E. Perform field inspection and testing according to provisions of this section.

#### 3.06 ACCEPTANCE TESTS

- A. CONTRACTOR shall furnish all materials, labor, and equipment necessary for the acceptance tests specified herein. Acceptance tests shall be performed in the presence of OWNER or OWNER's representative and must be passed before final acceptance of the work.

- B. CONTRACTOR shall be responsible for powered tests of each field-installed device unless specifically noted otherwise. CONTRACTOR shall be responsible for device operation as powered from its power source and signals as received at the I/O modules.
- C. Operation Test: By operational testing, OWNER will give final acceptance of the wiring system when all of the wiring is considered a complete system. All equipment shall function and operate in the proper manner as indicated in the details of the specifications and on the Drawings. All motors shall be properly connected to protective devices, and motor rotation shall be in the correct direction.
- D. At the request of OWNER's representative, demonstrate by test the compliance of the installation with these specifications and Drawings, the National Electrical Code, and the accepted standards of good workmanship. These tests shall include operation of equipment, continuity of the conduit system, grounding resistance and insulation resistance.
- E. A written record of performance tests on electrical and control and instrumentation systems and equipment shall be supplied to OWNER. Such tests shall show compliance with governing codes.
- F. The transformer, feeder, and subfeeds to the lighting panels shall be completely phased out as to sequence and rotation. Phase sequence shall be A-B-C as follows:
  - 1. Front-to-rear, top-to-bottom, or left-to-right when facing equipment.
  - 2. Phasing shall be accomplished by using distinctive colors for the various phases. The same color or variation of it shall be used for a particular phase throughout the building and project.

### 3.07 WIRE INSTALLATION SCHEDULE

- A. Install all wiring in raceways except as otherwise noted. This includes all low-voltage wiring such as temperature control, instruments, network, etc.

END OF SECTION



## SECTION 26 05 23

### INSTRUMENT AND COMMUNICATION WIRE AND CABLE

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: This specification contains the requirements for instrument wire and cable as opposed to electrical power wire and cable.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 QUALITY ASSURANCE

- A. Standards: Comply with standards specified in this section as listed in Division 01.
- B. Qualifications of Installers: Workers who are thoroughly trained and experienced in the necessary crafts, and who are completely familiar with the specified requirements and the methods needed for proper performance of the work.

##### 1.03 PRODUCT HANDLING

- A. Instrument cable shall be furnished in lengths as necessary.
- B. Reels, coils, or package rolls of instrument cable shall be identified with the project name and other tagging identification as called for.

##### 1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.

##### 1.05 QUALIFICATIONS

- A. CONTRACTOR shall have at least 10 years of experience in the installation of similar systems. CONTRACTOR shall provide documentation upon request to certify that all assigned staff have attended training courses corresponding to the type of cabling and equipment specified herein.
- B. CONTRACTOR shall currently be licensed to install low voltage electronic cabling systems in the state of the project.
- C. CONTRACTOR shall currently meet all manufacturer's requirements for the provision and installation of all equipment specified herein.

## PART 2-PRODUCTS

### 2.01 SHIELDED PAIR CABLING FOR ELECTRONIC INSTRUMENTS

- A. Shielded cabling shall have stranded, tinned-copper conductors, No. 16 AWG, twisted with 2-inch lay.
- B. Insulation of conductors shall be 15 mil, 90°C minimum PVC, rated for 300 volts. Materials shall equal or exceed UL 13 requirements for physical properties.
- C. Color coding shall be manufacturer's standard or as stated.
- D. The outer jacket shall be flame-retardant and weather- and ultraviolet-resistant PVC, 35 mils thick for shielded pair cables with an 80°C minimum rating. The outer jacket shall contain a ripcord and shall equal or exceed the requirements of UL 1277. Cable shall be UL labeled as power-limited circuit cable.
- E. A 100% coverage shield shall be applied over the insulated conductors. The shield shall consist of a 0.85 mil minimum thickness aluminum mylar tape. A stranded, tinned-copper drain wire shall be furnished in continuous electrical contact with the shield.
- F. Single-pair shielded cables installed in above-grade conduits shall be Belden 9316, or equal.

### 2.02 SHIELDED PAIR CABLING FOR CURRENT TRANSFORMERS

- A. Shielded pair cabling shall have stranded, tinned-copper conductors twisted with 2-inch lay.
- B. Insulation of conductors shall be 15 mil, 90°C minimum PVC, rated for 600 volts. Materials shall equal or exceed UL 13 requirements for physical properties.
- C. Color coding shall be manufacturer's standard or as stated.
- D. The outer jacket shall be flame-retardant and weather- and ultraviolet-resistant PVC, 47 mils thick, and 80°C minimum rating. The outer jacket shall contain a ripcord and shall equal or exceed the requirements of UL 1277. Cable shall be UL labeled as power-limited circuit cable.
- E. A 100% coverage shield shall be applied over the insulated conductors. The shield shall consist of a 0.85 mil minimum thickness aluminum mylar tape. A stranded, tinned-copper drain wire shall be furnished in continuous electrical contact with the shield.
- F. Single-pair shielded current transformer cables shall be Belden 9343 with No. 14 AWG conductors and No. 14 AWG drain wire. Current transformer cable runs over 25 feet in length, including the length of potted transformer leads, shall be Belden 9344 with No. 12 AWG conductors and No. 12 AWG drain wire. When extending potted transformer leads or when splicing conductors from shorting terminal blocks to meters with loop-through current sensors (no terminations), provide crimpless, self-soldered, tin-plated, heat shrink-type butt splices as manufactured by Raychem, Model CWT-900X, or equal.

## 2.03 HEAT SHRINK TUBING FOR SHIELDED INSTRUMENT CABLES

- A. Heat shrink tubing for sealing the ends of all shielded instrument and current transformer cables shall be heavy-wall, low-voltage tubing as manufactured by Raychem Type WCSM, or equal.

## 2.04 INDUSTRIAL ETHERNET CABLE

- A. 600-Volt Rated Shielded Cable:
  - 1. For communication with plant SCADA Systems and equipment in supervisory control centers, motor control centers, control panels, etc., over 300 volts, and other areas or raceways with power wiring over 300 volts, provide 600-volt-rated, 4-pair, shielded (F/UTP), twisted-pair cables. Transmission characteristics of the cables shall meet full Category 6 performance criteria as defined by the ANSI/TIA-568.2-D standard.
  - 2. Cable conductors shall be minimum 23 AWG with PVC jacket and aluminum foil shield with 100% coverage. The cable outer jacket shall be industrial-grade PVC with a maximum overall cable diameter of 0.34 inch. Cable shall be CMR rated, UL listed, 600 V UL AWM rated, and be Belden 7953A or equal.
  - 3. Cable jacket color shall be red.
  - 4. Provide a shielded RJ45 connector on one end of each cable and an unshielded RJ45 connector on the other end of each cable.
- B. 300-Volt Rated Unshielded Cable:
  - 1. For communication with plant SCADA Systems and equipment in communication racks, supervisory control centers, and control panels without VFDs, etc., under 300 volts, and other areas or raceways with power wiring under 300 volts, provide 300-volt safety voltage rated, 80-volt operating voltage rated, 4-pair, unshielded (U/UTP), twisted-pair cables. Transmission characteristics of the cables shall meet full Category 6 performance criteria as defined by the ANSI/TIA-568.2-D standard.
  - 2. Industrial Ethernet cable shall be minimum 23 AWG with PVC jacket. The cable outer jacket shall be industrial-grade PVC with a maximum overall cable diameter of 0.24 inches. Cable shall be CMR rated, ETL verified, and shall be CommScope 1071E, or equal.
  - 3. Cable jacket color shall be light blue.
  - 4. Provide unshielded RJ45 connectors on both ends of each cable.
- C. Patch cables shall be provided premanufactured by the cable manufacturer or connector manufacturer in sufficient length to connect the associated equipment to any port on the equipment, patch panel, or switch. Field-attached plugs shall be insulation displacement type and shall be by the same manufacturer as the cable.

## PART 3-EXECUTION

### 3.01 INSTALLATION REQUIREMENTS AND SPECIAL CONSIDERATIONS

- A. Shielded pair and industrial Ethernet specified in this section shall be installed in conduit, and may not be run free-air or in nonmetallic tubing such as innerduct.

### 3.02 GROUNDING

- A. The shielded connection for shielded network cabling shall be connected at the network switch or patch panel and not at the field device connection. Ground patch panels and network switches accepting shielded network cables.
- B. Shielded cabling shall be installed in accordance with manufacturer's instructions and to minimize electrical noise and interference to associated instruments. Refer to instrument manufacturer's instructions for additional requirements.
- C. Ends of signal wires shall be sealed to prevent the migration of moisture into the cable and to prevent unintentional grounding of the shield at the open end. Seal signal wires using a minimum 1-inch piece of heat-shrink tubing installed over PVC jacket and individual wires, and heat-shrink to a watertight fit.
- D. All shields must be grounded.
- E. Shields shall be grounded at one point only. Shielded cabling shall be isolated and left open at the instrument.
- F. Cable shield grounds shall be isolated from control system signal grounds, except at instrument system grounding electrodes.
- G. The control room instrument ground shall be separate and isolated from the electrical power grounding system.

### 3.03 CURRENT TRANSFORMER INSTALLATION

- A. Minimize the length of current transformer cables to maintain current transformer burdens below the specified accuracy burden limits.
- B. Shielded-pair transformer lead extension cables wired to power meters with loop-through current sensors (i.e., no current input terminals at the metering device) shall be spliced with a short length of No. 14 AWG conductor as specified in Section 26 05 19–Wire for the final loop-through connection at the power meter. Limit the length of the conductor to maintain as much of the shielded-pair cable as possible. Splices shall use self-soldered butt splices as specified herein.

END OF SECTION

SECTION 26 05 26  
SECONDARY GROUNDING

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. Power System Grounding.
  - 2. Electrical Equipment and Raceway Grounding and Bonding.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 SUBMITTALS

- A. Indicate location of system grounding electrode connections and routing of grounding electrode conductor.
- B. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

PART 2–PRODUCTS

2.01 MATERIALS

- A. Ground Rods: Copper-bonded, 5/8-inch diameter; minimum length 10 feet.
- B. Ground Connections Below Grade: Exothermic type by Cadweld, compression type by ABB (Thomas & Betts), or equal. Compression connectors shall be prefilled with an oxide inhibitor.
- C. Ground Fittings: O-Z/Gedney, Type ABG, CG, TG, GBL, or equal.

PART 3–EXECUTION

3.01 INSTALLATION

- A. Compression-type connectors shall be installed with the manufacturer recommended tools. Compression dies shall emboss an index on the connector when installed correctly. An indenter crimp shall be made on ground rods prior to connection of grounding conductor.
- B. Provide a separate insulated equipment grounding conductor for each feeder and branch circuit. Terminate each end on a grounding lug, bus, or bushing.
- C. Bond together system neutrals, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and cold water plumbing systems.

- D. Connect grounding electrode conductors to metal water piping, metal frame of building or structure, structural reinforcing bars, using suitable ground clamps. Make connections to flanged piping at a point ahead of meter or service shutoff valve. Provide jumper connection across meter or service shutoff valve.
- E. Ground system, transformer neutrals, and equipment as required by code and local ordinances.
- F. All bare copper conductors installed outdoors shall be buried a minimum of 2 feet below grade.
- G. Water system grounds and a minimum of three ground rods at 15-foot separations near service or feeder entrance of each building shall be provided and ground wires must attach to point ahead of meter or service shutoff valve. These shall be connected to ground bus by conductors sized to code requirements. The above are minimum requirements.
- H. Bends in grounding electrode conductors shall not exceed 90 degrees and shall have a minimum 8-inch bend radius.
- I. Grounding electrode conductor terminations on ground rods shall be made at a minimum depth of 2 feet below grade.
- J. Ground rods shall be installed a minimum of 2 feet horizontally from any below-grade footing or wall.
- K. All grounding electrode conductors shall be installed in PVC conduit. All conduit bends shall be made using sweep elbows. Conduit bodies and 90-degree bends are not allowed.
- L. Include ground for grounded receptacles, light fixtures, motors, and equipment items shown on the Drawings.
- M. Flexible connections do not qualify for ground. All flexible connections must have separate green ground wire from motor base, lighting fixture, or equipment frame to conduit system.
- N. Provide a separate grounding conductor system for the grounding of all lighting fixtures and devices installed in the same conduit as the branch circuit conductors. Ground conductors shall be individually connected at each fixture or device.
- O. All equipment in NEMA 4X areas that are fed from circuits in PVC conduit shall be provided with a separate green ground wire that is terminated at the metallic conduit system and the equipment.
- P. Separately derived systems as defined by the National Electrical Code shall be grounded as such. This shall include, but not be limited to, 4-wire transformers.
- Q. Refer to Section 26 05 23—Instrument and Communication Wire and Cable for additional grounding requirements.
- R. Exposed exterior terminations of grounding electrode conductors shall be completely sealed with the same anti-corrosion joint compound specified in Section 26 05 33—Conduit to be used on conduit threads.

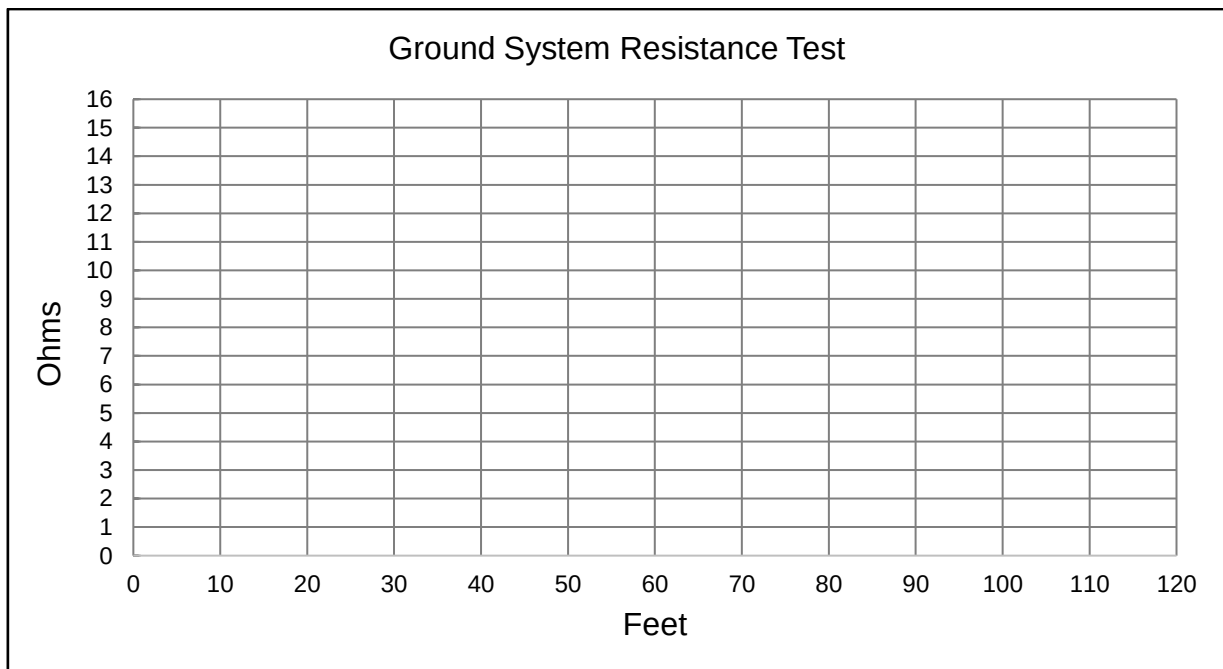
### 3.02 TESTING

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Provide ground system resistance test report for each ground grid. Test reports shall document ground system resistance following the three-point "Fall-of-Potential" test. The test results shall include a graph of the results plus a diagram of the testing layout. The remote current probe (C2) shall be placed a minimum of 100 feet from the ground system potential/current probe (P1/C1) or as required to provide sufficient spacing to demonstrate a resistance plateau on the graph. The ground resistance shall be tested with the potential probe (P2) between the P1/C1 probe and the C2 probe at 10% intervals starting at 0% and ending at 100% of the distance between P1/C1 and C2, 11 points total. A single point of measurement is not acceptable, and the two-point method of ground system testing shall only be used where there is no or insufficient "open earth" area to use the three-point Fall-of-Potential method. Resistance at any point in the grounding system shall not exceed 5 ohms. All ground system tests shall be witnessed by ENGINEER or OWNER. ENGINEER shall be notified a minimum of 72 hours in advance of all ground system testing.
- C. The test meter shall be Associated Research Vibroground test set with null balance, or equal. All ground system tests shall be performed in accordance with the procedures outlined in the instruction manuals of the ground system test equipment.
- D. Ground resistance testing shall be performed with all rods connected and shall be isolated from all metallic connections, such as from the ground rod to other grounded structures and electrical system neutrals.
- E. Multiple ground rod grids shall be isolated from all metallic connections such as from grid under test to other grounded structures and electrical system neutrals.
- F. Provide test report using the attached Form 26 05 26. Each ground grid shall have a form submitted.

END OF SECTION

## GROUND ROD RESISTANCE TO EARTH TEST RECORD

1. DATE \_\_\_\_\_
2. PROJECT NAME \_\_\_\_\_
3. LOCATION OF TEST \_\_\_\_\_
4. GROUND ROD TYPE \_\_\_\_\_  
DIAMETER \_\_\_\_\_ LENGTH \_\_\_\_\_
5. TEST METHOD \_\_\_\_\_  
INSTRUMENT TYPE \_\_\_\_\_  
SERIAL NO. \_\_\_\_\_
6. REQUIRED MAXIMUM RESISTANCE TO EARTH \_\_\_\_\_
7. MEASURED RESISTANCE TO EARTH \_\_\_\_\_  
GROUND ROD SYSTEM \_\_\_\_\_



TEST PERFORMED BY: \_\_\_\_\_  
Signature

TEST WITNESSED BY: \_\_\_\_\_  
Signature



SECTION 26 05 29  
SUPPORTING DEVICES

PART 1–GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. Conduit and Equipment Support Members.
  - 2. Fastening Hardware.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.02 QUALITY ASSURANCE

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

PART 2–PRODUCTS

2.01 MATERIAL

- A. Support Members:
  - 1. 316 stainless steel in exterior locations and damp and wet locations.
  - 2. Fiberglass in NEMA 4X chemical rooms where noted on the Drawings.
  - 3. Hot-dipped galvanized steel in all other areas.
- B. Hardware:
  - 1. 316 stainless steel in exterior locations and damp and wet locations.
  - 2. Fiberglass in NEMA 4X chemical rooms where noted on the Drawings.
  - 3. PVC-coated steel clamps and stainless steel hardware with 316 stainless steel members where used to support PVC-coated rigid steel conduits.
  - 4. Hot-dipped galvanized steel in all other areas.
- C. Manufacturers: Unistrut P-1000, B-line, Superstrut, or equal.

2.02 MAST-TYPE SUPPORT STRUCTURES

- A. Wall-Mounted Mast Support Structure:
  - 1. Provide a wall-mounted mast support structure with a three-point mounting frame as manufactured by Commscope, Model DM-300, or equal. The wall-mounting frame and adapters shall be constructed of hot-dipped, galvanized steel.
  - 2. Provide an equipment-mounting mast as specified herein for mounting the equipment where shown on the Drawings.

- B. Equipment-Mounting Masts:
  - 1. The main mast for wall-mounted mast support structures shall be 20 feet long with a 2 3/8-inch outside diameter and minimum 0.12-inch wall thickness as manufactured by Commscope, Model MT-538, or equal.
  - 2. Provide clamps with lugs as needed to bond the antenna, mast, and mounting frame to the grounding electrode conductor where noted on the Drawings.
  - 3. All masts shall be hot-dipped galvanized, round, A500C steel. All mounting hardware shall be hot-dipped galvanized steel.

## PART 3—EXECUTION

### 3.01 INSTALLATION

- A. All supporting devices and support structures shall be constructed such that the structure adequately supports the load of the equipment installed on it including any wind and/or snow loads. Provide additional support members to those shown on the Drawings to adequately support load.
- B. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors or support members. Do not use spring steel clips and clamps. Provide standoffs as specified in other technical sections.
- C. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
- D. The ends of all support members shall be ground smooth.
- E. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.
- F. Do not use powder-actuated anchors.
- G. Do not drill structural steel members.
- H. Fabricate supports with welded end caps and all welds and surfaces ground smooth for neat appearance. Use hexagon head bolts with steel spring-lock washers under all nuts.
- I. In wet locations, install free-standing electrical equipment on concrete pads. Anchor all equipment to adjacent walls with standoffs and caulk.
- J. Install surface-mounted cabinets with a minimum of four anchors.
- K. Do not use chain, wire rope, or perforated strap hangers.
- L. All welds shall be continuous and ground smooth.

END OF SECTION

## SECTION 26 05 33

### CONDUIT

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Rigid Metal Conduit and Fittings.
  - 2. Rigid Aluminum Conduit and Fittings.
  - 3. Polyvinyl Chloride (PVC) Externally and Internally Coated Galvanized Rigid Metal Conduit and Fittings.
  - 4. PVC Conduit and Fittings.
  - 5. Flexible Metal Conduit and Fittings.
  - 6. Liquidtight Flexible Conduit and Fittings.
  - 7. Conduit Seals and Special Fittings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ANSI C80.1–Electrical Rigid Steel Conduit (ERSC).
- B. ANSI C80.5–Electrical Rigid Aluminum Conduit (ERAC).
- C. ANSI/NEMA FB 1–Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.
- D. NEMA RN 1–Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal.

##### 1.03 QUALITY ASSURANCE

- A. Manufacturers of Raceways: Firms regularly engaged in the manufacture of electrical raceways of the types and capacities required whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that for the project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical materials, which have been listed and labeled by Underwriters Laboratories.
- E. Prior to shipment to the site, all conduit provided shall be new, unused material, and shall not have been stored outdoors or exposed to weather.

- F. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

#### 1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

#### 1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Provide color-coded thread protectors on the exposed threads of threaded rigid metal conduit.
- B. Handle conduit carefully to prevent end damage and to avoid scoring the finish.
- C. Store conduit inside and protect from weather. When necessary to store outdoors, elevate well above grade and enclose with durable, waterproof wrapping.

### PART 2–PRODUCTS

#### 2.01 RIGID METAL CONDUIT AND FITTINGS

- A. Rigid Steel Conduit: ANSI C80.1 and UL6. Heavy wall seamless tubing with hot-dipped galvanized coating.
- B. Conduit bodies for rigid steel conduit shall be as manufactured by Appleton, Form 35, or equal, and be constructed of stamped steel for sizes 2 inches and under, and cast malleable iron for sizes over 2 inches. Conduit bodies shall have domed gasketed covers and stainless steel screws. Conduit bodies sizes 1 1/4-inch and larger shall have built-in pulling rollers. Covers for conduit bodies must have bolts that thread into the conduit body. Snaptight and wedgenut covers are not allowed. CONTRACTOR shall select body style and size according to application.
- C. Rigid Aluminum Conduit: ANSI C80.5 and UL6A. Heavy wall.
- D. Conduit bodies for rigid aluminum conduit shall be as manufactured by Appleton, Form 85, or equal, and be constructed of pressure-cast, copper-free aluminum for sizes 2 inches and under, and sand-cast, copper-free aluminum for sizes over 2 inches. Conduit bodies shall have domed gasketed covers, and stainless steel screws. Covers for conduit bodies must have bolts that thread into the conduit body. Snaptight and wedgenut covers are not allowed. CONTRACTOR shall select body style and size per application.
- E. PVC-coated conduit and fittings shall be internally and externally hot dipped galvanized rigid metal conduit with hot dipped galvanized threads and PVC coating. PVC coating shall be UL listed with rigid metal conduit as the primary means of corrosion protection for the conduit, and PVC coating shall have an external 40 mil thickness with an internal 2 mil urethane coating. Acceptable manufacturers shall be Plasti-bond RedH<sub>2</sub>OT by Robroy Industries, Ocal-Blue by ABB (Thomas & Betts), Calbond, or equal. All installers shall be field-certified from the factory for installation and shall provide proof of certification. PVC-coated conduit and fittings shall meet the following listings and manufacturing standards, without exception:

1. ANSI C80.1.
  2. UL6.
  3. NEMA RN1.
- F. Conduit bodies for PVC-coated rigid conduit shall be as manufactured by Plasti-bond RedH<sub>2</sub>O<sub>T</sub> by Robroy Industries, Ocal-Blue by ABB (Thomas & Betts), Calbond, or equal, and have a 40 mil PVC exterior coating and 2 mil red urethane interior coating. Conduit bodies shall be Form 8 style or pulling elbow and include domed, gasketed covers and stainless steel screws. Covers for conduit bodies must have bolts that thread into the conduit body. Snaptight and wedgenut covers are not allowed. CONTRACTOR shall select body style and size according to application.
- G. Fittings and Conduit Bodies: ANSI/NEMA FB 1 and UL 514B; threaded-type material to match conduit. Split couplings are not allowed.
- H. Supports: One-hole straps with conduit clamps and backspacers shall be used for surface-mounted conduit. Where standoffs are required, provide conduit clamps and supporting devices as specified in Section 26 05 29—Supporting Devices. One-hole straps with conduit clamps and backspacers for PVC-coated rigid steel conduit shall be PVC-coated rigid steel material.

## 2.02 PVC CONDUIT AND FITTINGS

- A. Conduit: Heavy wall rigid, Schedule 40 where noted, UL listed for underground, encased, and aboveground applications. PVC conduit installed in exterior locations shall be UV resistant.
- B. Conduit bodies for PVC conduit shall be as manufactured by Carlon, or equal, and be suitable for use with Schedule 40 PVC conduit. Conduit bodies shall have smooth hubs, textured lids, and foam-in-place gaskets. CONTRACTOR shall select body style and size per application.
- C. Supports: Two-hole nonmetallic clamps shall be used for surface-mounted conduit. Where standoffs are required, provide pipe straps and supporting devices as specified in Section 26 05 29—Supporting Devices. Support material shall match that of the conduit type being provided.

## 2.03 LIQUIDTIGHT FLEXIBLE CONDUIT AND FITTINGS

- A. Liquidtight Flexible Metal Conduit:
1. Conduit: Spiral-wound, electrogalvanized, single-strip steel with integral grounding conductor continuously enclosed within the entire length of the convolutions. The flexible PVC jacket shall be sunlight-resistant, flame-retardant, and resistant to damage from mild acids. Conduit shall be UL Listed. Conduit shall be Liqueflex Type LA, or equal.
  2. Fittings: UL listed with thermoplastic elastomer sealing gasket.
    - a. Provide stainless-steel fittings in exterior and damp and wet locations, unless noted otherwise.
    - b. Provide electro-zinc plated steel fittings in all other areas, unless noted otherwise.
- B. Liquidtight Flexible Non-Metallic Conduit:
1. Conduit: Helically-wound, Type B, PVC construction with a continuous spiral of rigid PVC embedded within the PVC wall. The flexible PVC wall shall be sunlight-resistant,

flame-retardant, and resistant to damage from mild acids. Conduit shall be UL Listed. Conduit shall be Liquatite Type NM, or equal.

2. Fittings: UL listed with thermoplastic elastomer sealing gasket. Fittings shall be non-metallic nylon and rated for use with Type B liquidtight non-metallic conduit.

#### 2.04 CONDUIT SEALS AND SPECIAL FITTINGS

- A. Conduit Seals: Duct sealing compound, OZ Gedney Type DUX, or equal.
- B. Expansion Fittings: Crouse Hinds or Robroy Type XJG (non-hazardous location), or equal, for rigid or PVC-coated rigid conduit. Carlon E945 Series, or equal for PVC conduit.
- C. Expansion Deflection Fittings: O-Z type "DX," Crouse Hinds, type XD, or Appleton.
- D. Ground Bushings: Crouse Hinds Model GLL, or equal.
- E. Watertight Hubs: Diecast, insulated and gasketed, rated for wet or dry locations indoors or outdoors. Watertight hubs shall be Appleton HUBXXXDN, Crouse-Hinds Myers Hubs, or equal.
- F. Conduit Threads Joint Compound: Kopr-shield conductive, anti-corrosion joint compound as manufactured by Thomas & Betts, or equal.
- G. Conduit Riser Grips: Grips installed in vertical conduit for supporting conductors shall be O-Z/Gedney Type R or Type S, or equal. Grips installed in vertical conduit for supporting cables over 1/4 inch in diameter shall be Hubbell Dust-Tight Strain Relief Grips, or equal.

### PART 3-EXECUTION

#### 3.01 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT

- A. Size conduits for branch circuit conductors, control wires, and instrumentation cables so as to have not less than 25% spare capacity after installation; 3/4 inch minimum size. Minimum size for liquidtight flexible metal conduit is 1/2 inch.
- B. Maintain at least 1 inch of separation between conduit sizes to 1 1/2 inches and 2 inches between conduits 1 1/2 inches or larger. Maintain 1 foot of separation between signal conduits (below 100 volts) and power conduits (100 volts and above).
- C. All conduit shall be supported in accordance with the NEC and as specified herein. This shall apply to all conduit types, including flexible conduit.
- D. Provide for the proper application, installation, and location of inserts, supports, and anchor bolts for a satisfactory raceway system. Where any component of the raceway system is damaged, replace or provide new raceway system.
- E. Run conduits concealed to avoid adverse conditions such as heat and moisture, to permit drainage, and to avoid all materials and equipment of other trades. Maintain a minimum clearance of 6 inches from all hot water pipes, flues, or any high-temperature piping or ductwork.

- F. Conduits shall be attached to building surfaces and not suspended unless installed in a Unistrut-type conduit rack as specified herein. Individual conduits shall not be suspended. Clevis hangers are not allowed.
- G. Center conduit in structural slabs (other than topping), clear of reinforcing steel and spaced on centers equal to or exceeding three times the conduit diameter. Outside diameter of conduit shall not exceed one-third the slab thickness for each run of conduit 1 1/4 inches or larger. Provide shop drawings when conduit will be installed in structural slabs. Conduits shall not be run in slabs-on-grade or structural topping slabs.
- H. Independently support or attach the raceway system to structural parts of construction in accordance with good industry practice.
- I. Conduit attached to building surfaces that may be damp or wet shall be spaced out to avoid rust and/or corrosion using fittings approved for the use. Use back straps on all conduit in damp and wet locations, or mount conduit with Unistrut straps, or equal. Watertight hubs shall be used in all damp and wet locations.
- J. Conduits shall be securely fastened to building structure at intervals not exceeding 8 feet or closer, if necessary. Where hangers are necessary, 3/8-inch rod/eyelets/rings/or trapeze type in Unistrut channel and pipe clamps shall be used. Wire or perforated strap iron is not acceptable. PVC conduit shall be securely fastened to building structure at intervals not exceeding 3 feet.

### 3.02 GENERAL CONDUIT INSTALLATION REQUIREMENTS

- A. Interior conduit shall be run concealed in walls, building cavities, chases, attic spaces, and buried below floor slabs. Exterior conduit shall be buried below grade and concealed in structure walls. Exposed conduit runs shall be avoided. Conduit may be run exposed only where it is impossible to conceal.
- B. Run exposed conduit grouped and parallel or perpendicular to construction. Do not route exposed conduits over high-temperature machinery nor in contact with such equipment.
- C. All conduit installed below grade shall be buried a minimum of 2 feet 0 inch. All conduit installed below floor slabs shall be buried a minimum of 1 foot below slab.
- D. PVC-coated rigid steel conduit and PVC conduit installed in earth (interior and exterior) shall be bedded in compacted sand with a minimum of 6-inch cover on all sides.
- E. Ream conduit smooth at ends, cap upon installation, rigidly attach to structural parts of the building, and securely fasten to all outlet boxes, panel cabinets, junction boxes, pull boxes, splicing chambers, disconnect switches, and all other components of the raceway system.
- F. Conduits installed for future equipment or electrical work shall be cut off and capped flush with finished floor. Conduit ends shall have threaded fittings to accommodate future conduit installation.
- G. Provide all empty raceways 2 1/2 inches and over with No. 10 galvanized fishwire, and nylon cord for conduits smaller than 2 1/2 inches. Empty raceways and fishwire/nylon cord shall be identified with permanent label, and label shall include conduit termination point. All empty

conduits shall be threaded, capped and flush with finished floor or wall. Exposed conduits shall be threaded and capped.

- H. Provide conduit raceway for exposed cables that are not UV resistant. This shall include, but not be limited to, instrument wiring, etc.
- I. Conduit seals shall be provided where conduits pass from the interior to exterior of the building, any conduit entering a wet location, and any conduit entering a NEMA 4X area.
- J. Liquidtight flexible conduit shall be installed in such a manner that liquids tend to run off the surfaces and not drain toward the fittings.
- K. All runs of flexible conduit and flexible conduit couplings to equipment and devices shall be as short as practicable, of the same size as the conduit it extends, and with enough slack to reduce the effects of vibration to a minimum. A minimum of 18 inches of flexible conduit shall be installed for each motor.
- L. Provide conduit expansion-deflection fittings as specified herein in all conduit runs where movement perpendicular to axis of conduit may be encountered.
- M. Conduits shall be pitched so that drainage is away from all structures.
- N. Conduit bends for PVC conduit shall be made using a hot box, heat blanket, or glycol bender. Open flame or point heat sources of any type are not allowed.
- O. The PVC-coated rigid conduit manufacturer's touch-up compound shall be used on all conduit interior and exterior bare steel exposed because of nicks, cuts, abrasions, thread cutting, and reaming; minimum six coats.
- P. Where below-grade PVC conduit is connected to rigid metal conduit, the length of PVC conduit shall be a minimum of 10 feet. For short, below-grade conduit runs where required lengths of rigid metal conduit limit the length of PVC conduit to less than 10 feet, rigid metal conduit shall be used for the entire run.
- Q. Conduit bodies shall not be used for antenna cable routing. Provide pull boxes sized as required for antenna cable bending radius.
- R. Routing of conduits on exterior of buildings shall be avoided to the extent possible and shall not cover or interfere with lighting, signage, windows, louvers, or other openings. All conduit routing on exterior walls shall be reviewed with ENGINEER for approval prior to installation.
- S. Conduits installed in damp and wet locations shall have all threads coated with conduit threads joint compound.

### 3.03 CONDUIT PENETRATIONS AND TERMINATIONS

- A. Where fittings are brought into an enclosure with a knockout, a gasket assembly consisting of an O-ring and retainer shall be installed on the outside. Fittings shall be insulated throat type.
- B. Conduit penetrations for control panels or enclosures containing electronic equipment shall utilize watertight hubs and, if entering the top of the enclosure, shall be located at the front of the enclosure and not over any electronic equipment (e.g., PLC, power supplies, etc.).



- C. Conduit penetrations for all exterior enclosures (e.g., disconnects, junction boxes) shall utilize watertight hubs and enter the sides or bottom of the enclosure. Conduits shall not penetrate the top of the enclosure.
- D. Provide conduit expansion fittings as specified herein in all conduit runs that cross a structural expansion joint and for conduits protruding from earth.
- E. Provide firestopping for all conduits penetrating fire barriers as specified in Section 07 84 00–Firestopping.
- F. Conduits passing through masonry, concrete, or similar construction shall be cast in place using PVC-coated rigid conduit extending completely through the construction.
- G. Where above-grade conduits pass through cores in existing structures or through masonry walls, grout openings between conduit and walls or floors with sand cement mortar.

### 3.04 CONDUIT INSTALLATION SCHEDULE

- A. The following schedule lists specific conduit types allowed in designated areas. Those areas not listed under a specific conduit type shall not have that type of conduit installed:
  - 1. Rigid steel:
    - a. Interior locations requiring mechanical protection.
    - b. All exposed interior locations.
    - c. All concealed interior locations.
  - 2. Rigid aluminum:
    - a. All exposed interior locations.
    - b. Interior locations requiring mechanical protection.
    - c. Exterior locations (except in earth) and locations exposed to weather.
    - d. All locations where attached to aluminum structural members.
    - e. Where noted on the Drawings.
  - 3. PVC-coated rigid steel:
    - a. Conduits protruding from concrete.
    - b. Interior and exterior locations requiring mechanical protection.
    - c. Earth.
    - d. Exterior locations and locations exposed to weather.
    - e. Within 4 feet of building or structure footing or wall.
  - 4. PVC:
    - a. Earth, except within 4 feet of a building or structure footing or wall.
    - b. NEMA 4X areas (indoors only).
    - c. Grounding electrode conductors.
    - d. Buried below slabs on grade.
  - 5. Liquidtight flexible metal conduit not over 3 feet in length for final connections to:
    - a. Equipment with sliding bases or flexible positioning.
    - b. Equipment with vibration isolation mounting.
    - c. Equipment housing ferromagnetic cores or with integral moving components capable of generating noise or vibrations, including transformers and motors.
    - d. All pumps and associated equipment.
  - 6. Liquidtight flexible non-metallic conduit not over 3 feet in length for final connections to equipment in the Fluoride and Chlorine Rooms.

END OF SECTION

## SECTION 26 05 35

### BOXES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Switch, Outlet, and Small Junction Boxes.
  - 2. Pull and Junction Boxes.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern Work in this section.

##### 1.02 REFERENCES

- A. ANSI/NEMA OS 1—Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- B. ANSI/NEMA OS 2—Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
- C. NEMA 250—Enclosures for Electrical Equipment (1000 Volts Maximum).

##### 1.03 QUALITY ASSURANCE

- A. Manufacturers of switches, outlets, boxes, lamps, fuses, lugs, etc.: Firms regularly engaged in the manufacture of these products, of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation Work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical cable, boxes, raceways, wire, connectors, outlets, switches, etc. that have been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

##### 1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.

## PART 2-PRODUCTS

### 2.01 SWITCH, OUTLET, AND SMALL JUNCTION BOXES

- A. Masonry and Partition Boxes: Galvanized steel, nongangable. ABB (Thomas & Betts), MB Series, or equal. Provide number of gangs for devices shown on the Drawings.
- B. Cast Boxes: Aluminum or cast ferrous, deep-type, gasketed cover, threaded hubs, Eaton FD Series, or equal.
- C. NEMA 4X Boxes:
  - 1. Switch and Outlet Boxes: PVC or FRP, Carlon FD Series, or equal with proper cover and gasket.
  - 2. Small Junction Boxes: PVC or FRP, Carlon HS Series, or equal with proper cover and gasket.
- D. Covers for junction boxes shall have covers that match box type.

### 2.02 PULL AND JUNCTION BOXES

- A. NEMA 4X Boxes: PVC or FRP, Carlon HS Series, or equal with hinged cover, gasket, and locking system. Boxes shall be 316 stainless steel with hinged cover, recessed quarter-turn padlocking latches, and gasket, Saginaw Control and Engineering Enviroline Series, or equal, where specified herein.
- B. NEMA 12 Boxes: Painted steel with hinged cover, recessed quarter-turn padlocking latches, gasket, and locking system. Boxes shall be Hoffman CSD, or equal.
- C. Where terminal blocks or other devices are mounted in a pull or junction box, provide a 14-gauge steel back panel with a white enamel finish for mounting.
- D. Boxes specified in this section are not allowed to have knockouts and are not allowed to be used as enclosures for control panels.

## PART 3-EXECUTION

### 3.01 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on the Drawings and as necessary for splices, taps, wire pulling, cable bending radii, equipment connections, and code compliance.
- B. Electrical box locations shown on the Drawings are approximate. Verify location and size of outlet boxes in all work areas prior to rough-in.
- C. Where dedicated raceways are provided for different voltage systems or wiring, (e.g., motor power wiring and motor space heaters), separate boxes shall also be provided unless acceptable to ENGINEER. Where acceptable to ENGINEER, combined boxes shall be physically divided to separate the wiring.
- D. Locate and install boxes to allow access. Where installation is inaccessible, coordinate locations and sizes of access doors.

- E. Locate and install to maintain headroom and to present a neat appearance.
- F. All boxes attached to building surfaces that may be damp or wet shall be spaced to avoid rust and/or corrosion. All boxes in damp and wet locations shall be on 1/2-inch standoffs.

### 3.02 SWITCH, OUTLET, AND SMALL JUNCTION BOX INSTALLATION

- A. Locate boxes in masonry walls for cutting of masonry unit corners only. Coordinate masonry cutting to achieve neat openings for boxes.
- B. Provide knockout closures for unused openings.
- C. Support boxes independently of conduit.
- D. Use multiple gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- E. Install boxes in walls without damaging wall insulation.
- F. Switch and outlet boxes provided for branch circuits and feeders shall not contain control wiring. Control wiring shall have dedicated pull and junction boxes provided. Wiring for different voltage systems (e.g., 24 V, 120 V, 480 V) shall have dedicated pull and junction boxes for each voltage.
- G. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
- H. In concrete walls, single receptacle, single- or double-switch outlets, use 4-inch-square masonry boxes fitted with raised plaster covers.
- I. In unplastered brick or block walls, use masonry boxes.
- J. For weatherproof switches, devices, and exterior fixtures, use cast boxes with proper cover and gasket.
- K. All interior exposed wall and ceiling outlet boxes shall be cast boxes, unless otherwise noted.
- L. Knockout punches or saws shall be used for holes; boxes with prepunched holes are not acceptable.
- M. Boxes shall be of a depth to accommodate wires and splices and shall be equipped with both fixture hanging studs and tapped fixture ears. Boxes shall be installed so that they will support the weight of the fixture. Conduit will not be considered as adequate supports.
- N. Cast boxes with 3/4-inch hubs and aluminum fittings and enclosures may be used with all conduit types.
- O. PVC or FRP NEMA 4X boxes shall be provided only where noted on the Drawings.

### 3.03 PULL AND JUNCTION BOX INSTALLATION

- A. Locate boxes above accessible ceilings or in unfinished areas.

- B. Support pull and junction boxes independent of conduit.
- C. Knockout punches or saws shall be used for holes.
- D. Refer to Section 26 05 53—Electrical Identification for junction box labeling requirements.
- E. All interior exposed boxes and all interior boxes with a dimension equal to or greater than 12 inches shall be NEMA 12, unless noted otherwise.
- F. All exterior boxes shall be NEMA 4X stainless steel.
- G. PVC or FRP NEMA 4X boxes shall be provided only where noted on the Drawings.

END OF SECTION

## SECTION 26 05 53

### ELECTRICAL IDENTIFICATION

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Nameplates.
  - 2. Labeling Tags.
  - 3. Wire and Cable Markers.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Provide schedule for nameplates and labeling tags with shop drawings. Reference Drawings for type used.

#### PART 2–PRODUCTS

##### 2.01 NAMEPLATES

- A. Nameplate material shall be multi-color, two-layer, nonconductive engraving plastic suitable for permanent installations in indoor and outdoor locations. The material shall be UV-resistant and suitable for installation in direct sunlight.
- B. Type “A”:
  - 1. Use:
    - a. Motor starters.
    - b. Each separately mounted circuit breaker or disconnect switch.
    - c. Each device in motor control centers.
    - d. SPD.
    - e. Each device on Supervisory Control Center exterior.
    - f. Cabinets, enclosures, pull, and junction boxes.
    - g. Field devices (flowmeter transmitters, level transmitters).
  - 2. Size: 2 inches by 4 inches.
  - 3. Background Color: Black.
  - 4. Character Color: White.
  - 5. Character Size: 1/2-inch.
  - 6. Engraving: See MCC schedule, one-line, and I/O list for labels, or as requested by ENGINEER. Label shall include equipment number and description (i.e., SCAL-60-01, Fluoride Scale).
  - 7. Mounting Location: Front exterior.

- C. Type "B":
  - 1. Use:
    - a. Standby power systems.
    - b. Automatic Transfer Switches.
  - 2. Size: 2 inches by 4 inches.
  - 3. Background Color: Red.
  - 4. Character Color: White.
  - 5. Character Size: 1/4-inch.
  - 6. Engraving: See MCC schedule and one-line for labels, or as requested by ENGINEER.
  - 7. Mounting Location: As requested by ENGINEER.
- D. Type "C":
  - 1. Use:
    - a. Motor Control Centers.
    - b. Supervisory Control Centers.
  - 2. Size: 4 inches by 4 inches.
  - 3. Background Color: Black.
  - 4. Character Color: White.
  - 5. Character Size: 2 1/4 inches.
  - 6. Engraving: Equipment label. Label shall include equipment number and description (i.e., LP-10-01, First Floor Power Panel).
  - 7. Mounting Location: Equipment: Top wire way.
- E. Type "D":
  - 1. Use: Control stations, thermostats, conduit fittings, etc.
  - 2. Size: 1/2-inch by 4 inches.
  - 3. Background Color: Black.
  - 4. Character Color: White.
  - 5. Character Size: 1/4-inch.
  - 6. Engraving: Control station number and equipment description (e.g., T-15-01, Chlorine Room).
  - 7. Mounting Location: Device front at top.
- F. Type "E":
  - 1. Use Fire Alarm System.
  - 2. Size: As necessary.
  - 3. Background Color: Yellow.
  - 4. Character Color: Black.
  - 5. Character Size: 1/4-inch.
  - 6. Engraving and Mounting Location: As requested by ENGINEER.

## 2.02 LABELING TAGS

- A. Labeling tag material shall be multi-color, 2-layer, nonconductive engraving plastic suitable for permanent installations in indoor and outdoor locations. The material shall be UV-resistant and suitable for installation in direct sunlight.
- B. Use: Field-mounted devices without surfaces suitable for mounting fixed nameplates (Valves, Limit Switches, Level Transmitters, Flow Transmitters, etc.).
  - 1. Size: 3/8-inch by 2 inches.
  - 2. Character Size: 1/4-inch.
  - 3. Engraving: As requested by ENGINEER.

## 2.03 WIRE AND CABLE MARKERS

- A. Wire and cable markers shall be permanently-attached, heat-shrink type labels.
  - 1. Sleeve: Permanent, PVC, white, with legible machine-printed black markings.
  - 2. Acceptable Manufacturers: Raychem Model D-SCE or ZH-SCE, Brady Model 3PS, or equal.
  - 3. Grounding Conductor: Provide green wire marker; minimum 2 inches wide.
- B. Wire or cable numbering preprinted on the conductor or cable insulation, flag-type labels, and individual wraparound numbers (such as Brady preprinted markers) are not acceptable. All wire markers shall be the same throughout the project.

## PART 3–EXECUTION

### 3.01 INSTALLATION

- A. Degrease and clean surfaces to receive nameplates.
- B. Install nameplates parallel to equipment lines.
- C. Affix nameplates with weatherproof, UV-resistant adhesive in outdoor locations and sticky back adhesive in indoor locations.
- D. Affix labeling tags with stainless steel leaders; vinyl locking wire ties are not acceptable. Provide 3/8-inch hole to accommodate wire tie.
- E. Prepare and install neatly-typed circuit directories and schedules in all panels, including, but not limited to, panelboards where Work is done under this Contract.
- F. Labeling tags shall only be used for equipment enclosures without surfaces suitable for mounting fixed nameplates.

### 3.02 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor, including neutral and spare conductors, in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Neutral conductor labels shall include the associated branch circuit number. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams for control wiring. Spare conductors shall have control wire number or shall indicate termination point of wire.
- B. Conductors in pull boxes, motor control centers, supervisory control panels, control panels, cabinets, and panelboards shall be grouped as to circuits and arranged in a neat manner. All conductors of a feeder or branch circuit shall be grouped, bound together with nylon ties, and identified. Phase identification shall be consistent throughout the system. All wiring labels shall be able to be read without removing wire management (i.e., wiring trough covers, spiral windings, etc.) or twisting the wire/cable.
- C. Where terminal blocks are factory provided with non-project-specific labels by equipment manufacturers in MCC buckets, VFDs, and similar equipment and are wired to terminal blocks in control panels with project-specific labels, the interconnecting wiring shall be labeled at both ends to match the project-specific terminal blocks in the control panel.



Provide an additional label on the end of each wire that is connected to a terminal block with a non-project-specific label to indicate the associated terminal block.

D. Power Conductor Insulation Color Code:

1. 6 AWG and Larger: Provide general-purpose, flame-retardant, permanent tape at each termination and at accessible locations such as manholes, handholes, junction and pull boxes, panelboards, motor control centers, etc. Apply tape with at least six full, overlapping wraps; minimum 2 inches wide.
2. 8 AWG and Smaller: Provide conductors with color-coded insulation.
3. Colors:

| System                                                                                                                                                                | Conductor                                         | Color                          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|--------------------------------|
| All Systems                                                                                                                                                           | Equipment Grounding                               | Green                          |
| 120/208 Volts<br>Three-Phase, Four-Wire                                                                                                                               | Grounded Neutral<br>Phase A<br>Phase B<br>Phase C | White*<br>Black<br>Red<br>Blue |
| 277/480 Volts<br>Three-Phase, Four-Wire                                                                                                                               | Grounded Neutral<br>Phase A<br>Phase B<br>Phase C | Brown<br>Orange<br>Yellow      |
| Note: Phase A, B, C implies direction of positive phase rotation.                                                                                                     |                                                   |                                |
| * When installed as part of a 120-volt branch circuit, provide a color-coded stripe on the white neutral conductor insulation matching the branch circuit insulation. |                                                   |                                |

E. Control Panel and Field-Installed Control Conductor Insulation Color Code:

1. All conductors shall have color-coded insulation.
2. Colors:

| System                                                                                                          | Conductor                                                      | Color                                              |
|-----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------|
| Supply Voltage                                                                                                  | Ungrounded Circuit Conductors<br>Neutral                       | Black<br>White                                     |
| Discrete 120-volt AC<br>Input/Output                                                                            | Control Circuit Conductor<br>Neutral                           | Red<br>White                                       |
| Discrete 12/24-volt DC<br>Input/Output                                                                          | Control Circuit Conductor<br>Common                            | Blue<br>White with Blue Stripe                     |
| Conductors energized when<br>the main disconnect is in the<br>"off" position (e.g., foreign<br>supply voltages) | Control Circuit Conductor<br>AC Neutral<br>DC Common<br>Ground | Orange<br>White<br>White with Blue Stripe<br>Green |

F. Circuit Identification:

1. Identify power, instrumentation, and control conductors at each termination and at accessible locations such as junction and pull boxes, panelboards, motor control centers, etc.
2. Conductors for panelboard circuits shall identify circuit matching the circuit directory designations, including the neutral conductor.
3. Control conductor identification shall match the associated terminal block label.
4. Circuits Not Listed in Circuit Directories:
  - a. Assign circuit name based on unique device or equipment at load end of circuit.
  - b. Where unique device or equipment names are not available or apparent, add a unique number or letter modifier to each otherwise identical circuit name.

### 3.03 DATA CABLE AND COMMUNICATION EQUIPMENT IDENTIFICATION

- A. Individual labels shall be placed on both ends of all cables.
- B. Refer to Section 26 05 23—Instrument and Communication Wire and Cable for cable insulation color requirements.

### 3.04 JUNCTION BOX IDENTIFICATION

- A. All junction boxes shall be labeled with permanent nameplates. Nameplates shall indicate circuit or load served, as well as the power source and highest voltage present on any conductor.

### 3.05 CONDUIT FITTINGS IDENTIFICATION

- A. All conduit fittings that contain splices of any kind shall be labeled with permanent nameplates indicating "splice within." Nameplates shall be clearly visible at location installed. Nameplates shall be fastened to each conduit fitting with heavy duty, UV-resistant, cold weather cable ties.

### 3.06 TERMINAL BLOCK IDENTIFICATION

- A. Terminal blocks shall be labeled on both sides of each terminal block. Terminal block numbering shall match the numbers shown on the project-specific wiring diagrams.
- B. Fused terminal blocks labels shall be located on top of the terminal blocks and include the fuse voltage and ampere rating.

### 3.07 COMPONENT IDENTIFICATION

- A. All components (e.g., relays, timers, power supplies, transformers, etc.) within enclosures shall be identified with sticky-back adhesive, self-laminating, machine-printed marking labels. Labels shall be installed on the enclosure back panel and not on the device itself, wireway covers, or any other removable devices. Labels shall be included on the as-built drawings.

### 3.08 LABELING FONT REQUIREMENTS

- A. The font for all conductor, cable, and device labels shall be Arial with black characters on white background, and minimum font size 12.
- B. The text for all conductor, cable, and device labels shall be machine printed. Handwritten labels are not acceptable.

END OF SECTION

## SECTION 26 09 00

### CONTROLS AND INSTRUMENTATION

#### PART 1–GENERAL

##### 1.01 SUMMARY

###### A. Related Sections and Divisions:

1. Applicable provisions of Division 01 shall govern work in this section.
2. Section 26 09 10–Controls and Instrumentation Drawings.
3. All other sections of Division 26.

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## 1.02 SYSTEM DESCRIPTION

- A. The work includes furnishing, delivering, installing all items furnished, and placing in operation modifications to the Supervisory Control and Data Acquisition (SCADA) System for the Waunakee Utilities Well No. 6 Well Facility.
- B. System Supplier shall be defined as the fabricator, assembler, and supplier of all system components. This shall include, but not be limited to, all instrumentation as specified, all PLC cabinets and required interface hardware and internal wiring, hardware, system drawings, system software, and new MCCs.
- C. ENGINEER will be responsible for development of the SCADA System computer HMI graphics. System supplier shall be responsible for all OIP graphics programming.
- D. CONTRACTOR shall inspect all work. The Bid shall include everything necessary to obtain a complete installation operating in accordance with these specifications and the Bidder's proposal, whether necessary items and equipment are contained in, or are remote from the enclosures furnished under this Contract. All responsibility for this system ultimately lies with CONTRACTOR.
- E. CONTRACTOR shall be responsible for the placing of circuits and making of electrical connections in accordance with System Supplier-furnished drawings, instructions, and field supervision to provide proper connection. CONTRACTOR shall include the services of a System Supplier factory engineer to supervise the making of connections to power supplies, motor leads, communication circuits, existing control equipment, and any other connections external to the new control equipment; adjust the equipment; initiate and check operation; instruct OWNER's electrician on operation and maintenance of the equipment; and place the equipment in operation in an acceptable manner. This shall include on-site review of software/hardware controls from the central control point.
- F. Any auxiliary interface relays and controls needed for completion of this project, if not specifically called for, shall be by System Supplier.

## 1.03 QUALITY ASSURANCE

- A. System Suppliers: Firms regularly engaged in the design and manufacture of SCADA systems of the size and complexity specified herein, and whose systems have been in satisfactory use in similar service for not less than 10 years.
- B. Installer: A firm with at least 10 years of successful installation experience on projects with SCADA System design and installation work similar to that required for the project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide control panels, power supplies, controllers, relays, wire, and connectors that have been listed and labeled by Underwriters Laboratories.

- E. NECA Standards: Comply with applicable portions of National Electrical Contractor's Association's Standard of Installation.

#### 1.04 SUBMITTALS

- A. Manufacturer's Data: Submit manufacturer's data, specifications, and installation recommendations for each item specified herein.
- B. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- C. Provide product data on all equipment and devices specified herein as well as wiring schematics for all systems.
- D. Shop drawing submittals shall be assembled in phases.
  - 1. The first submittal shall include the following:
    - a. Detailed catalog information, descriptive literature, and specifications of hardware and software. All items being provided must be specifically noted on this literature, including all field devices and instruments.
    - b. Project implementation plan, including information on project organization, project management, engineering, programming, configuration, training, startup, and maintenance services. Plan shall include key personnel on project, point of contact, and communication protocol.
    - c. Overall network schematic showing all controllers, radios, network switches, and hardware addresses applicable to the system.
    - d. Wiring diagrams for all control panels and MCCs.
    - e. Database with PLC addresses.
  - 2. Subsequent submittals shall include the following:
    - a. Control narratives.
    - b. Database with PLC addresses.

#### 1.05 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provision of Section 01 33 00–Submittals.
- B. Include spare parts data listing, source and current prices of replacement parts and supplies, and recommended maintenance procedures and intervals.
- C. Submit Operation and Maintenance Manuals in accordance with Division 01. The following additional information shall apply:
  - 1. Manuals shall contain, but not be limited to, the following:
    - a. System Hardware.
    - b. System Software.
  - 2. Hardware section shall include:
    - a. Safety precautions, physical description, functional description, operating procedures, theory of operation, maintenance instructions, checkout procedures, troubleshooting procedures, servicing, and removal and replacement procedures.
    - b. Wiring schematic and logic diagrams, parts list, and point-to-point wiring.
    - c. Listing of all hardware timers installed in MCCs and SCCs, as well as the ranges set on each timer. Listing shall also include actual timer setting after completion of startup.

3. Software section shall include:
  - a. Software manual shall describe system techniques, general philosophies, list, and description of all standard software.
  - b. Program documentation (i.e., PLCs, radios, OIPs) shall include programs, documentation files, database and configuration as installed. Provide two USB flash drives with this information. Usernames and passwords for all programmable devices (i.e., PLCs, radios, OIPs) shall be turned over to OWNER at the time of final completion.
  - c. Organize IP address listing in Microsoft Excel format for the SCADA Ethernet Network(s) indicating device hostnames, VLAN ID, descriptions, IP addresses, as well as the subnet mask and default gateway IP addresses.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect equipment from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle equipment carefully to avoid damage to SCC components, enclosure, and finish.

#### 1.07 SYSTEM ENGINEERING

- A. System Supplier shall provide all engineering necessary to accomplish and document the requirements of this specification and be in accordance with the system configuration. The engineering to be performed by System Supplier on this project shall include, but not be limited to, the following categories:
  1. PLC system layouts.
  2. Panel layouts.
  3. I/O configuration and wiring diagrams.
  4. PLC programming.
  5. Network configuration. Coordinate system IP addresses with OWNER and ENGINEER.
  6. OIP programming.
  7. Modifications to existing Radio Telemetry Network.
- B. Installation: CONTRACTOR shall install all system equipment, including PLCs and interconnecting cabling, as required. This work shall include all interconnection wiring from new and existing equipment as required for the completion of the system.
- C. It shall be the responsibility of System Supplier to ascertain that all field devices are compatible and consistent with the new system design. This includes reviewing drawings and data to ascertain the compatibility and consistency of the system with the field devices on such considerations as:
  1. Equipment size and available space.
  2. Power levels.
  3. Power sources.
  4. Logic schemes.
  5. Signal types and levels.
  6. Interface devices where required.
  7. All other aspects of field devices impacting the design of the system.
- D. The system shall be programmed to implement the control sequences and to provide monitoring according to this specification. It shall be the responsibility of System Supplier to

include all inputs and outputs required to meet all aspects of this specification, regardless of whether they are specifically included in the I/O listing in this specification.

- E. System Supplier shall provide a complete list of spare parts required and where they may be obtained for operating the system for 3 years from startup.

#### 1.08 CONTRACTOR AND SYSTEM SUPPLIER GENERAL REQUIREMENTS

- A. This specification, along with the Contract Drawings, defines the requirements of a PLC-based process monitoring and control system. System Supplier shall construct a process monitoring and control system specifically for the demanding requirements of a real-time municipal water distribution system.
- B. It is the intent of this specification to define modifications and additions to an existing fully integrated open-type process monitoring and control system, with all new equipment, factory tested, delivered to the site, and ready to function upon connection of a power source and field instrument wiring. Components, peripherals, interconnections, cabling, power supplies, software, and services necessary to form a complete, integrated system shall be identified and provided by CONTRACTOR. CONTRACTOR shall submit to ENGINEER, in writing, any deficiencies noted during this review. Any changes required by CONTRACTOR because of a failure to complete this review shall be the responsibility of CONTRACTOR, at no increase in cost to OWNER.
- C. CONTRACTOR shall be responsible for complete coordination in providing all equipment, sensors, and meters supplied with input and output signals, and contacts that are compatible with the systems as specified herein and existing systems. The Contract Drawings and I/O Listing are symbolic representatives of the required work. It is not intended that the Drawings show all appurtenances. CONTRACTOR shall provide a complete and working system according to the true intent and meaning of the Drawings, Specifications, and standard industry practices.
- D. To provide a complete and totally integrated system, a single manufacturer who has experience in furnishing similar networked PLC-based monitoring and control systems of the same complexity and size for municipal water distribution shall provide the specified equipment and services. The system proposed to meet this specification shall be of field-proven design incorporating manufacturer's standard equipment and software. Service of all peripheral devices shall be provided by the manufacturer of the process monitoring and control system.
- E. Design and specification of devices and the completed system shall conform to the applicable portions of the latest edition of the National Electrical Code (NEC).
- F. Control panels shall bear a serialized UL label indicating that it is UL approved as an assembled unit. Panels that have individual components that are UL labeled, but do not have UL approval as an assembled unit are not acceptable.
- G. Training Program:
  - 1. Submit a training plan including course syllabus, personnel who will be conducting the training, and schedule.
  - 2. Provide materials, instructors, and workbooks to complete the training.

3. Training courses shall include:
    - a. Operator Training: The course shall consist of one 4-hour session at the wellhouse. Training shall utilize equipment specified herein following installation and field testing. Training sessions shall occur at a minimum of 2-week intervals.
    - b. Maintenance Training: The course shall consist of one 4-hour session at the wellhouse. Training sessions shall occur at a minimum of 2-week intervals.
  4. Manufacturer's training shall be directed to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than the process itself.
  5. Refer to Section 01 91 00—Starting of Systems for additional training requirements.
- H. System Supplier shall meet the following minimum requirements:
1. System Supplier shall have a full-time staff of qualified programmers who are knowledgeable in the configuration of the PLCs being provided.
  2. System Supplier shall have a minimum of one Microsoft-certified engineer.
  3. System Supplier shall have training capabilities and shall have conducted training courses in programming and maintenance.
  4. System Supplier shall have an adequate inventory of spare parts.
  5. System Supplier shall have a full-time staff of qualified service technicians.
  6. System Supplier shall be responsible for the programming and documentation of the system.
  7. System Supplier shall be responsible for all details that may be necessary to properly install, wire, adjust, and place in operation a complete and working system.
  8. System Supplier shall be responsible for all coordination between the system and the field devices, instrumentation equipment, motor control centers, and equipment furnished with other divisions of this specification. This shall include interface with existing equipment.
  9. System Supplier shall have a UL panel shop located inside the System Supplier's own facilities.
- I. All components shall be standard make acceptable to OWNER, with one manufacturer to provide all similar components. The Base Bid System Supplier shall be L.W. Allen-Altronex, (608) 222-8622, no substitutions.

#### 1.09 FACTORY ACCEPTANCE TESTING, SYSTEM STARTUP, AND SUPPORT SERVICES

- A. System Supplier shall be responsible for development of a formal address listing associated with each PLC and shall provide ENGINEER with an organized spreadsheet of all addresses to be used for programming of the HMI software specified herein. Point listing shall be provided in Microsoft Excel format, grouped individually for each PLC, and neatly organized into groups such as discrete I/O, analog I/O, setpoints, alarms, historical data, and dialer configuration. Points not used with the HMI software or for internal PLC logic shall be removed or hidden from the listing. Spreadsheet shall be sent to ENGINEER a minimum of 12 weeks prior to the factory acceptance testing specified below. Any revisions made to the original spreadsheet shall be clearly identified by highlighting, colored text, or notes within the documents. CONTRACTOR shall provide OWNER an as-built version of the spreadsheet prior to Substantial Completion. Electronic files shall be named with the date and revision number.
- B. Permit ENGINEER and OWNER to observe vendor's staging records or other quality assurance records relating to system(s) supplied. System Supplier shall assemble the system components as a complete process monitoring and control system and demonstrate that the system is operational before shipment from System Supplier factory to the job site.



This testing shall be as an integrated assembly by simulating each of the specified I/O points and all specified algorithms.

- C. This test shall be witnessed by OWNER and ENGINEER (two personnel). System Supplier shall provide lodging, meals, and transportation in the Bid for two days and two nights as a minimum for this witness test. Travel costs shall include all rental car fees and refueling fees for each person attending where the driving distance is less than 250 miles. Travel costs shall include all airplane travel fees for any personnel travel that would otherwise require a driving distance greater than 250 miles. ENGINEER will travel from Madison, Wisconsin, and OWNER will travel from Waunakee, WI. All problems, errors, insufficiencies, and failures identified during testing shall be resolved before shipment. In the event the equipment does not operate in accordance with the specifications, programming of controllers/computers is incomplete, or setup of equipment is incomplete, there shall be deducted from payments due CONTRACTOR the amount of \$1,500 per day for ENGINEER's time plus travel and expenses, \$500 per day for OWNER's travel and expenses, as well as all costs for additional time plus travel and expenses for OWNER and ENGINEER to witness additional factory acceptance testing.
- D. System Supplier shall make provisions to allow ENGINEER to test any modifications to existing PLC logic. This shall include a mock-up in their factory with temporary, equivalent, PLCs using project-specific programs and all required ancillary equipment.
- E. In order to allow remote participation in the Factory Acceptance Test, System Supplier shall make provisions to allow ENGINEER and OWNER to connect to the temporary PLC network in their factory using a high speed (minimum 30 mbps) Virtual Private Network (VPN). The VPN connection shall allow full network access to all PLCs, SCADA computers, and any other equipment needed to fully complete the factory acceptance testing. The VPN shall be activated and the latest version of VPN Client software shall be provided to OWNER and ENGINEER at least one week prior to the scheduled test to allow for VPN connection testing and troubleshooting. This VPN connection is in addition to the in-person factory acceptance testing specified above.
- F. On-Site Functional Acceptance Testing:
  - 1. After all equipment has been installed and is placed in full-time operation, CONTRACTOR and System Supplier shall demonstrate that all equipment and controls operate in compliance with the Contract Documents. For each piece of equipment being tested, all systems associated with the operation of the equipment (e.g., controls, supply/discharge piping, etc.) shall be installed and be in full operating condition so that all equipment functions are able to be completely tested without delay using real-time process I/O.
  - 2. All control wiring, hardwired interlocks, control programming, etc., shall be checked out and functionally tested by System Supplier prior to ENGINEER's on-site functional acceptance testing. All functional errors shall be corrected prior to ENGINEER's on-site functional acceptance testing.
  - 3. Coordination Videoconferences:
    - a. CONTRACTOR shall schedule and conduct an initial functional acceptance testing coordination videoconference at least two months prior to the anticipated functional acceptance testing. The videoconference shall include CONTRACTOR, System Supplier, Division 26 contractor, OWNER, and ENGINEER, and all other parties responsible for the equipment and controls scheduled for functional acceptance testing.
    - b. CONTRACTOR shall schedule and conduct additional functional acceptance testing coordination videoconferences one month prior to the date for functional acceptance

- testing to confirm status of equipment installation and System Supplier checkouts, and updates to the functional acceptance testing schedule, after which ENGINEER will finalize reservations for travel and accommodations. All parties shall agree on a date for functional acceptance testing or schedule an additional videoconference to establish a testing date one month prior to the delayed testing date. If the functional acceptance testing is rescheduled within one month of the agreed upon date, there will be deducted from payments due to CONTRACTOR the amount of penalties paid by ENGINEER for travel and accommodation cancellations. OWNER will deduct the amount of these charges from payments made to CONTRACTOR.
- c. CONTRACTOR shall provide the following information in written form at each videoconference. All information shall be updated prior to each videoconference.
- (1) Equipment installation and manufacturer's startup schedule.
  - (2) Status of all power and control system wiring for the equipment scheduled for functional acceptance testing.
  - (3) Schedule and status of System Supplier's on-site checkout and functional testing.
  - (4) Anticipated delays and the cause of each delay.
  - (5) Conflicts with OWNER's operation of the facility.
  - (6) Proposed dates for acceptance testing of all equipment and controls.
  - (7) Proposed dates for future acceptance testing coordination videoconferences.
4. After being notified by CONTRACTOR that the equipment has been installed and is in full operating condition and ready for ENGINEER's functional acceptance testing, ENGINEER will make one 1-day trip to check operation. CONTRACTOR and System Supplier shall be on-site during testing to adjust equipment, correct erroneous wiring, and make modifications to control system, as necessary. If the equipment and controls do not operate according to the Contract Documents, or if CONTRACTOR and System Supplier are not present during the scheduled testing, there will be deducted from payments due to CONTRACTOR the amount of \$1,500 a day for ENGINEER's time plus travel and expenses, and for all additional field and office time spent by ENGINEER checking equipment. OWNER will deduct the amount of these charges from payments made to CONTRACTOR.
5. System Supplier shall provide functional acceptance testing support through one or more on-site field service engineers and the project control system programmer. Time for the on-site field service engineers and programmer scheduled for functional acceptance testing shall be dedicated to the functional acceptance testing process and shall not be interrupted for other construction-related activities.
- G. Final acceptance and payment will not be made until the system has operated satisfactorily for a minimum of 30 consecutive days. CONTRACTOR shall include in the Bid field follow-up to provide proper adjustments and operation during the first year following project final completion. Prior to beginning the 30-day test, the following criteria shall be met:
1. Satisfactory operation of I/O control loops.
  2. Satisfactory operation of software.
  3. Satisfactory operation of control program.
  4. Satisfactory operation of peripheral equipment.
  5. The necessary debugging programs have been performed.
  6. Data output is reliable.
  7. Control loops are operational.
  8. Checking and calibrating of systems have been completed.
  9. Wired and wireless communication systems are reliable.

- H. CONTRACTOR, through System Supplier, shall provide the following support services:
1. Field Service Engineer: Field service engineer shall be responsible for programming of system PLCs and OIPs in the factory and at the site. Field service engineer shall be present at the factory acceptance test and be present for startup of all systems and available throughout the entire construction process until final completion. Service technicians sent for system startup will not be acceptable. Support shall include on-site time. Services shall include, but not be limited to:
    - a. Commissioning, installation, startup, and testing of equipment.
    - b. Revising or rewriting manuals to incorporate an installed and accepted system.
    - c. On-site training.
    - d. Software modifications.
  2. In-factory support shall include consultation following the acceptance testing and shipment. Services shall include, but not be limited to:
    - a. Researching and answering questions related to the system operation, documentation, and system use and functions.
    - b. Program modifications.
    - c. Revising or rewriting manuals.
  3. Post-startup support shall include follow-up services during the one-year period following final acceptance. Service shall include follow-up recalibration and replacement of defective equipment, as well as additional training, software modifications, and control configurations as requested by OWNER. This shall include 16 hours for work on-site other than warranty repair or replacement of defective equipment. This time shall be used for software enhancements and modifications to improve the operation of the system. In addition to the 16 hours, include one trip to the site.
- I. CONTRACTOR shall not install any hardware or software to enable remote access or control without written permission from OWNER and ENGINEER.

#### 1.10 COMMON REQUIREMENTS ALL EQUIPMENT

- A. All indicating and recording devices shall be electric or electronic.
- B. All indicating and control devices mounted on control panel, standalone VFD, and MCC enclosure doors (e.g., meters, gauges, electronic indicators, pilot lights, selector switches, VFD HIMs, OIPs, etc.) shall be located at eye level, minimum 48 inches, maximum 60 inches, from floor to bottom of device. Indicating devices on MCC enclosure doors located in the bottom half of an MCC section shall be mounted as high as possible.
- C. All motor control power shall be 120 volts with suitable circuit protection (fuses or breakers). Fuse holders shall be provided with integral LEDs to indicate when the fuse is blown.
- D. Devices powered at 120 volts from supervisory control panels shall be fused. This shall include, but not be limited to, solenoid valves, flowmeters, and transmitters.
- E. Provide lightning protection, isolation transformers, and fused disconnects at each end of each power circuit, supervisory circuit, and local supervisory circuit with transformers and relays, if necessary, to obtain supervisory power. 120-volt power shall be available at all control points. Lightning protection shall be completely solid-state and self-healing and shall not require the use of fuses. Provide a single switch with an indicating light to deenergize the control power for each location. Each panel shall have a GFI, duplex, 15 ampere, 120-volt receptacle.

- F. If enclosure and back panel space is specified to be provided for the installation of future equipment, the enclosure and back panel shall be constructed to accommodate all future equipment. Supports and wireway shall be provided for future equipment, and openings in the enclosure shall be provided for future pilot devices and covered with neat cover plates matching the finish of the enclosure.
- G. Where equipment is necessary to perform a function as called for in one part of this specification, it shall be provided, even though the detailed enumeration at various control points may omit listing that equipment.
- H. Where a certain accuracy of sensing and transmitting levels, flows, or other process conditions and controlling operations are called for, means shall be provided to read or determine that the process conditions are within the limits or accuracy specified for the sensing, transmitting, and controlling devices. Where no accuracy is specified, but a knowledge of process conditions is necessary to set operating points, provide accuracy consistent with the requirements for operation of the system.
- I. All control and auxiliary relays shall have indicating LEDs. All timing relays shall have On and timing Out LEDs.
- J. Status signals for motors powered from VFDs and associated equipment, noted in the Section 26 09 90–SCADA System I/O Listing to be communicated to the associated PLC via Ethernet shall be wired to inputs on the VFD and communicated to/from the PLC via the SCADA System EtherNet/IP network.
- K. Hardwired Motor Controls:
  - 1. Equipment and wiring specified to be hardwired shall be physically wired independent of controllers, programmable relays, and communication systems to allow manual operation in the event of an emergency.
  - 2. Motor control wiring and logic shall be set up such that in the event of a power failure, equipment shall automatically restart if previously running, or remain off if previously off. A manual reset shall not be required to restart equipment following a power failure.
  - 3. All hardwired local controls for VFDs shall be fully functional in the event of an Ethernet communication failure between the VFD and the PLC.

#### 1.11 GENERAL CONTROL ALGORITHMS

- A. In general, the following is a definition of I/O at each MCC:
  - 1. Run from auxiliary starter or VFD contact (dry contact or Ethernet).
  - 2. Fail from starter overload or VFD auxiliary contact (dry contact or Ethernet).
  - 3. Start/Stop maintained signal to starter or VFD, or as required (dry contact or Ethernet).
  - 4. In Auto/In Remote from selector switch on motor controller (dry contact or Ethernet).
  - 5. Any command to operate shall be acted upon within 5 seconds, and any status feedback signals shall be received within 5 seconds.
- B. Definitions:
  - 1. The "Master Telemetry PLC" for the SCADA System shall be the PLC located in Water System Main SCC located at the Waunakee Utilities Office. This PLC shall send and receive information to and from all remote PLCs connected to this PLC via radio telemetry, and shall make this information available to other networked PLCs and available for display at the SCADA System.

2. Where referenced herein, a "Remote Telemetry-Connected PLC" includes any PLC located at a facility remote from the Master Telemetry PLC location that communicates information back to the SCADA System via radio communications.
- C. All setpoints described in Part 3—Execution of this Section shall be operator adjustable throughout the specified range of each setpoint, unless setpoint is noted to be hardcoded into the PLC logic.
- D. Programming algorithms described herein and in Part 3—Execution shall reside within the PLC associated with that equipment and not in the Main PLC. Polling sequences for data transmission over new and existing radio telemetry shall be modified as needed to poll remote data based on the data type (e.g., alarms, historical) so that data transmission rates are not adversely affected.
- E. All alarm contacts or system changes following a command must exist or not change for 0 to 5 seconds to activate an alarm at the SCADA System.
- F. All analog and digital inputs shall be monitored in the PLC. This shall include, but not be limited to, flows (water, etc.), weights, pressures, electrical values, and levels. The following analog signals shall have minimum, maximum, and running average calculated values: all flows, kilowatts, levels, and pressures. Instantaneous values, totals, maximum, minimum, and average values shall be read by the HMI software and be reset on a daily basis as described below. Minimum, maximum, and average values shall be stored in the PLC for the current day and previous day.
- G. PLCs shall calculate equipment runtimes and number of starts for all equipment where run signals are monitored. Runtimes and number of starts shall be read by the HMI software and be reset on a daily basis as described below.
- H. Totalized flow values, chemical usage, electrical values (kilowatt-hours), and equipment runtimes as described above shall be stored in the PLC for a period of 7 days. This data shall be available for use by the HMI software for importing into a reporting software package for purposes of daily, weekly, and monthly reporting. The PLC shall indicate the specific date for each of the 7 previous days.
- I. Calculations for chemical usages shall be programmed so that tank filling cycles do not affect the usage totals. The totalizer shall only accumulate chemical usage when any pumps served by the tank are running. Provide a hardcoded tank-filling deadband to determine when the tank is being filled. When the tank weight/level increases more than the deadband (i.e., the tank is being filled), chemical usage totalizing shall be suspended until the tank weight/level stops rising for a hardcoded time delay (i.e., the tank is no longer being filled). The daily usage total shall be reset with the daily flow and runtime totals. Coordinate the hardcoded buffer and time delay values described above with OWNER during startup.
- J. Daily flow totals, chemical usage, runtimes, number of starts, electrical values (kilowatt-hours), and number of cycles as described above shall be reset on a daily basis. This reset shall occur based on a time (hour and minute) setpoint stored in the Master Telemetry PLC through the HMI software and shall be automatically communicated to all Remote Telemetry-Connected PLCs so that each PLC will reset daily totals for its associated equipment even if there is a loss of communication with the Master Telemetry PLC. The operator shall set the time when the daily reset will occur. Once this time setpoint matches the current time of the processor clock, each PLC shall clear any totals that have accumulated locally.

- K. In addition to the totalizers described above, the PLC shall also calculate cumulative totals for all runtimes, number of starts, flows, electrical values (kilowatt-hours), and chemical (weight) usage. Maximum, minimum, and running average for all analog inputs shall also be included as part of the cumulative total algorithm. Cumulative totals shall totalize until manually reset by the operator. The reset tag within the PLC shall be set by the operator at the HMI software and reset by the PLC. There shall be a manual reset for each signal. The PLC shall display the date of the last cumulative totalizer reset for each signal.
- L. Indication of time remaining for all timers (hardcoded and operator adjustable) within PLCs shall be made available for indication at the SCADA System.
- M. The existing clock and date setting shall be transmitted from the Master Telemetry PLC to all Remote Telemetry-Connected PLCs based on the setting in the Master Telemetry PLC.
- N. All analog signals shall be scaled to engineering units in the PLC with real or floating-point data types to prevent scaling values in the HMI. System Supplier shall provide all analog ranges and PLC register/tag addresses to ENGINEER for use with the HMI software. This shall include upper and lower limits for the associated device (i.e., 0 to 150 psi).
- O. For all analog input signals to the PLC I/O cards, provide a Transmitter Fail alarm at the SCADA System for each transmitter. Transmitter fail shall be defined as the signal from the transmitter being out of range.
- P. The following analog signals shall have associated high and low setpoints and alarms: all levels, pressures, and amps (high only). Provide a "Reorder Chemical" level setpoint for all bulk chemical storage tank level analog signals.
- Q. PLCs shall be set up so that the ranges of all analog input signals to the PLC I/O cards can be configured from the HMI software. Provide two operator-adjustable setpoints for each analog input, one corresponding to 4 mA and the other corresponding to 20 mA. These setpoints are applicable to devices attached to the Remote Telemetry-Connected PLCs (via the Master Telemetry PLC). This feature is intended to be used for startup and calibration purposes.
- R. All equipment controlled automatically from the SCADA System shall have "Call-to-Run" signals generated from their associated PLCs. These signals shall be displayed at the SCADA System through the HMI software. Each associated PLC shall also generate a Call-to-Run Fail alarm if the equipment is called-to-run but does not start within a specific time period. The Call-to-Run Fail alarm shall be generated within the PLC software and may not be combined with other fail signals such as hardwired motor fails, and overtemperature. Call-to-Run Fail alarms shall only be active when the selector switch on the motor controller is in the "Auto" position.
- S. All controlled equipment as described herein shall have the capability of manual control from the HMI software through the manipulation of analog or digital variables. This shall be through the use of a "SCADA H-O-A" switch or by forcing a single I/O point as a manual start command. All analog and digital outputs shall be capable of being manually set from the HMI software.
- T. Where a manual reset is required at the SCADA System (i.e., level lockout, pressure lockout), the HMI software shall be configured to set a discrete reset bit. Once the PLC

receives the bit and the alarm condition has cleared, the PLC shall clear the alarm and place the associated equipment back in service.

- U. Provide an analog PLC tag for each piece of equipment controlled or monitored from a SCADA System PLC that shall be used for the color animation associated with that equipment's HMI graphic object. The analog tag value shall be as follows: 0 = Off/Out of Service, 1 = In Auto at motor controller (e.g., starter in MCC), 2 = PLC Call-to-Run, 3 = Running Forward, 4 = Running Reverse, 5 = Failed (Call-to-Run, Starter Overload, etc.). Provide "Out of Service" indication for each piece of equipment when that equipment's MCC or SCADA H-O-A is not in the Auto position. Precedence shall be given to the higher number conditions; for example, if a pump is In Auto but has failed, the tag value shall be 5.
- V. The SCADA System shall allow the operator to change all setpoints and operating parameters within the PLCs as described herein. All control algorithms and alarms for equipment shall be programmed in the associated PLC and not in the Master Telemetry PLC. There shall be no control algorithms or alarms in the SCADA computers. Control of each piece of equipment shall be accomplished as described herein and in Part 3—Execution of this section.
- W. Each Master Telemetry PLC shall be setup so that these PLCs monitor the cycle of each associated Remote Telemetry-Connected PLC to detect a communication failure. This shall be accomplished by the Master Telemetry PLC setting and resetting a bit internal to the Master Telemetry PLC program every 60 seconds. This bit shall then be sent to each associated Remote Telemetry-Connected PLC. Once this bit is received by the Remote Telemetry-Connected PLC, the PLC shall copy the value of this bit to a second bit internal to its PLC program. This second bit shall be read by the associated Master Telemetry PLC. If the Master Telemetry PLC does not see a change in status of the second bit, a PLC communication fail alarm shall be activated at the SCADA System. The associated Master Telemetry PLC shall provide indication of which PLC is in alarm at the SCADA System.
- X. Radios installed in telemetry panels for Remote Telemetry-Connected PLCs shall be powered through a normally closed control power relay contact. If a Remote Telemetry-Connected PLC detects a communication fail, the PLC shall energize the control power relay that will deenergize power to the radio. The relay shall be energized for 5 seconds and then deenergized. Communication fail time delays shall be adjusted during startup based on the quantity of telemetry panels. One additional radio power cycle shall be attempted if the first power cycle does not restore communications.
- Y. Each alarm shall have a discrete PLC tag that is able to be toggled at the SCADA System HMI to enable or disable the associated alarm from being activated.
- Z. All alarms shall be tied to the existing software dialer and common alarms wired to the hardwired dialer via the Master Telemetry PLC to match existing functionality. The assignment of all alarms to the hardwired and software dialer shall be done through the SCADA System and be flexible for operation. The operator shall be able to assign any alarm to two channels on the alarm dialer. In the event of an alarm, the software dialer shall inform the operator as to what station or piece of equipment is in alarm. Provide a bit for each alarm that can be manipulated at the SCADA System allowing the operator to enable or disable the alarm from being sent to the hardwired and software dialer. Regardless of the state of the bit, the alarm shall be displayed at the SCADA System. An alarm silence/acknowledge bit shall also be provided to silence the alarm horn and disable all active alarms from being sent to the hardwired and software dialer.

- AA. In the event of a power failure, when power is restored, the PLC shall automatically stagger the restart of any controlled equipment that is being called to run by the PLC. The stagger shall be operator-adjustable from 0 to 300 seconds through the HMI graphics software on the SCADA computers.
- BB. Provide a hardcoded minimum speed within the associated PLC for each pump operating on a VFD. The minimum speed shall be the minimum speed at which the pump will still produce flow. Coordinate the minimum speed with the pump manufacturer during startup.

## 1.12 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

## PART 2-PRODUCTS

### 2.01 EQUIPMENT ENCLOSURES

- A. New enclosures shall be front access only, minimum No. 14 gauge steel, with continuously-hinged doors. Enclosures equal to or smaller than 24 inches wide by 24 inches high shall be equipped with at least two quarter turn latches. Enclosures larger than 24 inches in any dimension shall be equipped with 3-point latch with top and bottom bolts actuated by one rotating, lockable handle on each door. Provide a door stop kit for each door, data pocket for wiring diagrams, and minimum 12-inch, bolt-on, LED light and door switch. Panels over 48 inches wide shall have two lights. Painting shall include phosphate treatment, zinc chromate iron oxide primer, baked rust-inhibiting enamel, and white interior. All doors and panels shall be gasketed. All louvers shall be filtered and forced-air cooling shall be provided as necessary for conditions where installed. Provide enclosure dimensions as specified herein. Enclosures shall be as manufactured by Hoffman or Saginaw. MCC structures are not acceptable.
- B. Each PLC enclosure shall include, but not be limited to, the following equipment:
  - 1. PLC, I/O modules, and communication modules.
  - 2. Power supplies.
  - 3. Surge protective devices.
  - 4. DIN-rail mounted terminal blocks for field wiring terminations.
  - 5. Plastic wiring ducts.
  - 6. General purpose 15-amp, 120-volt AC duplex GFCI receptacle.
  - 7. 20-amp, 120-volt AC main circuit breaker and branch circuit breakers as required to feed the PLC and the I/O controlled field devices.
  - 8. Other accessories required to provide a complete and working PLC system.
  - 9. UPS backup for the SCC.
  - 10. Network switch.
  - 11. Front panel-mounted programming port with RJ-45 jack and 120-volt receptacle.
- C. The equipment mounted within the enclosures shall be mounted on the enclosure back panel, neatly organized, and shall be in accordance with the manufacturer's recommendations.



- D. Refer to Section 26 05 53—Electrical Identification for the control panel and field wiring color code.
- E. 24 VDC power supplies shall be provided in the enclosures to power all 24 VDC devices and loop-powered analog input signals, where required.
- F. NEMA ratings of enclosures shall be as required for the area where installed, unless specified otherwise.
- G. Manufacturer of Accessories:
  - 1. Plastic wiring duct shall be Panduit Panduct, or equal.
  - 2. Terminal blocks shall meet the requirements of Section 26 05 19—Wire.
  - 3. Wire markers shall meet the requirements of Section 26 05 53—Electrical Identification.
  - 4. Circuit breakers shall be Square D Type QO with mounting bases, or equal. Circuit breakers can be rail-mounted type, Square D, Class 9080, Type GCB-150, or equal.
  - 5. Signal conditioners shall be Action Instruments, DIN rail mount, or equal.
  - 6. Power supplies shall be Allen-Bradley Model 1606-XLS, or equal, and shall meet the following requirements:
    - a. Sized for the connected load plus inrush with capacity for a 50% power boost for up to 5 seconds.
    - b. Integral, dry-contact relay for monitoring "DC OK" status at the SCADA System.
    - c. UL Listed.
    - d. Conformal coated.
    - e. Temperature Range: -25°C to 60°C.
    - f. Protection Features:
      - (1) Over-voltage protection.
      - (2) Protection against no-load and short circuit conditions.
      - (3) Over-temperature protection.
      - (4) Internal input fuse.
      - (5) MOV-type input transient protection.
- H. All wiring within the enclosure shall be through plastic wiring troughs. Plastic wiring troughs shall have removable covers. Maximum fill for wiring troughs shall be 60%. All wiring in supervisory enclosures and control panels not in wiring troughs shall be bound with continuous-type spiral windings. Terminal strips located adjacent to wiring troughs shall have a minimum of 1 1/2 inches between terminal strip and wiring trough. All wiring labels shall be able to be read without removing wiring trough covers. Wiring troughs shall be provided for all field wiring.
- I. All wiring for new panels shall be done in the factory, Class II, Type C with master terminal strips for exterior connections. Terminal strips shall be located either at the bottom or on the side of the enclosure, depending on where the I/O conduits penetrate the enclosure. Splices are not allowed within enclosures or wireways. All enclosures must pass through doors to point of installation, and if enclosures are shipped in sections, all wiring and connections between sections shall be done by CONTRACTOR. The field wiring terminals shall be clearly identified as to which I/O terminals they are wired. Jumpers between adjacent terminal blocks shall be copper jumper bars supplied by the terminal block manufacturer. All wiring shall be labeled at each end with corresponding numbers matching the associated terminal block. This numbering shall be shown on the shop and Record Drawings.
- J. All door-mounted devices shall be furnished flush-mounted, and an exterior-engraved phenolic nameplate worded by OWNER (upon receipt of shop drawings) shall be provided for each component, device, and light. All components within the enclosures shall be

identified with sticky-back adhesive, self-laminating, machine-printed marking labels with white background and black text; minimum size 12 font. Labels shall be installed on the enclosure back panel and not on the device or wireway. Devices shall be grouped for each device or unit being controlled.

- K. All panels with DIN rail-mounted equipment shall include a minimum of 25% spare DIN rail space.
- L. In addition to spare I/O specified herein, provide a minimum of 25% spare hot and neutral terminals wired to terminal strips. Spares shall be provided for all voltage sources within the panel (e.g., 120 V, 24 V).
- M. Enclosures that include motor controllers shall have a main disconnect for the enclosure.

## 2.02 PLC REMOTE TELEMETRY SYSTEMS

- A. All control signals, status signals, alarm, and variable analog data shall be transmitted and received between the associated Master Telemetry PLC and the Remote Telemetry-Connected PLCs via a SCADA System using digital telemetry. The mode of communication for the PLCs shall be via radios as specified herein. The SCADA System shall convert commands, alarms, and variable analog data to digital data blocks and transmit this information between a master and the multiple remote sites.
- B. The digital blocks of data shall be sent/received in half-duplex mode from the Telemetry system to the PLCs via the Ethernet interface.
- C. If communications cannot be verified between the associated Master Telemetry PLC and a Remote Telemetry-Connected PLC, the associated Master Telemetry PLC shall try to send the data three times before a data fail output is energized.
- D. The system shall communicate at a rate sufficient to perform any command to operate control within 5 seconds and receive any status feedback signals within 5 seconds.
- E. The associated Master Telemetry PLC shall normally sequentially poll all the Remote Telemetry-Connected PLCs, but shall be field-programmable to alternate sequences to minimize the update time for critical remotes. Provisions shall be included to field-program a time delay between PLC interrogations and between scan sequences.

## 2.03 COMPACTLOGIX PROGRAMMABLE LOGIC CONTROLLERS

- A. Construction:
  - 1. The PLC shall include a CPU, memory, embedded dual Ethernet ports, and embedded energy storage.
  - 2. The PLC and all system modules shall be DIN rail mounted.
  - 3. All system modules shall be able to operate in an industrial environment with an ambient temperature of 32°F to 140°F.
  - 4. All system modules shall be able to operate in a free airflow environment.
  - 5. All system modules shall be able to operate in high electrical noise environments.
- B. The system shall support a minimum of eight local I/O expansion modules in up to three chassis.
  - 1. Local expansion modules shall be installed in the local chassis or in chassis adjacent to the local chassis.

2. The manufacturer shall have available a variety of I/O modules, including, but not limited to, AC or DC discrete input, AC or DC relay contact output, 4-20 mA analog input and output, and RTD.
3. Each chassis in multiple-chassis installations shall be interconnected via Ethernet.
4. Discrete I/O cards shall be 120 VAC 16 point maximum, unless otherwise noted.
5. Isolated discrete I/O cards shall be 8 point maximum. Isolated discrete cards shall be used if there are multiple or external power sources associated with the signals, if wiring leaves the building, or if the card is driving a load (i.e., solenoids, etc.).
6. Analog input cards shall be 8 point.
7. Analog output cards shall be 4 point isolated type.

C. CPU:

1. The CPU shall be a self-contained unit, and shall be capable of providing control program execution, supporting remote and local programming, controlling all I/O scanning and inter-controller and peripheral communication and diagnostic functions as follows:
  - a. 32 tasks (1,000 programs per task):
    - (1) Continuous—one allowed.
    - (2) Periodic—Run via an interrupt at a user-defined interval in 1  $\mu$ s increments from 1 ms to 2000 s.
    - (3) Event—Triggered by consumed tag or EVENT instruction.
  - b. 256 controller connections.
  - c. Network connections:
    - (1) Up to 256 EtherNet/IP.
    - (2) Up to 120 TCP/IP.
2. The PLC shall organize user applications as tasks, which can be specified as continuous, periodic, or event based. Tasks shall be triggered by input point or instruction.
3. The CPU shall have a real-time clock.
4. When the main power supply is removed, the CPU shall have the ability to back up user program and all data, or a nonenergy storage option.
5. The front of the CPU shall have a USB port.
6. The front of the CPU shall have an integrated latching mechanism for securing the secure digital (SD) memory card. The PLC shall operate with the memory card removed.
7. The processor module shall have LED indicators to indicate CPU status.
8. The processor module shall have a mode switch.

D. Memory:

1. The PLC shall have a minimum of 3 MB of standard user memory. Provide processor configurations with additional memory as required.
2. The program storage medium shall be solid-state, nonvolatile type.
3. The PLC shall include a 2 GB SD memory card to store the user program and the firmware of all modules residing in the same chassis to protect against memory loss.

E. Programming Environment:

1. Programming shall be through the USB 2.0 port or through the EtherNet/IP network.
2. The programming software shall run on the latest version of Windows and the programming methods shall be:
  - a. IEC 61131-3 compliant ladder diagram.
  - b. Structured text.
  - c. Function block diagram.
  - d. Sequential function chart.

- F. Communication:
1. USB 2.0 port to support upload and download, online edits, firmware updates, and bridging to other modules.
  2. EtherNet/IP switch and dual 10/100/1000 Mbps EtherNet/IP ports with unique IP addresses or a single IP address when connected as part of a device level ring. The interface shall support:
    - a. IEEE 802.3 Physical and Data Link Standard.
    - b. Common Industrial Protocol (CIP), the protocol that provides real-time I/O messaging and information/peer-to-peer messaging.
    - c. Standard TCP/IP and UDP/IP communication.
    - d. 10/100/1000 Mbps auto sensing and auto switching.
    - e. Standard Ethernet media.
    - f. Subnet masking.
    - g. BOOTP and DHCP support.
    - h. Manual configuration using specified software.
    - i. Programmable Logic Controller messaging to peer controllers and workstations.
    - j. I/O data, real-time interlocking and information.
    - k. Full-duplex communication.
    - l. Built-in web access to diagnostics.
    - m. I/O control.
    - n. Precision Time Protocol (CIP Sync, IEEE 1588).
- G. Power Supply:
1. The PLC shall be provided with separate, dedicated, field-side power supplies, quantity as needed, for sensor/actuator (SA) power, and a separate, dedicated, system-side power supply for power to the PLC and I/O modules (MOD) power.
  2. Provide field-potential-distributor modules as needed to transition SA power from AC to DC or from DC to AC input power for downstream I/O modules.
- H. PLCs shall be as manufactured by Rockwell Automation, CompactLogix 5380 L3 Series, or equal.
- I. PLC Programming and PLC Software: System Supplier shall provide all PLC programming and software required to meet this specification. The software shall include, but not be limited to, the following:
1. PLC logic programs to be written by System Supplier for the PLC systems to accomplish the monitoring and control functions as specified herein. The System Supplier shall document and annotate the programs, update them as required after startup, and then turn two copies of the programs over to OWNER on two USB flash drives with project-specific labels.
  2. All I/O addressing that is to be viewed or manipulated by the HMI software shall be organized into contiguous blocks of integer tags for discrete bits and floating point tags for all other values to facilitate block data transfer between computers and PLCs.

## 2.04 UNINTERRUPTIBLE POWER SUPPLIES

- A. Provide a UPS backup in each SCC that will provide continuous communication for at least 30 minutes following a power failure. UPS power shall be provided, at a minimum, to the following equipment:
1. PLCs and I/O cards, controllers, and OIPs.
  2. Network switches, signal converters, and other communication devices.
  3. Power fail and communication indicating lights and alarm devices.
  4. Power supplies for loop-powered instruments.

5. Hazardous material detection and alarming instrumentation and notification devices.
  6. Intrusion detection system devices.
- B. Interior control panels with PLCs shall be provided with a true online 120-volt AC UPS.
1. Each UPS shall be provided with a dry contact output for remote indication of a common UPS alarm or if UPS batteries need replacement.
  2. UPS shall be APC with relay I/O module, Liebert GXT5 with relay card, or Eaton 9SX.

## 2.05 INDUSTRIAL CONTROL RELAYS AND CONTACTORS

- A. Industrial control and power relays shall be installed in motor control centers, pump control panels, and motor controller enclosures where required by System Supplier. Relays used to interface with PLC I/O, motor control circuits, hard-wired control logic, and for loads less than 8 amps shall be terminal style, interposing/isolation relays. Relays for inductive loads, alarm lights, alarm horns, field wiring, or loads up to 15 amps shall be industrial, general purpose square base relays. Relays for monitoring the output voltage of uninterruptible power supplies shall be UPS voltage monitoring relays. Contactors for lighting circuits, branch circuits, or loads greater than 15 amps shall be industrial, electrically-held lighting contactors. Contactors for motor power control shall be industrial, electrically-held power contactors.
- B. Relays shall meet the following requirements:
1. Interposing/Isolation Relays:
    - a. Configuration: SPDT or DPDT as required by System Supplier.
    - b. Mounting: DIN rail with screw terminal base socket.
    - c. Voltage: 120 VAC, or as required by System Supplier.
    - d. Contact Rating: 8 A (DPDT), 16 A (SPDT).
    - e. Mechanical Operating Life: 10 million cycles.
    - f. Status: On-Off flag-type or LED indicator.
    - g. UL listed.
    - h. Manufacturer: Allen-Bradley, 700-HK, or equal.
  2. General Purpose Relays:
    - a. Configuration: DPDT or 3PDT as required by System Supplier.
    - b. Mounting: DIN rail with screw terminal base socket.
    - c. Voltage: 120 VAC.
    - d. Contact Rating: 15 A, minimum; 3/4 hp.
    - e. Mechanical Operating Life: 10 million cycles.
    - f. Status: On-Off flag-type or LED indicator.
    - g. UL listed.
    - h. Manufacturer: Allen-Bradley, 700-HB, or equal.
  3. UPS Voltage Monitoring Relays:
    - a. Configuration: SPDT.
    - b. Mounting: DIN rail.
    - c. Voltage: 120 VAC.
    - d. Contact Rating: 15 A.
    - e. Mechanical Operating Life: 10 million cycles.
    - f. Over-Voltage Range: 80 to 150 VAC, adjustable.
    - g. Under-Voltage Range: 30 to 95% of pickup, adjustable.
    - h. Drop-Out Time Delay: 0.1 to 10 seconds, adjustable.
    - i. UL listed.
    - j. Manufacturer: Macromatic, VWKE120A, or equal.
  4. Power Contactors:
    - a. Configuration: Electrically-held, 3 poles.

- b. Mounting: DIN rail.
- c. Voltage: 120 VAC.
- d. Minimum Contact Rating: 20 A continuous, 1 hp.
- e. Mechanical Operating Life: 1.3 million cycles.
- f. UL listed.
- g. NEMA rated.
- h. Manufacturer: Allen-Bradley, Bulletin 300, or equal.

## 2.06 UHF RADIO TELEMETRY SYSTEM

- A. Provide one remote radio at the PLC controller location described herein, and all appropriate accessories for a complete, operational radio telemetry system.
- B. System Supplier must design the radio telemetry system for at least 99.9% reliability. System Supplier shall also provide all radio frequency coordination and FCC licensing procedures.
- C. Remote Radios:
  - 1. The units shall operate in the 450 to 512 MHz frequency band.
  - 2. The units shall have authorization of notification or type acceptance for operation in a 12.5 KHz bandwidth including 20,000 bps operation.
  - 3. The unit chassis shall be cast aluminum to eliminate interference with data/controller equipment. Plastic housings are not acceptable. All PC boards, including modem and diagnostic boards, shall be enclosed in the chassis.
  - 4. The remote radios shall be suitable for 120/240 VAC input with battery backup. Individual LED status indicators shall be located on the front of the unit.
  - 5. Antenna connection shall be Type N, female.
  - 6. Temperature range for full performance shall be -30°C to 60°C with operational performance from -40° to 70°C. Humidity range for full performance shall be 0% to 95% relative humidity, noncondensing.
  - 7. Radio communication shall occur at a minimum of 20,000 baud. Each radio shall have internal 20,000 baud, asynchronous modem with Ethernet and RS-232 interface. Request to send/clear turnaround time shall not exceed 10 milliseconds. The interface must work in a 12.5 KHz channel.
  - 8. The remote unit must be fully synthesized and programmable to all frequencies via a personal computer or hand-held terminal without changing internal components. Opening the radio to change modules, frequency crystals, or DIP switches is unacceptable.
  - 9. Bands of Operation:
    - a. Frequency Range: 450 to 512 MHz. Existing FCC license is 458.0875 MHz.
    - b. Frequency Programming: Programmable in 6.25 KHz increments to any channel in radio operating subband.
  - 10. The unit shall operate in the half-duplex mode with the transmitter keying provided by the associated controller.
  - 11. The remote radio transmitter shall meet the following specifications:
    - a. Output Power (at the antenna port): 1 to 10 watts.
    - b. Duty Cycle: 100%. Power must not degrade by more than 1 watt at 60°C.
    - c. Frequency Programming: Programmable in 6.25 KHz increments to any channel in radio operating subband.
    - d. Stability: 1.0 ppm from -30° to 60°C
    - e. Modulation Type: 2FSK, 4FSK, 8FSK, 16FSK.
    - f. Spurious/Harmonic Emissions: Per FCC requirements.
    - g. Output Impedance: 50 Ohms.
    - h. Time-Out Timer: Programmable from 2 to 255 seconds; via PC or Hand-held unit.

- i. RTS-CTS Delay: Programmable from 5 to 255 milliseconds via PC or Hand-held unit.
- 12. The remote radio receiver shall meet the following specifications:
  - a. Type: Direct Conversion.
  - b. 12K bps Digital Interface: -100dBm for 1x10<sup>-6</sup> BER.
  - c. Frequency Programming: Programmable in 6.25 KHz increments to any channel in radio operating subband.
  - d. RF Input Impedance: 50 Ohms.
  - e. Intermodulation (EIA): -75 dB, minimum.
  - f. Desensitization (EIA): -65 dB, minimum.
- 13. The remote unit shall have a loop-back decoder board that operates in conjunction with the master station's microprocessor to provide signal strength, frequency error, and deviation levels for each remote unit.
- 14. Antenna connectors must be Type N. Lower quality UHF connectors are not acceptable.
- 15. The radio design shall not make use of custom-designed large-scale integrated circuits that are not commercially available through normal distribution channels.
- 16. The remote unit shall have the ability to monitor their internal operation via a hand-held terminal or personal computer. The terminal or computer must be able to monitor the following functions and parameters.
  - a. Transmit and receive frequencies.
  - b. Time-out timer setting.
  - c. Soft carrier dekey setting.
  - d. Transmit power.
  - e. Loopback code.
- 17. The radios shall be Viper SC+ 200 series as manufactured by CalAmp, no equal, to match OWNER's existing equipment.
- 18. Provide all necessary interface cabling between the radios and the PLCs.
- D. The radio telemetry system manufacturer shall provide the radio antenna. Instructions for installing and grounding these antennas shall be given to CONTRACTOR to provide a reliable system. Unless specifically stated, the antennas shall be attached to existing structures. Each remote station shall be tested to verify that reflected power is 5% of forward power or less.
- E. Antennas shall be directional as described below. They shall be of aluminum construction and rated to withstand at least 100 mph winds. Adequate lengths of transmission cable shall be provided for connection between the antenna and radio transceiver at each location:
  - 1. Antennas shall be directional (YAGI) type with the following characteristics:
    - a. Type: Dual conversion, superheterodyne.
    - b. Frequency Range: 390 to 512 MHz.
    - c. Gain: 10 dB, minimum.
    - d. Maximum Power Input: 150 Watts.
    - e. Lightning Protection: Direct ground protection to mast with Citel Model P8AX, or equal, surge protection device.
    - f. Front-to-Back Ratio: 20 dB, minimum.
    - g. Connector: Type N, female.
    - h. Mounting Hardware: As recommended by manufacturer.
    - i. Acceptable Manufacturers: Telewave, Scala, Sinclair, or equal.
- F. All antennas shall be grounded in accordance with the antenna manufacturer's recommendations.

- G. Transmission cable for all antennas shall be low-loss foam dielectric-type, Heliax cable with copper-clad aluminum inner conductor and corrugated copper outer conductor with 100% coverage. Cables over 100 feet shall have a hollow copper, round-tube inner conductor.
1. Provide a 6-foot section of "super flexible" transmission cable with male Type N connectors at the radio antenna ports to the connector at the enclosure. This section shall pass through the enclosure. Provide standard Type N connectors for connection to a continuous cable extending from enclosure to antenna. Cable shall be weatherproof and suitable for direct environmental exposure. Connections shall have O-ring seals.
  2. Provide a male-to-male Type N connector where the antenna cable leaves the enclosure in which the radio is mounted. Cable from radio to connector at enclosure shall be "super flexible" and from the enclosure to the antenna shall be low-loss foam. Provide a coaxial lightning arrestor for the antenna cable.
  3. Coaxial lines to antennas shall be installed in conduit. Provide a drip loop where antenna cabling exits the conduit.
  4. Antenna cables shall be as manufactured by Commscope, model as follows, or equal:
    - a. For run lengths less than 50 feet: LDF2-50.
    - b. For run lengths between 50 and 100 feet: LDF4-50.
    - c. For run lengths greater than 100 feet: AVA5-50.
- H. System Supplier shall supervise the installation of all radio systems by CONTRACTOR.

## 2.07 FLOAT SWITCHES

- A. Station/building flooding alarms where called for shall be App4Water (Whel-Tech) 101FX, float switches, or equal.

## 2.08 LIMIT SWITCHES

- A. Limit switches (door switches) where called for on the Drawings shall be Square D, Class 9007, Type C, or equal. Door switches in NEMA 4X areas shall be Omron, Model D4B-21\*\*N. CONTRACTOR shall provide head and body style to fit application.
- B. Limit switches for sensing the position of swing arm check valves shall be Allen-Bradley Bulletin 802T, or equal. Switch shall include enclosure rated for the space installed, cat whisker sensor in length required for application, and mounting hardware for check valve swing arm and flexible cable to junction box.

## 2.09 RADAR LEVEL TRANSMITTERS

- A. Radar level transmitters shall utilize a microwave, non-contacting method with a beam angle of 8 degrees to measure level with an accuracy of  $\pm 2$  mm. Transmitter adjustments shall be performed from a smartphone, tablet, or notebook using Bluetooth. The transmitter shall be loop-powered at 24-volts DC and the output shall be 4-20 mA DC.
- B. Transmitters in non-hazardous locations shall be FM approved and have an operating range of -40°F to 176°F.
- C. Transmitter enclosures that are noted on the Drawings to be provided with a manufacturer-furnished cable shall be PVDF with an IP66/IP68 protection rating and be rated NEMA 4X/6P. The enclosure shall have threaded NPT connections on the process connection and conduit/cable connection and be provided with all required mounting hardware. Transmitters shall be as manufactured by VEGA Model VEGAPULS C 21, or



equal. Provide cable length as required for a continuous run to the terminating point as shown on the Drawings. Transmitters shall not be supported using the cables.

## 2.10 MAGNETIC FLOW METERS

- A. The magnetic flow meters shall be suitable for measuring water flows in the range indicated in the table below. The magnetic flow meters shall consist of a flanged flow tube with grounding rings and integral transmitter. The flow tube shall be of 304 stainless steel with hard rubber liner. Flanges shall be carbon steel and conform to ANSI B16.5, Class 150.
- B. The meters shall utilize bipolar DC coil excitation or other means to automatically rezero. Meters shall be provided with grounding rings made of material compatible with electrode material. Electrodes shall be bullet nose, 316 stainless steel NSF-approved for drinking water applications.
- C. The meter shall incorporate design features to minimize the effect of greasy (nonconductive) coatings or incorporate a means to automatically clean the electrodes during continuous operation. Meter accuracy shall not be affected by greasy coatings, and cleaning of the meter manually shall not be required.
- D. Meter accuracy shall be  $\pm 0.5\%$  of rate from 1.0 to 30.0 ft/sec and 0.1% of scale below 1.0 ft/sec when installed with the appropriate upstream and downstream pipe diameters. The meters shall be wet-calibrated in a primary flow laboratory traceable to the National Institute of Standards and Technology. Transmitters and flow tubes shall be interchangeable.
- E. The transmitter shall be designed to operate on 120 VAC, 60 Hz. Power consumption shall not exceed 20 watts. Connections at the flow tube shall be factory-potted. Outputs shall be 4-20 mA and totalizer scaled pulse, suitable for driving a solid-state counter. Pulse width and volume of flow per pulse shall be widely adjustable before or after installation to allow interface with PLC input cards and other devices.
- F. Outputs shall be field-adjustable for range changes. Response time or damping shall be adjustable from 0.8 to 8.0 seconds. The meters shall be operable in all liquids with 5.0 umhos/cm or more conductivity.
- G. The meters shall include empty pipe detection. Meters shall be capable of reading forward and reverse flow. Provide a single analog output representing instantaneous flow.
- H. Enclosure Ratings: Flow tube with integral transmitter enclosure shall be NEMA 4.
- I. The magnetic flow meters shall be Endress and Hauser ProMag 400, or Krohne Optiflux 2000. Meters shall be sized to match the nominal pipe diameter in which they are installed. Flow meters shall be provided as follows:

| Tag No. | Transmitter | Size (Inches) | Maximum Scale |
|---------|-------------|---------------|---------------|
| FIT-01  | Integral    | 8             | 1500 GPM      |

- J. Transmitter shall be FM approved and CSA certified. Integral transmitter shall include back-lit display and push buttons or other means for local operation and maintenance. Display shall include instantaneous flow and totalized flow and indication of present faults.
- K. Provide stainless steel information tag that indicates instrument number, service, and calibration range.

## 2.11 PRESSURE TRANSMITTERS

- A. Pressure transmitters shall sense gauge pressure and provide a 4-20 mA<sub>dc</sub> signal proportional to the sensed pressure. Pressure transmitters shall accept 24 VDC loop power. Increasing pressure shall result in increasing signal.
- B. Transmitters shall be suitable for use in ambient conditions of 0° to 180°F and 0% to 100% relative humidity.
- C. Accuracy (including linearity, hysteresis, and repeatability) shall be at least  $\pm 0.075\%$  of span. Long-term drift shall be less than  $\pm 0.05\%$  of the upper range limit over a 5-year period. The transmitter output signal shall not change more than 0.005% of span for a 1 V change in the loop voltage. Ambient temperature effect shall be less than  $\pm 0.6$  psi for a 10 to 300 psi transmitter that experiences a 50°F change in ambient temperature within the normal operating range. Mounting position shall not affect transmitter performance. RFI effect shall be less than 0.1% of span for radio frequencies in the range of 27 to 1,000 MHz and field intensity of 30 V/m.
- D. Process connection shall be 316L stainless steel fitting size and type as required by CONTRACTOR. Sensor material shall be 316L stainless steel, with silicone fill fluid. Sensor shall be suitable for use with process liquid/gas temperature from -50°F to 250°F.
- E. Calibrated range shall be determined by CONTRACTOR based on process conditions. Calibrated range and process conditions used to determine range and span limits shall be included in submittal.
- F. Pressure transmitter housing shall be NEMA 4X, epoxy-coated aluminum with a minimum of one 1/2-inch NPT conduit connection. Housing shall provide separation between electronics and field connections.
- G. Digital indicator with transmitter configuration push buttons shall be provided in the transmitter housing. Transmitter configuration shall be performed using push buttons on the transmitter. A HART communicator or other electronic device shall not be required to configure the transmitter.
- H. Transmitter shall be direct-connected to process unless specified otherwise on the Drawings. Provide stainless steel two-valve manifold for pressure transmitters.
- I. Provide stainless steel information tag that indicates instrument number, service, and calibration range.
- J. Pressure transmitters shall be Foxboro Model IGP10S, ABB, or equal.

## 2.12 SUBMERSIBLE DRAWDOWN TRANSMITTERS

- A. Provide submersible pressure transmitters to measure well pump drawdown levels. The transmitters shall be designed for direct submergence in groundwater, surface water, salt water, or wastewater, and be as manufactured by Endress and Hauser, Water Pilot FMX21, Esterline, Model 300DS, or equal.
- B. The cable jacket shall be made of polyurethane and be compatible with groundwater, surface water, salt water, or wastewater.

- C. The nose cone shall be made of 316 stainless steel.
- D. Transmitted Operating Specifications:
  - 1. Excitation Voltage: 10.5 to 35 VDC.
  - 2. Output: 2-wire, 4-20 mA.
  - 3. Compensated Temperature Range: 14°F to 158°F.
  - 4. Electrical Connection: Vented two-conductor insulated polyurethane cable shielded with aluminum film, strain relief members, and pressure compensation tube with Teflon filter. Cable shall be approved for use in drinking water, and length shall be coordinated with depth and setting of the associated pump.
  - 5. Electronics:
    - a. Internally potted with molded cable.
    - b. Accuracy: Stainless steel  $\pm 0.2\%$  of set span.
  - 6. Maximum Diameter: 0.87 inch.
  - 7. Range: 0 to 300 PSI, selected to meet project requirements.
  - 8. Overload Pressure: 580 psi.
  - 9. Insulation Resistance: Less than 0.09 ohms per meter.
- E. Submersible pressure transmitters shall have a ceramic measuring cell and an integral cable that contains a vent tube that references the sensor to atmospheric pressure. The molded polyurethane cable and internal potting in the transmitter shall prevent the ingress of water into the back of the transmitter. The vent tube shall be attached to the back of the sensing element, providing a gauge reference to atmosphere.
- F. Pressure transmitters shall include a terminal enclosure with desiccant to prevent moisture ingress via the vent tube or cable conductors. Enclosure shall dry the air that breathes into the tube via vent opening with a 35-micron PTFE filter that prevents water ingress even during flood conditions. Enclosure shall meet the following requirements:
  - 1. NEMA 4X rated.
  - 2. PVC base and clear Halogen-free self-extinguishing polycarbonate cover.
  - 3. Equipped with screw terminals and DIN rail mounted terminal blocks.
  - 4. Equipped with microfilter that prevents ingress of water.
  - 5. Equipped with desiccant module with sight gage for determining desiccant change intervals.

## 2.13 OPERATOR INTERFACE PANEL

- A. The operator interface shall meet the following general specifications:
  - 1. Voltage: 85 VAC to 264 VAC.
  - 2. Temperature: 0°C to 55°C.
  - 3. Humidity: 5% to 95% noncondensing.
  - 4. RFI: MIL-STD-461B.
  - 5. EMI: IEEE 472-1974.
  - 6. Communication Port: Ethernet.
- B. The operator interface shall have the following minimum features:
  - 1. Type: Color Active Matrix Thin Film Transistor (TFT) touchscreen LCD.
  - 2. Display Size: 6.5-inch.
  - 3. Resolution: 640 by 480, 18-bit color graphics.
  - 4. Clock: Battery-backed real time.
  - 5. Application Memory: 512 MB.
  - 6. Enclosure: NEMA Type 12.

- C. The operator interface panel shall be as manufactured by Allen-Bradley, Panelview Plus 7 Performance, or equal.

#### 2.14 THERMOSTATS

- A. Thermostats associated with the SCADA System as specified in Section 26 09 90–SCADA System I/O Listing shall be provided by System Supplier. Thermostats not specified in Section 26 09 90–SCADA System I/O Listing shall be provided as part of Section 26 27 26–Wiring Devices.

#### 2.15 SURGE PROTECTIVE DEVICES FOR CONTROL PANELS

- A. The incoming power supply of each supervisory control center shall be protected with a surge protective device (SPD). SPD unit shall be as manufactured by Citel, Model DS72US, or equal. Surge protection shall be provided for all phases and neutral.

#### 2.16 PRELUBE FLOW SWITCHES

- A. Flow switches when specified herein, shown on the Drawings, or necessary to complete an operating system shall be as follows: The flow switches shall consist of stainless steel housing and bonnet with 1-inch-diameter NPT ports.
- B. Flow switches shall be Gems Model FS200:
  - 1. Operating pressure range shall be 0 to 400 psi.
  - 2. Provide fixed-typesetting.
  - 3. Provide accurate flow detection with 1% repeatability.

#### 2.17 INDUSTRIAL ETHERNET SWITCHES

- A. Gigabit Uplink: Provide managed Ethernet network switches with Gigabit-Uplink SFP ports where shown on the Drawings. Network switches shall be as manufactured by Allen-Bradley Stratix 5200 series. Each switch shall include, but not be limited to, the following:
  - 1. Selectable Gigabit Ethernet star or ring topology with redundant fail-over. Switches shall be configured for a ring topology, unless noted otherwise.
  - 2. DIN rail mounting and redundant 24-volt DC power supply inputs. Provide redundant power supplies, Hirschmann Model RPS series, or equal.
  - 3. Command line interface, DHCP, and store and forward switching.
  - 4. SNTP real time clock.
  - 5. IP and MAC port security and SNMPv3.
  - 6. Compliance with the following IEEE Standards: 802.1D, 802.1p QoS, 802.3, 802.3u, 802.3x flow control, 802.1w RSTP, and 802.1Q VLAN.
  - 7. SNMP with web browsing for switch configuration, diagnostics, and monitoring.
  - 8. Dry contact alarm output for indication that the switch has failed.
  - 9. Up to two combo SFP, Gigabit Ethernet uplink ports and up to 16 copper 10/100 Fast Ethernet ports. The switch shall have a minimum of 25% spare ports.

#### 2.18 NOTIFICATION DEVICES

- A. Warning Lights and Strobes:
  - 1. Nonhazardous and NEMA 4X, and Class I, Division 2 locations:
    - a. General: The light shall provide a visual warning in the area where a potential hazard may occur in nonrated spaces and NEMA 4X locations.

- b. Required Features:
    - (1) Beacon light: LED, field-selectable between steady-on mode (green) and flashing mode (amber and red), field-set to 65 flashes per minute.
    - (2) LED colors: Red, green, and amber. LED colors shall be capable of being individually controlled by a remote device. When the circuits for multiple LED colors are energized, the light shall automatically cycle through the energized colors.
    - (3) Lens color: Clear.
    - (4) Enclosure: UL listed; NEMA 4X and Class I, Division 2, Groups C, and D.
    - (5) Power: 120 VAC.
  - c. Product and Manufacturer: Model 105XBRIrGA120A as manufactured by Edwards Signaling, or equal.
  - d. Provide Model 105BX outlet box attachment and 105BM mounting bracket as manufactured by Edwards Signaling, or equal, for wall mounting the lights.
- B. Alarm Horns:
- 1. General: The horn shall provide an audible warning in the area where a potential hazard may occur.
  - 2. Required Features:
    - a. Decibel output: Minimum 100 dB at 10 feet.
    - b. Enclosure: Cast aluminum/epoxy-coated corrosion-resistant housing.
    - c. Horn diaphragm: Stainless steel.
    - d. Power: 120 VAC.
  - 3. Product and manufacturer: Series 876-N5 in nonrated and NEMA 4X locations as manufactured by Edwards Signaling, or equal.
- C. Glass-Break Control Stations:
- 1. General: Control stations shall be provided for manual ventilation system shutdown where shown on the Drawings.
  - 2. Required Features:
    - a. Enclosure: UL listed; glass-break cover with NEMA-rated back box.
    - b. Legend text: HVAC Shut-Down.
    - c. Minimum two normally-open and two normally-closed contacts for monitoring and ventilation system interlocks.
  - 3. Product and Manufacturer: Model ST120SN4XS304BP2SL in NEMA 4X and exterior locations as manufactured by Pilla, or equal.
- D. Danger Signs:
- 1. General: Provide a danger sign next to each set of warning lights, strobes, and horns.
  - 2. Required features:
    - a. Material: High impact polystyrene or fiberglass.
    - b. Sign Size: Minimum 14 inches wide by 10 inches high.
    - c. Color: White background with red and black lettering.
    - d. Text shall be determined by OWNER.
  - 3. Provide stainless steel mounting hardware as required.
- E. Hazardous Materials Pull Stations:
- 1. General: Pull stations shall be provided for manual activation of "Hazardous Materials Alarm" where shown on the Drawings.
  - 2. Required Features:
    - a. Enclosure: UL listed; weather-proof, dual action, blue color pull station with weather-proof back box.
    - b. Legend Text: "HAZ MAT."

- c. Minimum dual form c dry contacts (DPDT) for monitoring hazardous material alarm interlock.
3. Product and Manufacturer: Model RMS-6T-LP-WP Blue as manufactured by Potter, or equal.

### PART 3–EXECUTION

#### 3.01 WELL PUMP ACTIVE FRONT END VARIABLE FREQUENCY DRIVE

- A. Well Pump (WP-01):
  1. H-O-A Selector Switch:
    - a. With the H-O-A selector switch in the “Hand” position, the motor shall start and run continuously at the speed set on the VFD HIM.
    - b. With the H-O-A selector switch in the “Off” position, the motor shall be inoperable.
    - c. With the H-O-A selector switch in the “Auto” position, the motor shall be controlled from the SCADA System as described under Main SCC.
  2. The motor has internal thermostats that shall shut down the motor in the event of overtemperature (“Hand” and “Auto” modes). Manual reset shall be required to restart the motor. Provide a hardwired time delay (0 to 5 seconds) to prevent overtemperature lockouts due to momentary power interruptions.
  3. There is a pre-lubrication solenoid valve (SV-01) on the well discharge that shall open for a hardwired time delay (0 to 10 minutes) when the well pump is called to run (“Auto” mode only). The well pump shall not start until the time delay expires. The pre-lubrication solenoid valve shall remain open for a hardwired time delay (0 to 10 minutes) after the pump is shut down. Provide an extra capacity control power transformer for 120-volt power to the solenoid valve.
  4. The chemical feed pumps (MP-01 and MP-02) shall be interlocked with the check valve limit switch (ZSO-01) such that when the pump is running and the check valve is open, a dry contact output shall be energized, and the chemical feed pumps shall run. When the pump is shut down or the check valve is not open, the chemical feed pumps shall shut down.
  5. There is a limit switch (ZSO-01) on the pump discharge check valve that shall shut down the motor if the motor is running and the switch is not activated before a hardwired time delay (0 to 300 seconds) expires (“Auto” mode only). Manual reset shall be required to restart the motor.
  6. There is a flow switch (FS-01) on the pre lube piping that shall shut down the motor if the pre-lubrication solenoid valve is called open and the switch is not activated before a hardwired time delay (0 to 300 seconds) expires (“Auto” mode only). Manual reset shall be required to restart the motor.
  7. Provide a hardwired backspin time delay (0 to 15 minutes) to prevent the motor from restarting against backflow each time the motor shuts down (“Hand” and “Auto” modes).
  8. The motor shall shut down if the building flooding float switch (LS-01) is activated. Manual reset shall be required to restart the motor. Provide a hardwired time delay (0 to 5 seconds) to prevent lockouts due to momentary power interruptions.
  9. All of the above controls shall be hardwired and not through the PLC.

#### 3.02 MCC-6 NOTES

- A. Fluoride Room Exhaust Fan (EF-01):
  1. O-O Selector Switch:
    - a. With the O-O selector switch in the “On” position, the motor shall start and run continuously.

- b. With the O-O selector switch in the "Off" position, the motor shall be inoperable.
  2. The associated damper (DA-EF-01) shall open when the motor is running. Provide an extra capacity control power transformer for 120-volt power to the associated damper.
  3. There is a glass break type emergency stop push button (CS-02) that shall shut down the unit when the switch is activated. The motor shall be reset by resetting the emergency stop switch.
  4. All the above controls shall be hardwired and not through the PLC.
- B. Chlorine Room Exhaust Fan (EF-02):
  1. O-O Selector Switch:
    - a. With the O-O selector switch in the "On" position, the motor shall start and run continuously.
    - b. With the O-O selector switch in the "Off" position, the motor shall be inoperable.
  2. The associated damper (DA-EF-01) shall open when the motor is running. Provide an extra capacity control power transformer for 120-volt power to the associated damper.
  3. All the above controls shall be hardwired and not through the PLC.
- C. Generator Room Exhaust Fan (EF-04):
  1. The VFD is integrated into the fan's ECM motor located within the fan housing. The integrated VFD includes the following signals:
    - a. 24-Volt DC Inputs: Start/Stop
    - b. 24-Volt DC Output: Running.
    - c. Dry-Contact Output: VFD Fault.
  2. Provide a control power transformer for 120-volt power to the control circuit and associated dampers (DA-EF-04, DA-INTAKE, and DA-EXHAUST).
  3. Provide interface relays as needed for the 24-volt DC signals. The signals are powered at 24-volts DC from the integrated VFD.
  4. H-O-A Selector Switch:
    - a. With the H-O-A selector switch in the "Hand" position, the motor shall start and run continuously at the speed set on the VFD.
    - b. With the H-O-A selector switch in the "Off" position, the motor shall be inoperable.
    - c. With the H-O-A selector switch in the "Auto" position, the motor shall start and run at the speed set on the VFD when the room temperature rises above the temperature set on the associated thermostat (T-04). The motor shall shut down when the room temperature falls below the temperature set on the associated thermostat
  5. The associated damper at the fan (DA-EF-04) shall open when the motor is running ("Hand" and "Auto" modes). The associated exhaust air damper on the wall (DA-EXHAUST) shall open when a "Running" signal is received from the generator control panel ("Hand," "Off," and "Auto" modes). The associated inlet-air damper on the wall (DA-INTAKE) shall open when the motor is running or when a "Running" signal is received from the generator control panel ("Hand," "Off," and "Auto" modes). The inlet and exhaust air damper on the wall is spring-open, powered closed.
  6. The motor disconnect has an auxiliary contact that shall be wired to the MCC bucket such that control power is disconnected when the disconnect is in the "Off" position. This interlock shall not disconnect power to the inlet and exhaust air dampers on the wall.
  7. All of the above controls shall be hardwired and not through the PLC.

### 3.03 GENERAL OPERATOR INTERFACE PANEL (OIP) REQUIREMENTS

- A. Each OIP shall be programmed to allow the operator to enter all control and alarm setpoints associated with its SCC. Each OIP shall be set up such that it prompts the operator for the setpoints to be entered. All setpoints changed at the OIP shall be updated automatically at

the plant SCADA System and vice versa. Each OIP shall provide indication and operating functions for the system as follows:

1. A process overview and zoomed-view screens as required for additional details for all processes that are monitored and/or controlled from this PLC.
  2. System status.
  3. Control switches (e.g., Hand-Off-Auto, On-Off, Open-Close-Auto, etc.) and pushbuttons for each piece of equipment.
  4. Adjustment for all system setpoints.
  5. Running, failed, open, closed, required, etc. for each piece of equipment.
  6. Status of all equipment and equipment run times.
  7. Indication of all analog signals.
  8. Control system timers and indication of time remaining and time to start for each timed sequence.
  9. Indication of all alarm conditions on an alarm summary screen. This screen shall show the last 10 alarms, indicate whether the alarm is active, unacknowledged, or returned to normal. The operator shall be able to acknowledge all or individual alarms from this screen. When an alarm is received, the OIP shall default to this screen to show the current alarm. The current alarm shall blink until acknowledged. Alarms shall list the time and date of each occurrence and be listed in chronological order.
- B. The OIP graphics configuration shall follow a situational-awareness theme that avoids the excessive use of color for process screen backgrounds, menus, borders, headers, buttons, equipment symbols, and text displays. Equipment symbols shall adhere to a specific color code for indication of equipment status and alarms. Avoid non-animating colors on equipment graphics. Main process graphic and popups screens shall use a light gray background color. Simulated facility graphics, environments, and three-dimensional layouts shall not be included on the backgrounds. Piping shall be represented by thin, solid-gray lines and shall not include contour shading. Process structures and tanks shall be represented using simple shapes (e.g., squares, rectangles, circles, etc.) and process equipment should be represented by simple, equipment-specific shapes (i.e., no gradients or shading).
1. Equipment:
    - a. Light gray shall be used to indicate that the equipment is not operating or running and has been disabled from automatic operation.
    - b. Yellow shall be used to indicate that the equipment is not running or operating, but is in an automatic control state and ready to operate once the operating conditions are met.
    - c. Orange shall be used to indicate that the equipment is called to run, but is not yet running.
    - d. Green shall be used to indicate that the equipment is running or operating in the forward direction.
    - e. Blue shall be used to indicate that the equipment is running or operating in the reverse direction.
    - f. Red shall be used to indicate failure conditions for equipment and signals.
  2. Valves:
    - a. Light gray shall be used to indicate that the valve is closed.
    - b. Green shall be used to indicate that the valve is open.
    - c. Red shall be used to indicate a valve actuator fault or a valve out of position alarm.
- C. In addition to the color code for equipment statuses, text indicating when equipment is "Running" or "Not Running" and when equipment is "In Auto" or "Not In Auto" shall be displayed next to the equipment using blue text for indication that the text is dynamic. Blue



shall be reserved only for dynamic text, excluding the analog process variables described below.

- D. Analog process variable displays shall use black text inside of a thin, dark gray border with light gray background. The text shall animate to white and the background shall animate to red during an alarm condition for the associated process variable (e.g., high level, low level, transmitter fail, etc.), and shall remain in that state until the alarm condition is cleared.
- E. Setpoint-entry boxes be sized similar to the analog process value displays, but shall instead use a thicker border. The background color for setpoint entry boxes shall be light green for process control and system setpoints and shall be light red for alarm setpoints.
- F. Text size and font requirements:
  - 1. Font shall be Segoe UI Bold or Arial Bold.
  - 2. Text for general labels on process screens and menus shall be size 12.
  - 3. Text for value displays shall be size 14.
  - 4. Text for process graphic titles and menu titles may be sized as needed by the software developer, minimum size 16.

#### 3.04 SUPERVISORY CONTROL CENTER (SCC)–GENERAL

- A. Control descriptions described herein are specific in nature to equipment associated with each SCC. CONTRACTOR shall refer to Paragraph 1.12–General Control Algorithms for additional programming requirements. Control descriptions shall reside in each local PLC and not in the Main PLC.
- B. UPSs installed in all SCCs shall be configured to provide a dry contact output to the PLC in the event of a UPS common alarm. The common alarm shall include, but not be limited to, “UPS Fault” and “Replace Battery” alarms. Indication of a “UPS Common Alarm” shall be provided at the SCADA System for each UPS.
- C. Each SCC shall have an exterior, panel-mounted receptacle and programming port for the Ethernet network mounted to the front of the panel. The receptacle and programming port shall be provided to allow for PLC programming via laptop without opening the panel door.
- D. Provide a control power fail relay in each SCC that shall be used to indicate an incoming control power fail alarm at the SCADA System. Provide a red indicating light on the front of each SCC to indicate a loss of incoming line power to the SCC. Control power fail wiring shall be hardwired and not through the PLC.
- E. Provide a red indicating light on the front of each SCC to indicate loss of communication with the Master Telemetry PLC.
- F. The signal contact on each managed network switch shall be configured to activate an alarm at the SCADA System for any of the following minimum conditions: connection errors, loss of fiber ring redundancy (where applicable), and power supply fault.
- G. Refer to the Section 26 09 90–SCADA System I/O Listing for all required I/O that shall interface with each PLC. For each PLC, provide the lesser of a minimum of 25% spares or one completely spare I/O module for analog and discrete inputs and outputs. All spare and unused I/O shall be wired to terminal blocks.

### 3.05 SUPERVISORY CONTROL CENTER (SCC-34)

- A. Provide a new NEMA 12 freestanding, PLC-based supervisory control center sized a minimum of 36 inches wide by 20 inches deep by 90 inches high, where shown on the Drawings. All control algorithms and alarms described herein shall be programmed into this PLC.
- B. The Fluoride Metering Pump (MP-01) shall be controlled from this PLC as follows: The pump is hardwired to start when the well pump is running and shut down when the well pump shuts down. The pump speed shall be calculated by this PLC as follows:

$$\text{Pump Speed (\%)} = [(QMGD * 8.34 * CPPM)] / [(CCHEM / 100) * WtCHEM] / [(QMAX, F / (SL / 100))]$$

Where:

CPPM = mg/L, chemical feed dosage, (0.00 to 5.00 mg/L).

CCHEM = percent, percent active chemical.

WtCHEM = lbs/gal, chemical weight.

QMAX, F = GPD, maximum chemical feeder capacity.

SL = percent, chemical metering pump stroke length, (0 to 100%).

QMGD = MGD, well flow.

- C. The Chlorine Metering Pump (MP-02) shall be controlled from this PLC as follows: The pump is hardwired to start when the well pump is running and shut down when the well pump shuts down. The pump speed shall be calculated by this PLC as follows:

$$\text{Pump Speed (\%)} = [(QMGD * 8.34 * CPPM)] / [(CCHEM / 100) * WtCHEM] / [(QMAX, F / (SL / 100))]$$

Where:

CPPM = mg/L, chemical feed dosage, (0.00 to 5.00 mg/L).

CCHEM = percent, percent active chemical.

WtCHEM = lbs/gal, chemical weight.

QMAX, F = GPD, maximum chemical feeder capacity.

SL = percent, chemical metering pump stroke length, (0 to 100%).

QMGD = MGD, well flow.

- D. Door position switches on the doors (ZS-01 through ZS-06) shall be monitored at this PLC for intrusion alarm indication at the SCADA System. The intrusion alarm system shall be controlled from this PLC with SCADA "Enable" and "Disable" pushbuttons and white momentary, lighted pushbutton on the front door of this SCC. Do not provide a nameplate for this pushbutton.
1. When the SCADA "Disable" pushbutton is pressed or when the system is enabled and the pushbutton on the front door of this SCC is pressed, the intrusion alarm system shall be disabled. When the intrusion alarm system is disabled, the light on the pushbutton shall be illuminated continuously and all intrusion alarms shall be disabled.
  2. When the SCADA "Enable" pushbutton is pressed or when the system is disabled and the pushbutton on the front door of this SCC is pressed, the light on the pushbutton shall turn off immediately and the intrusion alarm system shall be enabled after a hardcoded 60-second time delay to allow anyone inside the building to exit without activating an intrusion alarm.
  3. If the intrusion alarm system is enabled and any of the door switches are activated and the intrusion alarm system is not disabled within a hardcoded 60-second time delay, an

intrusion alarm shall be activated. There shall be individual intrusion alarms for each door switch such that only the alarms for the door switches that were activated prior to the time delay expiring shall be activated.

4. The enabled/disabled status of the intrusion alarm system shall be indicated at the SCADA System.

- E. Provide an independent, hardwired control circuit and relays in this SCC as needed to provide audible and visual indication of the Fluoride Room hazardous material system (HMS-01) as follows:

1. When the containment flooding float switch is active (LS-02) or the "Hazardous Material Emergency" pushbutton is active as described below, a hazardous material emergency alarm shall be activated and be used to activate all associated alarm horns and lights.
2. Provide a hazardous material emergency control station (CS-01) with a red, mushroom head-type, maintained "Hazardous Material Emergency" pushbutton and a momentary "Silence" pushbutton where shown on the Drawings.
  - a. When the "Hazardous Material Emergency" pushbutton is pressed, the hazardous material emergency alarm shall be activated until the pushbutton is reset.
  - b. When the "Silence" pushbutton is pressed, the horns shall be silenced. The red light shall remain active until the hazardous material emergency alarm is inactive.
3. All horns in the associated chemical room as shown on the Drawings shall be energized when the hazardous material emergency alarm is active and shall remain energized until the alarm is inactive or the silence pushbutton is pressed.
4. Provide combination green/amber/red lights in the chemical room and at each entrance to the chemical room as shown on the Drawings. The lights shall be controlled as follows:
  - a. The green light shall be energized and the amber and red lights shall be de-energized when the hazardous material emergency alarm is inactive.
  - b. The amber light shall be energized and the green and red lights shall be de-energized when the hazardous material emergency alarm is inactive.
  - c. The red light shall be energized and the green and amber lights shall be de-energized when the hazardous material emergency alarm is active.
5. 120-volt power to the associated horn and lights shall be from this SCC. Power to the equipment shall be fused.
6. The tank containment flooding float switch and hazardous emergency material alarm circuit shall be hardwired for fail-safe operation and not through the PLC.

### 3.06 MAIN SUPERVISORY CONTROL CENTER (MAIN SCC, WAUNAKEE UTILITIES OFFICE MODIFICATIONS

- A. The existing SCC contains an Allen-Bradley Compact Logix, 1769-L36ERM PLC, and communicates with the remote sites via Ethernet-based Radio Telemetry. Modify the existing PLC programming as required for the controls specified herein. All control algorithms and alarms herein shall be programmed into this PLC.
- B. The existing water distribution system consists of five well pumps (Well Pump No. 1, No. 2, No. 3, No. 4, and No. 5) and two booster pumps at Well No. 3 that are each controlled from this PLC based on five elevated tank levels as follows:
  1. There are six winter mode start and stop setpoints and six summer mode start and stop setpoints for each of the pumps associated with the level in each of the five elevated tanks. There is an existing toggle button to allow the operator to toggle between winter and summer modes.
  2. The operator has the ability to select which elevated tank is used for control of each pump. In the event more than one pump is selected for any given tank, the operator has

the ability to select a fixed sequence or an automatic alternation for each pump assigned to the associated tank.

- C. Provide programming modifications as required to incorporate the new well pump into the existing water distribution system controls described above to match existing functionality.
- D. The existing radio telemetry system master radio is installed within this control panel and is a Calamp Viper SC+ Radio. Provide all polling sequence and programming modifications as required to incorporate the new equipment, signals, and controls as specified herein at the new elevated tank.

END OF SECTION

## SECTION 26 09 10

### CONTROLS AND INSTRUMENTATION DRAWINGS

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Submit drawings in accordance with provisions of Section 01 33 00–Submittals.

##### 1.03 COORDINATION

- A. The requirements set forth in this section are intended to apply to the drawings provided as specified in Section 26 09 00–Controls and Instrumentation and Section 26 24 19–Motor Control.

#### PART 2–PRODUCTS

NOT APPLICABLE

#### PART 3–EXECUTION

##### 3.01 GENERAL REQUIREMENTS

- A. A bound set of as-built drawings shall be provided in the associated equipment enclosure.
- B. All drawings shall have the following information:
  - 1. Project information, including name of OWNER and specific project name.
  - 2. Drawing title, accurately representing what is on the drawing.
  - 3. Unique drawing identifier, consisting of a unique drawing number or drawing number with individual sheet number. If sheet numbers are used, total number of sheets must be identified on each sheet.
  - 4. System Supplier company name, address, and phone number.
  - 5. Original design information, including person responsible for design, date of original design, person responsible for checking of design, and date of design check.
  - 6. Revision block indicating revision number, date, description of revision, and person responsible for revision.
- C. All drawings shall have line numbers that can be uniquely referenced from other drawings.
- D. All drawings showing wiring shall include unique wire numbers assigned to wiring that is installed between devices in the panel. The wire number shall be shown on the drawings.
- E. All drawings showing relays shall include reference to the drawings where the relay contacts are shown. Spare relay contacts that are not used shall be identified.

### 3.02 DRAWINGS REQUIRED

- A. Index of Drawings: Index of Drawings shall list drawing number, sheet number (if applicable), and drawing title for each drawing in drawing package.
- B. Symbol Sheet: Symbol Sheet shall include:
  - 1. Explanation of all symbols used on the drawings, including, but not limited to, normally open/normally closed contacts, flow switches, limit switches, pressure switches, selector switches, pushbuttons, timers, control relays, solenoids, fuses, circuit breakers, terminal blocks, and contactors. Symbol sheet does not need to be specific to project, but must contain explanation of all symbols used on the drawings (i.e., special symbols used for a particular project must be added to standard symbol sheets).
  - 2. List of abbreviations used on the drawings.
  - 3. Explanation of continuation method for circuits that cannot be shown on a single sheet.
- C. Exterior Enclosure Layout Drawing: Exterior layout drawing shall show location of all externally-mounted equipment. Exterior layout drawing shall include:
  - 1. Enclosure dimensions, enclosure NEMA rating (i.e., NEMA 1, NEMA 4X stainless steel, NEMA 4X nonmetallic, etc.), and enclosure color or finish.
  - 2. Location and actual depiction of panel latches, hinges, mounting holes and lifting eyes.
  - 3. Location and accurate representation of equipment mounted on enclosure (i.e., switches should look like actual switches being installed; indicating lights should look like actual lights being installed).
  - 4. Equipment nameplate location.
  - 5. Description for each piece of equipment or unique identifier and parts list, or bill of materials.
  - 6. Nameplate list including nameplate wording, size, construction (i.e., lamicoid with Black background and White letters), and mounting method (i.e., stainless steel screws). Label size must include size in inches or reference to standard sizes included on symbol sheet, or elsewhere in drawing package.
  - 7. Identification of area reserved for equipment located inside enclosure, but not actually mounted on enclosure back panel, such as UPSs.
- D. Interior Enclosure Layout Drawing: Interior layout drawing shall show location of all internally-mounted equipment. Interior layout drawing shall include:
  - 1. Back panel dimensions and finish.
  - 2. Location and accurate representation of equipment (i.e., terminal blocks should look like actual terminal blocks; receptacle should look like actual receptacle, etc.).
  - 3. Dimensions of internally-mounted equipment are not necessary, but equipment should be drawn to scale such that an accurate representation of the way equipment will be mounted is shown on the drawing.
  - 4. Description for each piece of equipment or unique identifier and parts list, or bill of materials.
- E. Interconnection Diagram, Network Diagram or Block Diagram: Interconnection Diagram, Network Diagram or Block Diagram shall show all cabling between system components and identify any station addressing or node numbers that are assigned to equipment. All cables shall be identified by cable type, including specific manufacturer and model/part number. Party responsible for furnishing and installing cable shall also be included. Some examples of cables that must be shown are:
  - 1. Antenna cables.

2. Communications cables between system components (copper). This includes fiber optic jumpers between fiber patch panels and equipment, and Ethernet patch cables between switches and devices.
  3. Communications cables (copper) between PLCs, controllers, operator interface equipment that are not shown on the elementary schematics.
- F. Elementary Schematic: Elementary schematics shall be developed for each motor or supplied equipment and shall include:
1. Nominal voltage, AC or DC designation, number of phases (if AC), and frequency in hertz (if AC) for each source of electrical supply to the enclosure.
  2. Prospective short-circuit current available at the point of electrical supply to the enclosure.
  3. Type of power supply system grounding (e.g., wye phase midpoint grounded, delta phases corner grounded, wye phases midpoint grounded, delta phases ungrounded, etc.).
  4. Complete documentation of electrical circuit from supply to motor or supplied equipment. Documentation shall include disconnecting means, main overcurrent protection (when supplied), branch overcurrent protection (when supplied), control circuit and special purpose control protection, motor control, overload protection, local disconnect (when supplied) and motor horsepower, and full load amps from nameplate or supplied equipment full load amps.
  5. Documentation of PLC or controller inputs and outputs.
  6. Documentation of all circuit breaker/motor protector ratings, fuse sizes, control power transformer VA ratings, dip switch settings, etc.
  7. Documentation of all RVSS and VFD settings (e.g., under-voltage shutdown, ramp time, overload, excessive starts/hour, etc.) which have been changed from the factory default setting.
- G. Wiring Diagram: Wiring diagrams shall show all terminations for all cables external to the enclosure. Terminations may be shown on the elementary schematics as long as the termination information is concise and easily understood by the personnel installing the field wiring. Termination information shall be shown for all devices, including devices that are not part of System Supplier's scope of supply. A box with two dots or continuation arrows indicating continuation to a piece of equipment are not acceptable. Information shown on System Supplier's wiring diagrams shall include a description of the drawings where terminations are found (i.e., drawing title), drawing number where the terminations are found, and terminal blocks referenced on the drawing. System Supplier shall coordinate with supplier of other wiring diagram to provide information on System Supplier's wiring diagrams.
- H. Calculations Summary: Calculations summary shall include calculations performed to:
1. Determine size of UPS.
  2. Determine air conditioning equipment requirement.
  3. Determine control power transformer sizing. Control power transformer sizing calculations may be generic based on typical circuits.
- I. Functional Testing Recommendations: Testing recommendations shall include description of functional tests that must be performed by operators. Functional test description shall be included for UPS, indicating lights, and other devices whose condition can only be determined by testing.

### 3.03 SAMPLE DRAWINGS

- A. The samples included in the appendix do not represent the only acceptable method of showing the required information.

END OF SECTION



**SCADA SYSTEM I/O LISTING**

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| SCC | EQUIPMENT NAME                        | NUMBER | DI | DO | AI | AO | WIRE    | COMMENTS                                  |
|-----|---------------------------------------|--------|----|----|----|----|---------|-------------------------------------------|
| 34  | <b>CONTROL POWER FAIL</b>             |        | 1  | 0  | 0  | 0  | 2~#14   | FROM CONTROL POWER FAIL RELAY IN THIS SCC |
| 34  | <b>COMMON UPS ALARM</b>               |        | 1  | 0  | 0  | 0  | 2~#14   | FROM UPS IN THIS SCC                      |
| 34  | <b>NETWORK SWITCH ALARM</b>           |        | 1  | 0  | 0  | 0  | 2~#14   | FROM NETWORK SWITCH IN THIS SCC           |
| 34  | <b>RADIO POWER CYCLE</b>              |        | 0  | 1  | 0  | 0  | 2~#14   | TO RADIO POWER CYCLE RELAY IN THIS SCC    |
| 34  | <b>COMMUNICATION FAIL PILOT LIGHT</b> |        | 0  | 1  | 0  | 0  | 2~#14   | TO PILOT LIGHT ON FRONT OF THIS SCC       |
| 34  | <b>MCC-6 POWER METER</b>              |        |    |    |    |    |         |                                           |
| 34  | VOLTAGE                               |        | 0  | 0  | X  | 0  | ENET    | FROM POWER METER IN MCC                   |
| 34  | CURRENT                               |        | 0  | 0  | X  | 0  | ENET    | FROM POWER METER IN MCC                   |
| 34  | KVAR                                  |        | 0  | 0  | X  | 0  | ENET    | FROM POWER METER IN MCC                   |
| 34  | KW                                    |        | 0  | 0  | X  | 0  | ENET    | FROM POWER METER IN MCC                   |
| 34  | FREQUENCY                             |        | 0  | 0  | X  | 0  | ENET    | FROM POWER METER IN MCC                   |
| 34  | POWER FACTOR                          |        | 0  | 0  | X  | 0  | ENET    | FROM POWER METER IN MCC                   |
| 34  | <b>MCC-6 POWER FAIL</b>               |        | 1  | 0  | 0  | 0  | 2~#14   | FROM PHASE MONITOR IN MCC                 |
| 34  | <b>MCC-6 SPD FAIL</b>                 |        | 1  | 0  | 0  | 0  | 2~#14   | FROM SPD IN MCC                           |
| 34  | <b>AUTOMATIC TRANSFER SWITCH</b>      | SE-ATS |    |    |    |    |         |                                           |
| 34  | NORMAL POSITION                       |        | 1  | 0  | 0  | 0  | 2~#14   | FROM AUTOMATIC TRANSFER SWITCH            |
| 34  | EMERGENCY POSITION                    |        | 1  | 0  | 0  | 0  | 2~#14   | FROM AUTOMATIC TRANSFER SWITCH            |
| 34  | <b>STANDY GENERATOR</b>               |        |    |    |    |    |         |                                           |
| 34  | RUNNING                               |        | 1  | 0  | 0  | 0  | 2~#14   | FROM GENERATOR CONTROL PANEL              |
| 34  | FAILED                                |        | 1  | 0  | 0  | 0  | 2~#14   | FROM GENERATOR CONTROL PANEL              |
| 34  | BATTERY CHARGER FAILED                |        | 1  | 0  | 0  | 0  | 2~#14   | FROM GENERATOR CONTROL PANEL              |
| 34  | REMOTE E-STOP ACTIVATED               | CS-03  | 1  | 0  | 0  | 0  | 2~#14   | FROM REMOTE EMERGENCY STOP PUSHBUTTON     |
| 34  | <b>WELL PUMP NO. 1</b>                | WP-01  |    |    |    |    |         |                                           |
| 34  | IN AUTO                               |        | 1  | 0  | 0  | 0  | 2~#14   | FROM HOA SWITCH ON VFD                    |
| 34  | RUNNING                               |        | 1  | 0  | 0  | 0  | 2~#14   | FROM VFD                                  |
| 34  | VFD FAULT                             |        | X  | 0  | 0  | 0  | ENET    | FROM VFD                                  |
| 34  | MOTOR OVERTEMP                        |        | X  | 0  | 0  | 0  | ENET    | FROM MOTOR THERMOSTATS VIA VFD            |
| 34  | START/STOP                            |        | 0  | 1  | 0  | 0  | 2~#14   | TO VFD                                    |
| 34  | AMPS                                  |        | 0  | 0  | X  | 0  | ENET    | FROM VFD                                  |
| 34  | kW                                    |        | 0  | 0  | X  | 0  | ENET    | FROM VFD                                  |
| 34  | SPEED FEEDBACK                        |        | 0  | 0  | X  | 0  | ENET    | FROM VFD                                  |
| 34  | SPEED CONTROL                         |        | 0  | 0  | 0  | 1  | SH. PR. | TO VFD                                    |
| 34  | FLOW FAIL ALARM                       | ZSO-01 | X  | 0  | 0  | 0  | ENET    | FROM CHECK VALVE LIMIT SWITCH VIA VFD     |
| 34  | <b>PRE-LUBE FLOW SWITCH</b>           | FS-01  | X  | 0  | 0  | 0  | ENET    | FROM FLOW SWITCH VIA VFD                  |
| 34  | <b>FIRE ALARM CONTROL PANEL</b>       |        |    |    |    |    |         |                                           |
| 34  | TROUBLE                               |        | 1  | 0  | 0  | 0  | 2~#14   | FROM ALARM CONTROL PANEL                  |
| 34  | ALARM                                 |        | 1  | 0  | 0  | 0  | 2~#14   | FROM ALARM CONTROL PANEL                  |

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| SCC | EQUIPMENT NAME                          | NUMBER | DI | DO | AI | AO | WIRE    | COMMENTS                                |
|-----|-----------------------------------------|--------|----|----|----|----|---------|-----------------------------------------|
| 34  | SUPERVISORY                             |        | 1  | 0  | 0  | 0  | 2~#14   | FROM ALARM CONTROL PANEL                |
| 34  | WATER FLOW ALARM                        |        | 1  | 0  | 0  | 0  | 2~#14   | FROM ALARM CONTROL PANEL                |
| 34  | <b>HAZARDOUS MATERIALS ALARM SYSTEM</b> |        |    |    |    |    |         |                                         |
| 34  | FLOURIDE ROOM LEAK DETECTED             | LS-02  | 1  | 0  | 0  | 0  | 2~#14   | FROM BUILDING FLOODING FLOAT SWITCH     |
| 34  | CHLORINE ROOM LEAK DETECTED             | LS-03  | 1  | 0  | 0  | 0  | 2~#14   | FROM BUILDING FLOODING FLOAT SWITCH     |
| 34  | HAZARDOUS MATERIAL ALARM PULL STATION   |        | 1  | 0  | 0  | 0  | 2~#14   | FROM PULL STATION                       |
| 34  | <b>GENERATOR ROOM EXHAUST FAN</b>       | EF-04  |    |    |    |    |         |                                         |
| 34  | IN AUTO                                 |        | 1  | 0  | 0  | 0  | 2~#14   | FROM HOA SWITCH ON MCC                  |
| 34  | RUNNING                                 |        | 1  | 0  | 0  | 0  | 2~#14   | FROM INTEGRAL ECM VFD VIA MCC           |
| 34  | VFD FAULT                               |        | 1  | 0  | 0  | 0  | 2~#14   | FROM INTEGRAL ECM VFD VIA MCC           |
| 34  | <b>WELL PUMP FLOW</b>                   | FIT-01 |    |    |    |    |         |                                         |
| 34  | INSTANTANEOUS FLOW (0-1500 GPM)         |        | 0  | 0  | 1  | 0  | SH. PR. | FROM FLOW METER TRANSMITTER             |
| 34  | TOTALIZED FLOW                          |        | 1  | 0  | 0  | 0  | 2~#14   | FROM FLOW METER TRANSMITTER             |
| 34  | <b>WELL PUMP DISCHARGE PRESSURE</b>     | PIT-01 | 0  | 0  | 1  | 0  | SH. PR. | FROM PRESSURE TRANSMITTER               |
| 34  | <b>FLUORIDE METERING PUMP</b>           | MP-01  |    |    |    |    |         |                                         |
| 34  | DRIVE FAULT                             |        | 1  | 0  | 0  | 0  | 2~#14   | FROM CHEMICAL FEED PUMP                 |
| 34  | RUNNING                                 |        | 1  | 0  | 0  | 0  | 2~#14   | FROM CHEMICAL FEED PUMP                 |
| 34  | SPEED FEEDBACK                          |        | 0  | 0  | 1  | 0  | SH. PR. | FROM CHEMICAL FEED PUMP                 |
| 34  | SPEED CONTROL                           |        | 0  | 0  | 0  | 1  | SH. PR. | TO CHEMICAL FEED PUMP                   |
| 34  | TUBE LEAK DETECTED                      |        | 1  | 0  | 0  | 0  | 2~#14   | FROM CHEMICAL FEED PUMP                 |
| 34  | <b>CHLORINE METERING PUMP</b>           | MP-02  |    |    |    |    |         |                                         |
| 34  | DRIVE FAULT                             |        | 1  | 0  | 0  | 0  | 2~#14   | FROM CHEMICAL FEED PUMP                 |
| 34  | RUNNING                                 |        | 1  | 0  | 0  | 0  | 2~#14   | FROM CHEMICAL FEED PUMP                 |
| 34  | SPEED FEEDBACK                          |        | 0  | 0  | 1  | 0  | SH. PR. | FROM CHEMICAL FEED PUMP                 |
| 34  | SPEED CONTROL                           |        | 0  | 0  | 0  | 1  | SH. PR. | TO CHEMICAL FEED PUMP                   |
| 34  | TUBE LEAK DETECTED                      |        | 1  | 0  | 0  | 0  | 2~#14   | FROM CHEMICAL FEED PUMP                 |
| 34  | <b>FLUORIDE BULK TANK LEVEL</b>         | LT-01  | 0  | 0  | 1  | 0  | SH. PR. | FROM LEVEL TRANSMITTER                  |
| 34  | <b>CHLORINE BULK TANK LEVEL</b>         | LT-02  | 0  | 0  | 1  | 0  | SH. PR. | FROM LEVEL TRANSMITTER                  |
| 34  | <b>WELL DRAWDOWN LEVEL</b>              | LT-03  | 0  | 0  | 1  | 0  | SH. PR. | FROM LEVEL TRANSMITTER                  |
| 34  | <b>INTRUSION SYSTEM</b>                 |        |    |    |    |    |         |                                         |
| 34  | ENABLE/DISABLE PUSHBUTTON               |        | 1  | 0  | 0  | 0  | 2~#14   | FROM ILLUMINATED PUSHBUTTON ON THIS SCC |
| 34  | SYSTEM DISABLED PILOT LIGHT             |        | 0  | 1  | 0  | 0  | 2~#14   | TO ILLUMINATED PUSHBUTTON ON THIS SCC   |
| 34  | PUMP ROOM EAST DOOR STATUS              | ZS-01  | 1  | 0  | 0  | 0  | 2~#14   | FROM DOOR SWITCH                        |
| 34  | PUMP ROOM SOUTH DOOR STATUS             | ZS-02  | 1  | 0  | 0  | 0  | 2~#14   | FROM DOOR SWITCH                        |
| 34  | PUMP ROOM WEST DOOR STATUS              | ZS-03  | 1  | 0  | 0  | 0  | 2~#14   | FROM DOOR SWITCH                        |
| 34  | PUMP ROOM NORTH DOOR STATUS             | ZS-04  | 1  | 0  | 0  | 0  | 2~#14   | FROM DOOR SWITCH                        |
| 34  | CHLORINE ROOM DOOR STATUS               | ZS-05  | 1  | 0  | 0  | 0  | 2~#14   | FROM DOOR SWITCH                        |

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| SCC | EQUIPMENT NAME                       | NUMBER | DI | DO | AI | AO | WIRE  | COMMENTS                                          |
|-----|--------------------------------------|--------|----|----|----|----|-------|---------------------------------------------------|
| 34  | FLUORIDE ROOM DOOR STATUS            | ZS-06  | 1  | 0  | 0  | 0  | 2~#14 | FROM DOOR SWITCH                                  |
| 34  | <b>PUMP ROOM FLOODING</b>            | LS-01  | 1  | 0  | 0  | 0  | 2~#14 | FROM BUILDING FLOODING FLOAT SWITCH VIA WELL PUMP |
| 34  | <b>PUMP ROOM LOW TEMPERATURE</b>     | T-01   | 1  | 0  | 0  | 0  | 2~#14 | FROM LOW TEMPERATURE THERMOSTAT                   |
| 34  | <b>CHLORINE ROOM LOW TEMPERATURE</b> | T-02   | 1  | 0  | 0  | 0  | 2~#14 | FROM LOW TEMPERATURE THERMOSTAT                   |
| 34  | <b>FLUORIDE ROOM LOW TEMPERATURE</b> | T-03   | 1  | 0  | 0  | 0  | 2~#14 | FROM LOW TEMPERATURE THERMOSTAT                   |
| 34  | <b>FLUORIDE ROOM EXHAUST FAN</b>     | EF-01  |    |    |    |    |       |                                                   |
| 34  | RUNNING                              |        | 1  | 0  | 0  | 0  | 2~#14 | FROM STARTER IN MCC                               |
| 34  | STARTER OVERLOAD                     |        | 1  | 0  | 0  | 0  | 2~#14 | FROM STARTER IN MCC                               |
| 34  | E-STOP ACTIVATED                     | CS-02  | 1  | 0  | 0  | 0  | 2~#14 | FROM GLASS BREAK CONTROL STATION VIA MCC          |
| 34  | <b>CHLORINE ROOM EXHAUST FAN</b>     | EF-02  |    |    |    |    |       |                                                   |
| 34  | RUNNING                              |        | 1  | 0  | 0  | 0  | 2~#14 | FROM STARTER IN MCC                               |
| 34  | STARTER OVERLOAD                     |        | 1  | 0  | 0  | 0  | 2~#14 | FROM STARTER IN MCC                               |
|     | ***TOTALS***                         |        | 41 | 4  | 7  | 3  |       |                                                   |

SECTION 26 21 00  
ELECTRICAL SERVICE SYSTEM

PART 1—GENERAL

1.01 SUMMARY

- A. Work Included:
  - 1. Utility Company.
  - 2. Secondary Service Characteristics.
  - 3. Definitions.
  - 4. Underground Electrical Service.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. See Division 01 for temporary service requirements. This section applies to permanent services only.

1.02 UTILITY COMPANY

- A. The Utility Company is Waunakee Utilities.

1.03 SECONDARY SERVICE CHARACTERISTICS

- A. The secondary service will be 277/480-volt, 4-wire, three-phase.

1.04 DEFINITIONS

- A. Service: As defined in the NEC, Article 100.
- B. Primary Voltage: Above 600 volts.
- C. Secondary Voltage: 600 volts and below.

1.05 UNDERGROUND ELECTRICAL SERVICE

- A. Provide complete underground electrical service except for items provided by the Utility Company.
- B. Provide electrical service system, except the Utility Company will provide:
  - 1. Transformer (pad by CONTRACTOR).
  - 2. Meter (socket by CONTRACTOR).
  - 3. Primary cable and conduit from transformer to meter socket.
  - 4. Secondary cable and conduit from transformer to meter socket.
- C. Coordinate the new electrical service with the Utility. All other costs for the electrical service shall be included in the Lump Sum Bid.

## PART 2-PRODUCTS

NOT APPLICABLE

## PART 3-EXECUTION

### 3.01 UTILITY COORDINATION

- A. Division 26 Contractor shall obtain all required permits and licenses, pay all charges and fees, and give all notices necessary for utilities to perform the Work. Division 26 Contractor shall comply with all permit requirements whether the permit is issued to CONTRACTOR, the state, or the maintaining authority.
- B. Division 26 Contractor shall complete all required electrical service applications and forms based on the Drawings and Division 26 Contractor's means and methods for the work required.

END OF SECTION

## SECTION 26 24 19

### MOTOR CONTROL

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Motor Control Devices, Accessories, and General Requirements.
  - 2. Manual Motor Starters.
  - 3. Magnetic Motor Starters.
  - 4. Variable Frequency Drives.
  - 5. Motor Control Centers.
- B. Related Sections and Divisions:
  - 1. Applicable provisions of Division 01 shall govern work in this section.
  - 2. All other sections of Division 26.

|                                                                           |    |
|---------------------------------------------------------------------------|----|
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##### 1.02 REFERENCES

- A. ANSI/NEMA ICS 6–Enclosures for Industrial Controls and Systems.
- B. NEMA AB 1–Molded Case Circuit Breakers.
- C. NEMA ICS 2–Industrial Control Devices, Controllers, and Assemblies.
- D. NEMA ICS-18–Motor Control Centers.
- E. NEMA KS 1–Enclosed Switches.

F. NEMA PB 1–Panelboards.

G. NEMA PB 1.1–Instruction for Safe Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

#### 1.03 QUALITY ASSURANCE

A. Manufacturers of Motor Control Equipment: Firms regularly engaged in the manufacture of motor control equipment of the types and capacities required whose products have been in satisfactory use in similar service for not less than 10 years.

B. UL Labels: Provide motor control devices, manual motor controllers, magnetic motor starters, variable frequency drives, motor control centers, etc., which have been listed and labeled by Underwriters Laboratories.

#### 1.04 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

B. Provide product data on motor starters and combination motor starters, VFDs, relays, pilot devices, and switching and overcurrent protective devices.

#### 1.05 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01 33 00–Submittals.

B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

#### 1.07 COORDINATION

A. To provide proper coordination between Section 26 09 00–Controls and Instrumentation, and equipment specified herein, all equipment specified in this section shall be supplied as part of the Controls and Instrumentation package described in Section 26 09 00. This shall include, but not be limited to, equipment such as MCCs and stand-alone VFDs. Drawings for MCCs, motor controllers, and motor control equipment shall be provided by the Section 26 09 00 System Supplier. Drawings from equipment manufacturers will not be accepted as shop drawings or O&M documents.



## 1.08 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

## PART 2–PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

- A. Motor control devices, motor starters, and motor control centers shall be as manufactured by Allen-Bradley, or equal, as approved by ENGINEER and in accordance with substitutions under provisions of the General Conditions. All equipment specified in this section and provided by CONTRACTOR shall be by the same manufacturer.
- B. The Drawings and Specifications were prepared based on Allen-Bradley. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.

### 2.02 MOTOR CONTROL DEVICES, ACCESSORIES, AND GENERAL REQUIREMENTS

- A. Auxiliary Contacts: NEMA ICS 2; two field convertible contacts minimum, in addition to seal-in contact, or as necessary.
- B. Push buttons: NEMA ICS 2; heavy-duty, oiltight (30 mm) as specified herein and shown on the Drawings. Pushbuttons in exposed, outdoor locations shall be rated NEMA 4X.
- C. Indicating Lights: NEMA ICS 2; heavy-duty, oiltight (30 mm), LED, push-to-test type as specified herein and shown on the Drawings.
- D. Selector Switches: NEMA ICS 2; heavy-duty, oiltight, (30 mm) as specified herein and shown on the Drawings.
- E. Contactors: NEMA ICS 2. All contactors for starters specified herein shall be NEMA rated. IEC contactors are not allowed. Contactors shall be Allen-Bradley, Bulletin 509, or equal.
- F. Control Power Transformers: 240/120-volt secondary. Each motor controller shall have a dedicated control power transformer.
- G. Elapsed Time Meters: Redington/Engler 722 series, or equal, 3 inches round, flush door mounted, capable of reading up to 99,999.9 hours, nonreset type.
- H. Industrial control and power relays shall be installed in motor control centers where required by System Supplier. Relays used to interface with PLC I/O, motor control circuits, hard-wired control logic, and for loads less than 8 amps shall be terminal style, interposing/isolation relays. Relays for inductive loads, alarm lights, alarm horns, field wiring, or loads up to 15 amps shall be industrial, general purpose square base relays.

Relays for loads greater than 15 amps shall be industrial, electrically held power relays. Relays shall meet the following requirements:

1. Interposing/isolation relays:
    - a. Configuration: SPDT or DPDT as required by System Supplier.
    - b. Mounting: DIN rail with screw terminal base socket.
    - c. Voltage: 120 VAC, or as required by System Supplier.
    - d. Contact Rating: 8A (DPDT), 16 A (SPDT).
    - e. Operating Life: 10 million cycles.
    - f. Status: On-Off flag-type or LED indicator.
    - g. UL listed.
    - h. Manufacturer: Allen-Bradley, 700 HK, or equal.
  2. General purpose relays:
    - a. Configuration: DPDT or 3 PDT as required by system supplier.
    - b. Mounting: DIN rail with screw terminal base socket.
    - c. Voltage: 120 VAC.
    - d. Contact Rating: 15 A, minimum; 3/4 hp.
    - e. Operating Life: 10 million cycles.
    - f. Status: On-Off flag type or LED indicator.
    - g. UL listed.
    - h. Manufacturer: Allen-Bradley, 700-HB, or equal.
  3. Power relays.
    - a. Configuration: Electrically-held, 2-12 poles.
    - b. Mounting: DIN rail, square base.
    - c. Voltage: 120 VAC.
    - d. Contact Rating: 20 A continuous; 1 hp.
    - e. Operating Life: 10 million cycles.
    - f. UL listed.
    - g. NEMA rated.
    - h. Manufacturer: Allen-Bradley, 700-PK, or equal.
  4. All timing relays shall have On and timing Out LEDs. Timing relays shall be Allen-Bradley, 700-HN, or equal.
- I. Manufacturer of Accessories:
1. Terminal blocks shall meet the requirements of Section 26 05 19–Wire.
  2. Wire markers shall meet the requirements of Section 26 05 53–Electrical Identification.
- J. All motor control power shall be 120 volts with suitable protection (fuses or breakers). Fuse holders shall be provided with integral LEDs to indicate when the fuse is blown.
- K. All motor controllers shall be equipped with the auxiliary devices to meet the requirements of the Drawings and Specifications. Each motor controller operating at other than 120-volt, single-phase shall be equipped with a control transformer providing 120-volt secondary for control power. Transformer shall have fused primary and secondary connections and shall be sized per manufacturer's recommendations. Coils and pilot lights in all motor controllers shall be 120 volts.
- L. Enclosures for Stand-Alone Controllers, Starters, and Control Devices:
1. Enclosures in indoor dry locations shall be NEMA 1 gasketed.
  2. Enclosures in indoor damp or wet locations and outdoor locations shall be NEMA 4X, stainless steel.
  3. All wiring within motor controller enclosures shall be landed on terminal blocks. This shall include internal control wiring, field wiring, and any spare or unused wiring.

4. Control stations shall include devices as shown on the Drawings and specified in Section 26 09 00—Controls and Instrumentation.

## 2.03 MANUAL MOTOR CONTROLLERS

- A. Where noted on the Drawings, controllers for motors rated 2 hp or less, for operation at 120 V or 240 V single-phase, shall be specification grade wall switches as specified in Section 26 27 26—Wiring Devices.

## 2.04 MAGNETIC MOTOR STARTERS

- A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower. Each magnetic starter shall be equipped with a solid-state overload relay.
- B. Full-Voltage Starting: Nonreversing type as shown on the Drawings.
- C. Coil Operating Voltage: 120 volts, 60 Hz.
- D. Size: NEMA ICS 2; size as shown on the Drawings. Contactors shall be Allen-Bradley, Bulletin 509 (Nonreversing), or equal.
- E. Overload relays without EtherNet/IP communications shall be Allen-Bradley E100, Bulletin 592-1EF, or equal, and have the following features:
  1. Self-powered, solid-state.
  2. Up to 5:1 adjustment range.
  3. DIP switch settings for trip class and reset mode.
  4. Current transformers (no heaters).
  5. Thermal memory.
  6. Ambient temperature compensation.
  7. Visible trip indicators.
  8. Phase loss protection.
  9. Low energy consumption.
- F. Magnetic motor starters in motor control centers shall be combined with magnetic only molded case circuit breakers. Magnetic motor starters in combination motor starters or control panels shall be combined with thermal-magnetic molded case circuit breakers.
- G. Through-the-door overload reset pushbuttons shall be provided for all magnetic starters installed in motor control centers and combination motor starters.

## 2.05 VARIABLE FREQUENCY DRIVES

- A. VFDs shall be provided to match the load type (constant or variable torque) of the specified application, as well as the full load amps of the motor furnished for the project.
- B. System Operating Conditions:
  1. 480 VAC  $\pm 10\%$ .
  2. Three-phase, 3-wire, any phase sequence.
  3. 60 Hz  $\pm 2\%$ .
  4. Storage temperature -25°C to +55°C.
  5. Operating temperature 0 to 40°C.

6. Altitude: 3,300 feet above sea level maximum.
7. Humidity: 95% noncondensing maximum.

C. Variable Frequency Unit:

1. Conform to NEMA and NEC standards.
2. CSA and ETL approved and/or UL approved.
3. Overall VFD efficiency shall be a minimum of 96.5%,  $\pm 1\%$ , at 100% speed and motor load at nominal line voltage. Efficiency rating shall include control power supplies, control circuits, and all cooling fans.
4. Input:
  - a. Withstand without component failure line voltage transients up to 3,000 volts per ANSI C37.
  - b. Design shall include DC bus chokes (two) used in conjunction with one or more capacitors. The DC bus chokes shall be incorporated in the design to minimize line-side harmonics. Magnetic-only designs shall include line filters to limit harmonics to a value no greater than in a system using dual DC bus chokes.
  - c. Include MOV line-side protection.
  - d. Inverter input for six pulse VFDs shall have a true power factor of 0.95 or better at rated load and nominal line voltage throughout the entire speed range. Inverter input for active-front-end VFDs shall have a true power factor of 0.98 or better at rated load and nominal line voltage throughout the entire speed range.
  - e. Units shall be capable of operating attached to the same power bus without affecting each other's operations. If operational problems occur, an isolation transformer shall be added to each drive at no additional Contract cost.
  - f. Drives larger than 40 hp shall include fuses on the drive input. Fuses shall be provided with indicating-type fuse blocks as manufactured by Bussman Model JM60, including see-through covers with integral open fuse indicating lights for each fuse. Fuses 60A and greater are allowed to have integral blown fuse indication and be provided with nonindicating type fuse blocks. Fuses shall be provided for all horsepower sizes for active-front-end VFDs.
5. Inverter Output:
  - a. Inverter shall utilize latest generation IGBTs, be microprocessor based, and isolated from power circuits.
  - b. Match motor specified.
  - c. Three-phase, 3-wire.
  - d. Pulse width modulated wave form with selectable Sensorless Vector, Flux Vector, Volts/Hertz, and adjustable voltage control modes.
  - e. Maximum output 460 volts.
  - f. Frequency 2 to 650 Hz.
  - g. Frequency accuracy  $\pm 1\%$  of setting at any point in the specified speed range in a 24-hour period.
  - h. Full load output current shall be rated in excess of the AC motor selected.
  - i. Motor performance:
    - (1) 3% regulation in the manual speed control mode.
    - (2) Normal duty overload rating: 110% continuous current for 1 minute; 150% for 3 seconds.
    - (3) Heavy-duty overload rating: 150% continuous current for 1 minute; 180% for 3 seconds.
    - (4) 110% starting torque minimum.
6. AC drive features:
  - a. Embedded I/O for discrete and analog signals. Analog signals shall include 4-20 mA circuitry mounted on separate printed circuit board to include offset,

- slope, minimum clamp, and separate acceleration and deceleration adjustments from 0 to 3600 seconds. An internal manual speed potentiometer is to be provided for simulating the 4-20 mA input for start-up and maintenance. The circuit is to be designed to accept either a positive or negative signal, grounded or ungrounded.
- b. Embedded 100BASE-TX Ethernet port supporting the EtherNet/IP protocol.
  - c. Slot-based architecture for expansion control and communication cards.
  - d. Real-time clock with battery for date/time stamping of events.
  - e. Integral thermostat control of door-mounted cooling fans.
  - f. Current limit circuitry: 20% to 160% of drive-rated amps.
  - g. Additional features for constant torque units shall include:
    - (1) IR compensation to provide automatic voltage boost or reduction to optimize both starting torque and system input kW.
    - (2) Slip compensation to provide 0.5% regulation with a 100% load change.
    - (3) Inner current loop regulator.
7. Enclosures:
- a. The VFD system shall be furnished with NEMA-rated (as previously specified) floor mounting. MCC structure shall be 91 1/2 inches high by 20 inches deep with a width to accept the unit specified. MCC structure shall incorporate bus where field wiring can be reduced.
  - b. Items to be mounted in the VFD structure or structures:
    - (1) Inverter.
    - (2) Incoming door interlocked, thermal-magnetic, molded-case circuit breaker.
  - c. NEMA 4/13 items to be door-mounted on the MCC structure:
    - (1) Control devices, pilot lights, selector switches, etc., as shown on the Drawings and specified herein.
    - (2) Interface to the drive shall be via a removable human interface module (HIM) with integral display. This unit shall be a 7-line by 21-character backlit LCD display with graphics capability. HIM shall be used to display drive-operating conditions, fault/alarm indications, and programming information with full text support in multiple languages. The LCD HIM shall be rated IP20/Type 1 and may also be used as a handheld terminal by connecting via a separate cable. The HIM keypad shall include programming keys, drive operating keys (Start, Stop, Direction, Jog, and Speed Control), numeric keys for direct entry and an ALT (alternate function) key to allow drive programming or operating functions to be accessed directly without knowledge of programming structure. The HIM unit shall be mounted on the front of the enclosure door so the operator does not have to open the enclosure to access the HIM.
8. VFD protection:
- a. Adjustable current limit of 20 to 160% minimum.
  - b. Instantaneous overcurrent trip.
  - c. Electronic ground fault and short-circuit protection to shut down the drive without fuse or component failure. Electronic ground- and short-circuit protection to be functional with an input line of 480 VAC  $\pm 10\%$ . The drive manufacturer is to be prepared to demonstrate ground fault and short-circuit protection without the use of an isolation transformer at drive start-up.
  - d. Input thermal-magnetic ambient compensated circuit breaker with a through-the-door interlocked operator.
  - e. Shut down on loss of any input phase for longer than 3 cycles.
  - f. Output phase sequence to be independent of input phase sequence.
  - g. High- or low-sustained voltage.
  - h. 120 VAC grounded control circuits.

- i. Electrically and/or optically isolated low voltage logic.
    - j. Corrosion protection:
      - (1) Gold-plated plugs (male and female section) on all printed circuit boards.
      - (2) Protective board coating (conformal coating).
    - k. MOV converter protection.
    - l. DC bus chokes to minimize line side current harmonics.
    - m. Additional features for constant torque units:
      - (1) I<sup>2</sup>T protection to provide 150% current for one minute.
      - (2) Regenerative override protection.
  - 9. VFD adjustments:
    - a. Maximum speed: 50 to 100%.
    - b. Minimum speed: 0 to 70%.
    - c. Current limit: 20 to 110%, 160% on constant torque units.
    - d. Linear acceleration 0 to 3,600 seconds.
    - e. Linear deceleration 0 to 3,600 seconds.
    - f. Output volts/Hz trim.
    - g. Voltage boosts.
    - h. Additional features for constant torque units:
      - (1) Slip compensation.
      - (2) IR compensation.
    - i. All drives shall attempt to restart three times prior to indicating failure.
  - 10. Inverter digital or LED diagnostic features:
    - a. Current limit signal.
    - b. Regenerative override signal.
    - c. External fault (e.g., motor overload).
    - d. Low line voltage.
    - e. High line voltage.
    - f. Current overload.
    - g. High DC bus voltage.
    - h. Current trip.
    - i. Short-circuit.
  - 11. Inverter construction: Modular construction for ease of maintenance.
  - 12. Mount modules on enclosure subpanel:
    - a. Easily accessible from front.
    - b. Interconnect with plugs.
    - c. Construct boards of fire-retardant materials in accordance with NEMA grade FR4 specifications.
- D. Inverter Quality Control:
- 1. Test all power devices at rated temperature and current for dv/dt, tq, TRR, and leakage.
  - 2. Test integrated circuits for programmed parameters at rated temperature.
  - 3. Treat printed circuit boards for corrosion resistance (conformal coating).
  - 4. Provide gold-plated connections at all points where plugs are used.
  - 5. Thermal cycle all printed circuit boards for 10 cycles between 0°C to 65°C prior to installation in inverter.
  - 6. All units to be tested at a rated load and temperature after assembly.
- E. The active-front-end variable frequency drives shall be ABB ACQ 580-37 (low-harmonic, free-standing), no equal. All drives shall be by the same manufacturer.

- F. Minimum, maximum, and harmonic skip speed setpoints shall be programmed into each VFD. CONTRACTOR shall coordinate these setpoints with the manufacturer of the equipment served. CONTRACTOR shall provide a table listing the minimum, maximum, and skip setpoints programmed into each VFD on the project to ENGINEER and OWNER.
- G. Provide expansion I/O cards, quantity as required, so that signals noted in the I/O list are transmitted/received to/from the plant SCADA System via the EtherNet/IP network.
- H. Provide manufacturer certified start-up and warranty service for each VFD. Service shall be for 2 years and include all travel and expenses. Warranty service shall commence at the date of substantial completion.

## 2.06 MOTOR CONTROL CENTERS

- A. Starters, VFDs, and disconnect devices for motors shall be installed in MCCs except where shown to be remote-mounted at the motor location. Starters and disconnect devices shall be NEMA rated, sized according to application as specified. The MCC and NEMA Class IIB drawings shall be supplied as part of the Controls and Instrumentation package described in Section 26 09 00—Controls and Instrumentation. MCC drawings provided by the MCC manufacturer or through any contractor will not be accepted as shop drawing submittals or O&M documents. System supplier described in Section 26 09 00—Controls and Instrumentation shall wire and test all MCCs for the functions described herein in its shop prior to shipment to the site. Provide one copy of the test report to ENGINEER.
- B. It shall be assumed that colors will be selected by OWNER and shall be nonstandard. Color shall match that specified for control enclosures specified in Section 26 09 00—Controls and Instrumentation.
- C. Auxiliary contacts shall be of quantity necessary for equipment functions.
- D. MCC design shall be in accordance with latest applicable NEMA standards, shall have been tested to prove adequate mechanical and electrical capabilities, and all major components shall have been individually tested.
- E. Structures shall be totally enclosed, dead front, free-standing vertical sections, 90 inches high and not less than 20 inches deep for front-mounted units and not more than 40 inches deep for units mounted back-to-back. Each vertical section shall have side panels extending the full height of the section to minimize fault-propagation to adjacent sections.
- F. Each structure shall contain a main horizontal bus continuously braced within each section, with rating as specified, and vertical bus feeding unit compartments with a minimum rating of 300 amperes, or as necessary for load and feeder breakers. All horizontal and vertical bus of all MCC sections shall be powered regardless of location of transfer switch, unless otherwise noted. All motor control centers shall include a 1/4-inch by 2-inch ground bus. All bus shall be tin-plated copper and braced to withstand short-circuit currents as indicated.
- G. Structures shall contain a horizontal wireway at the top, isolated from the horizontal bus, and shall be readily accessible by removal of its cover plate. Adequate space for conduit and wiring to enter the top or bottom shall be provided without structural interference and accessible without disrupting service.

- H. A vertical wireway with a minimum of 28 square inches of cross-sectional area shall be adjacent to each vertical unit compartment and shall be covered by its own door. These vertical wireways shall be free of all live parts and shall contain vertical wireway tie bars. Exceptions to this are as shown on the Drawings.
- I. All units shall be provided with a mechanical interlock with the unit door to prevent access unless the disconnect is in the off position. A defeater shall be provided to bypass this interlock. With the door open, an interlock shall be provided to prevent inadvertent closing of the disconnect.
- J. Padlocking facilities shall be provided to positively lock the disconnect in either the on or off position with from one to three padlocks whether the door is open or closed.
- K. All disconnect operating handles located higher than 6 feet 7 inches above finished floor in the on position (including the MCC pad height) shall be provided with handle extensions. All disconnect operating handles above this height must operate in the vertical direction.
- L. All unit heights shall be of modular dimensions to allow for unit layout, in any combination, without structural interference. Drawout units shall have a tin-plated stab assembly for connection to the vertical bus; no wiring to these stabs shall extend into the bus compartments. All bus access openings shall be provided with automatic shutters that close when the unit (e.g., motor controller or breaker) is withdrawn.
- M. Terminal blocks for NEMA Type B assemblies shall be mounted within the unit and shall be factory-wired. Provide a minimum of 25% spare terminals for all terminal blocks furnished.
- N. MCCs shall be NEMA Class II.
- O. Wiring in MCCs shall be Type B. All conductors supplying power from the MCC bus to frame-mounted equipment shall have the phases identified as specified in Section 26 05 53—Electrical Identification.
- P. Provide neutral landing lugs for all MCCs accepting utility service-entrance conductors. Neutral landing lugs shall be bonded to the ground bus at the utility service entrance, unless otherwise noted.
- Q. MCCs shall have NEMA 1 gasketed enclosures, unless otherwise noted.
- R. Remote-mounted controls shall be heavy-duty, oiltight (30 mm) of same quality and type furnished in starters and as shown on the Drawings. Equipment controls that require a manual reset shall be accomplished through a reset push button on the enclosure or MCC bucket for the associated piece of equipment. All reset buttons shall be appropriately labeled, including mechanical type.
- S. All lighting and small power transformers shall be dry type, Class H insulation, DOE 2016 Efficiency rated, 115°C rise (kVA as indicated on Drawings). Coil windings shall be copper, glass-taped, dipped in silicone varnish, with two taps 2 1/2% above and below, 480-volt primary, Delta with 120/208-volt, three-phase, 4-wire secondary, unless indicated otherwise. Circuit breakers that feed lighting panel transformers shall be provided with electronic sensing, timing, and tripping circuits for adjustable current settings. Provide adjustable long-time pickup, long-time delay, short-time pickup, short-time delay, and instantaneous pickup settings.



- T. All lighting panelboards shall be Eaton Pow R-Line 1a, or equal, with 10,000 amps interrupting capacity, at 120/208-volt, three-phase, 4-wire with bolt-on branch breakers as shown on the Drawings, unless indicated otherwise. All power panelboards shall be Eaton Pow-R-Line 2a, or equal, with 35,000 amps interrupting capacity, at 480-volt, three-phase, 3-wire with branch breakers as shown on the Drawings, unless indicated otherwise. Branch-mounted main circuit breakers will not be allowed. Minimum size shall be 20 inches wide by 5 3/4 inches deep. All bus shall be aluminum. Provide laminated, typewritten panel schedule for all panelboards at project final completion.
- U. All motor control centers shall be factory-assembled, wired, and tested. All internal wiring shall be numbered, and each wire shall be terminated on terminal strips, including internal spares, field wiring, and spare field wires. Schematic and wiring layout drawings following JIC Standards which show all connections to external devices, a complete bill of materials, and a detailed description of operation, shall be submitted for each piece of equipment.
- V. Arrangement and physical locations of all equipment within each motor control center shall be subject to shop drawing approval.
- W. All components shall be properly identified with laminated engraved nameplates with 3/8-inch-high letters (white or black). Nameplates located outdoors shall be stainless steel screw on type. Nameplates located indoors shall be adhesive type.
- X. Unless otherwise indicated, all conduit entrances shall be through the bottom only.
- Y. MCC interrupting rating shall be as shown on the Drawings, minimum 65,000A.
- Z. Main lugs in the MCC shall be provided with a surge protection device and a three-phase voltage monitor. This surge protection device shall be on the load side of the main and be as specified in Section 26 43 13—Surge Protective Devices (SPD). SPD red and green LED indicators, to indicate if one or more modules have reduced protection and if power is present on each phase, shall be displayed on the front of the bucket door. The three-phase voltage monitor shall be on the load side of the main and be Timemark \*269, or equal. CONTRACTOR shall select voltage to match electrical service.
- AA. Provide power meters and appropriately sized metering-class current transformers (CTs) installed on the load side of the associated MCC main lugs. Power meters shall be Allen-Bradley PowerMonitor 5000, Bulletin 1426-M5E, or equal. CTs shall be Allen-Bradley Bulletin 1411-180-XXX or 1411-8SHT-XXX as required for monitoring parallel phase conductors, or equal, and shall be rated for ANSI/IEEE C57.13 metering Class 0.3 or 0.6 accuracy. Provide CT cabling as specified in Section 26 05 23—Instrument and Communication Wire and Cable, for the specified CT accuracy class, minimum 14 AWG. Power meter shall be provided with an EtherNet/IP communications module matching the SCADA System communication protocol so that all readings can be monitored at the SCADA System HMI. Power meter shall be installed in a dedicated MCC bucket as shown on the Drawings with a remote display mounted on the MCC bucket door. The MCC bucket shall be provided with a control power transformer, fused disconnects for the control power circuit and voltage sensing lines, and CT shorting blocks as specified in Section 26 05 19—Wire.
- BB. Feeder circuit breakers shall be provided in accordance with the requirements specified in Section 26 28 00—Overcurrent Protective Devices.

## PART 3–EXECUTION

### 3.01 INSTALLATION

- A. Provide motor control equipment in accordance with manufacturer's instructions and Drawings.
- B. Panelboard Installation: In conformance with NEMA PB 1.1.
- C. Overloads shall be selected on the basis of nameplate horsepower and service factor. Selection of overloads based on horsepower shown on the Drawings is not acceptable. Where power factor correction capacitors are provided, overload protection shall be compensated for the lower motor running current because of improved power factor.
- D. All motor control wiring shall be installed in accordance with control wiring diagrams furnished.
- E. Wireways in MCCs shall be used only for routing of conductors. Splices are not allowed within wireways.
- F. All wiring within MCCs shall be landed on terminals inside buckets or equipment compartments and not left unterminated within wireways. This shall include all internal MCC wiring and external field wiring, including spare wires.
- G. Motor Data: Provide neatly typed label inside each motor controller enclosure identifying motor served, nameplate horsepower, full-load amperes, code letter, service factor, and voltage/phase rating.
- H. Control wiring and field wiring (120 V and below) within MCCs shall be separated from power wiring (277 V and above). Where possible, route control and field wiring in separate raceways or wireways. Provide a minimum of 2 inches separation between control wiring, field wiring, and power wiring.
- I. All motors will be provided by other divisions, ready for connections. CONTRACTOR shall be responsible for electrical connections for power and control circuit wiring, proper phase relationships, and correct motor rotation.
- J. Provide motor circuit wiring for each motor from the source of supply to the terminal box on the motor including all intermediate connections at devices such as motor starters, VFDs, disconnect switches, etc.
- K. All feeder cable connections to motor leads up to 600 volts shall be insulated and sealed with factory-engineered kits, as specified in Section 26 05 19–Wire.
- L. Provide motor controllers as specified for all motors, unless shown or specified that motor controllers or control equipment will be furnished by others.
- M. Provide motor circuit disconnect devices for all motors, unless shown or specified that disconnect devices or starters are furnished with other equipment.

END OF SECTION

## SECTION 26 27 26

### WIRING DEVICES

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Wall Switches.
  - 2. Receptacles.
  - 3. Cover Plates.
  - 4. Wall-Mounted Occupancy Sensors.
  - 5. Outdoor Photo Cells.
  - 6. Thermostats.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. NEMA WD 1–General-Color Requirements for Wiring Devices.
- B. NEMA WD 5–Specific-Purpose Wiring Devices.
- C. Drawings–Bill of Materials.

##### 1.03 QUALITY ASSURANCE

- A. Manufacturers of switches, outlets, boxes, lamps, fuses, lugs, etc.: Firms regularly engaged in the manufacture of these products, of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide electrical material, etc., which have been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

##### 1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

- B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

## PART 2-PRODUCTS

### 2.01 WALL SWITCHES

- A. A-C general use Industrial specification grade, snap switch, 20 amperes, 277 volts, one of the following: Eaton 122\*, Leviton 122\*, or Pass and Seymour PS20AC\*.
- B. Provide white-colored handles.
- C. Manual motor switches or manual motor controllers for 120 V or 208 V motors on circuits 20 amps or less shall be specification grade snap switch as specified above. Manual motor switches or manual motor controllers for 120-volt or 208-volt motors and single-pole or two-pole switches for other equipment up to 277 volts on circuits 30 amps or less shall be Eaton 303\*, Leviton 303\*, or Pass and Seymour PS30AC\*. Manual motor switches for three-phase motors 30 amps or less shall be as specified in Section 26 28 16-Disconnect Switches.

\*Complete catalog number for pole arrangement necessary.

### 2.02 RECEPTACLES

- A. Twenty ampere, 125-volt, NEMA 5-20R, Industrial specification grade, straight blade, 3-wire duplex grounded outlets, one of the following: Eaton 5362, Leviton 5362, Pass and Seymour 5362. Provide white color.
- B. Weather-Resistant Receptacle: Weather-resistant receptacles shall include GFCI protection and be UL 498 listed, 20 ampere, 125-volt, NEMA 5-20R, heavy-duty, commercial grade, with WR marking on the face, Eaton WRS GF20, or equal.
- C. GFCI Receptacle: GFCI receptacles shall be UL 943 listed, Pass and Seymour 2097, Eaton TRSGF20 receptacle with integral ground fault current interrupter. Provide white color.

### 2.03 COVER PLATES

- A. Indoor outlet and switch boxes that are surface mounted or recessed in unfinished spaces shall be provided with standard 302 series stainless steel cover plates.
- B. NEMA 4X and weatherproof switch covers shall be Thomas and Betts, Industrial Gray, toggle switch cover, Model E98TSCN-CAR, Eaton S2983 or equal.
- C. While in use receptacle covers for exterior use shall be Leviton IUM1V-GY, or equal. Receptacle covers for NEMA 4X locations shall be Leviton 5980, Eaton WIU-1VX, or equal.
- D. Cover plates for manual motor switches, manual motor controllers, and NEC required equipment disconnects shall have provisions for locking the switch in the On or Off position.

## 2.04 WALL-MOUNTED OCCUPANCY SENSORS (DOUBLE POLE [TYPE 2])

- A. The sensor shall use both passive infrared and ultrasonic detection methods for detecting room occupancy. The unit shall fit on/in a standard single-gang switchbox and shall require two wires and a grounded box for proper operation.
- B. The sensor shall utilize a temperature compensated, dual element sensor and a multielement Fresnel lens. The lens shall be Poly IR4 material to filter short wavelength IR, such as those emitted by the sun and other visible light sources.
- C. Sensor shall have selectable DIP switches to adjust automatic time delay to fit occupant usage patterns.
- D. The sensor shall operate at universal voltages of 100 to 300 VAC. Sensor shall be capable of switching line voltage loads without the use of relay power packs.
- E. Sensor shall have no minimum load requirement and shall be capable of switching from 0 to 800 watt incandescent, or 1/6 hp @ 120 VAC, 60 Hz.
- F. Double pole sensors shall have the capability of switching two independent line voltage circuits. Each pole shall have no minimum load requirement and shall be capable of switching from 0 to 800 watts incandescent, or 1/6 hp @ 120 VAC, 60 Hz.
- G. Sensor shall not protrude more than 3/8 inch from the wall.
- H. Sensor shall have a 28-segment, two-level, Fresnel injection molded lens.
- I. Sensor shall cover up to 1,000 square feet for walking motion, with a field view of 180 degrees.
- J. In automatic mode, sensor shall be able to automatically return to Automatic-on after lights are turned off manually.
- K. Sensor shall have a LED indicator that remains active at all times in order to verify detection within the area to be controlled.
- L. Sensor shall have a service switch to allow end-users to operate the sensor in the event of a failure, set by a DIP switch.
- M. Sensor shall be able to control incandescent, magnetic low voltage, and electronic low voltage loads.
- N. Switching mechanism shall be a relay(s). Triac and other harmonic generating devices shall not be allowed. Sensor shall have ground wire and grounded strap.
- O. The PIR wall switch sensor shall be a completely self-contained control system that replaces a standard toggle switch.
- P. Double-pole wall-mounted passive infrared occupancy sensor shall be Model DSW-302 as manufactured by Wattstopper, Eaton OSD10DH, or equal.

## 2.05 OUTDOOR PHOTOCELLS

- A. Photocell type shall be silicone diode and shall have electronic photocontrols. Photocell shall accept an input voltage range from 120 volts AC to 277 volts AC, be rated for a 1000 watts tungsten range, and be rated for 1,650 watts at 277 volts AC for LED installations. Photocell controller shall be gasketed for outdoor installation.
- B. Photocell shall instantly turn on when activated and shall have an adjustable sensor-off time delay (2 to 5 seconds) to prevent false off switching. On activation shall occur at 1.5 foot-candles and off activation shall occur at 4.5 foot-candles. In the event the photo controller fails, the photo controller shall fail on.
- C. Operational temperature range shall be -40°F to 158°F. Photocell shall be UL listed and include an 8-year warranty.
- D. Photocells for new construction shall be model EK4336S, as manufactured by Intermatic, or equal. Photocell mounting shall be suitable for installation in an approved in-wall, outdoor outlet box with weatherproof wall plate model K43-WP-KIT, as manufactured by Intermatic, or equal. Provide a light shield accessory model 6LV1352, as manufactured by Intermatic, or equal.

## 2.06 THERMOSTATS

- A. Line voltage thermostats for single-stage heating or single-stage ventilation, and for low-temperature alarms shall be PECO Model TF115-001, or equal. Thermostats shall be rated NEMA 4X with a 40°F to 110°F temperature range and fixed 3°F deadband.
- B. Thermostats shown on the Drawings shall be single-stage unless otherwise noted.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Weather-resistant receptacles shall be provided in all damp and wet locations.
- B. GFCI receptacles shall not be series wired.
- C. Install wall switches 48 inches above floor (top of box), "Off" position down, unless otherwise noted.
- D. Install receptacles vertically with the grounding pole on the top and at the heights shown on the Drawings, unless otherwise noted. Heights listed on the Drawings are to the bottom of the box.
- E. Install thermostats 48 inches above floor (top of box).
- F. Install devices and cover plates flush and level.
- G. Back wiring is not allowed for switches and receptacles. Wires shall be terminated with the device screw terminal.

- H. Individual labels shall be placed on the back of all switch faceplates and receptacle faceplates indicating the lighting panel and circuit from which the switch or receptacle is fed. Labels shall be white background with black lettering no smaller than 12-point font. Provide permanently attached self-adhesive type, machine fed, and self-laminating labels, or equal. All labels must be by the same manufacturer, same size, and same font. Handwritten labels are not acceptable.
- I. Individually adjust each occupancy sensor's sensitivity and install sensor shields as required such that the sensor properly serves movement in all areas of the room, but does not energize lighting due to movement in adjacent rooms or due to ambient noise in the space when unoccupied (e.g., noise from pumps, refrigerators, HVAC equipment, servers, etc.). Adjust off-delay timers as required so that sensors operate in a manner that is acceptable to OWNER.

END OF SECTION

## SECTION 26 28 00

### OVERCURRENT PROTECTIVE DEVICES

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Provide overcurrent protective devices as shown on the Drawings, as specified herein, and as needed for a complete and proper installation.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Submit shop Drawings and product data in accordance with provisions of Section 01 33 00–Submittals, including electrical ratings, physical size, interrupt ratings, trip curves, I<sup>2</sup>t curves, and manufacturer's detailed specifications.

##### 1.03 QUALITY ASSURANCE

- A. Comply with the following requirements:
  - 1. NFPA 70 National Electrical Code (NEC).
  - 2. Local codes and ordinances.
  - 3. Provide overcurrent protective devices by same manufacturer for each type of device.

##### 1.04 SPARE PARTS

- A. Provide the following spare parts to OWNER that match items specified:
  - 1. In three-phase circuits: Three fuses of each type and rating.
  - 2. In single-phase circuits: Two fuses of each type and rating.

##### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Comply with pertinent provisions of Section 01 60 00–Materials and Equipment.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

#### PART 2–PRODUCTS

##### 2.01 CIRCUIT BREAKERS

- A. General:
  - 1. Comply with UL 489 requirements.
  - 2. Provide thermal and magnetic protection unless noted otherwise.



- B. Main Breakers:
  - 1. Circuit breakers shall have a short-circuit interrupting rating as indicated on the Drawings.
  - 2. Provide solid-state circuit breakers with electronic sensing, timing, and tripping circuits with adjustable settings. Provide adjustable long-time pickup, long-time delay, short-time pickup, short-time delay, and instantaneous pickup settings.
- C. Feeder Breakers:
  - 1. Circuit breakers shall have a short-circuit interrupting rating as indicated on the Drawings.
  - 2. Solid-State Circuit Breakers:
    - a. Circuit breakers with frame sizes 400 amperes and larger shall be provided with electronic sensing, timing, and tripping circuits with adjustable settings. Provide adjustable long-time pickup, long-time delay, short-time pickup, short-time delay, and instantaneous pickup settings.
    - b. Circuit breakers that feed lighting panel transformers, including transformers installed in MCCs, shall be provided with electronic sensing, timing, and tripping circuits with adjustable settings. Provide adjustable long-time pickup, long-time delay, short-time pickup, short-time delay, and instantaneous pickup settings.
  - 3. Field-Adjustable Thermal-Magnetic Trip Circuit Breaker: NEMA AB1. Provide circuit breakers with frame sizes less than 400 amperes with adjustable instantaneous pickup setting for automatic operation. Range of adjustment shall be three to ten times the trip rating.
  - 4. Field-Changeable Magnetic-Only Ampere Rating Circuit Breakers/Motor Circuit Protectors: UL 489. Provide circuit breakers with frame sizes 200 amperes and larger with changeable trip units.
- D. All lugs shall be rated to accept copper conductors.

## 2.02 ENCLOSURES

- A. Circuit breakers shall be installed within MCC, panelboard, etc. as shown on the Drawings.

## 2.03 ACCESSORIES

- A. Provide accessories as listed below: Handle Lock: Include provisions for padlocking.

# PART 3–EXECUTION

## 3.01 INSTALLATION

- A. Install overcurrent protective devices in accordance with manufacturer's recommendations.

## 3.02 ADJUSTMENT

- A. Set and record adjustable settings on circuit breakers to provide selective coordination and proper operation.

END OF SECTION

## SECTION 26 28 16

### DISCONNECT SWITCHES

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Disconnect Switches.
  - 2. Fractional hp Motor Switches.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. NEMA KS 1–Enclosed Switches.

##### 1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Include outline drawings with dimensions and equipment ratings for voltage, capacity, horsepower, and short-circuit.

#### PART 2–PRODUCTS

##### 2.01 ACCEPTABLE MANUFACTURERS

- A. Disconnect Switches: Square D Class 3110 or Eaton Type DH.
- B. Manual Motor Switches: Square D Class 2510 Type K or Eaton B330.
- C. Substitutions: Under provisions of the General Conditions.

##### 2.02 DISCONNECT SWITCHES

- A. Fusible Disconnect Switches: NEMA KS 1; heavy-duty; quick-make, quick-break, load interrupter enclosed knife switch with externally-operable handle interlocked to prevent opening front cover with switch in “On” position. A defeater shall be provided to bypass this interlock. Handle shall be lockable in “Off” position. Provide fuse clips designed to accommodate Class R fuses, and auxiliary contacts to remove control power associated with field devices or instruments interlocked with equipment served. Auxiliary contacts shall be by the disconnect manufacturer.
- B. Nonfusible Disconnect Switches: NEMA KS 1; heavy-duty, quick-make, quick-break, load interrupter enclosed knife switch with externally-operable handle interlocked to prevent opening front cover with switch in “On” position. A defeater shall be provided to bypass this interlock. Handle lockable in “Off” position. Provide auxiliary contacts to remove control

power associated with field devices or instruments interlocked with equipment served. Auxiliary contacts shall be by the disconnect manufacturer.

- C. Manual Motor Switches: Where noted on the Drawings, manual motor switches shall be provided for three-phase motors with circuit rating of 30 amps, or less. Manual motor switches shall have toggle operator without overload protection or indicator light. Provide cover plate for all switches to meet the finish or classification of the space. Cover plate shall have provisions for locking the switch in the "On" or "Off" position.

#### 2.03 SINGLE-PHASE MOTOR SWITCHES (2 HP OR LESS)

- A. Where noted on the Drawings, motors rated 2 hp or less, for operation on 120 V or 240 V, single-phase, shall be provided with a specification-grade wall switch as disconnecting means. See Section 26 27 26—Wiring Devices for additional information.

#### 2.04 ENCLOSURES

- A. Provide disconnect switch enclosures as listed below, unless noted otherwise on the Drawings:
  - 1. Indoor dry locations: NEMA 12, steel.
  - 2. Outdoor, corrosive, or wet locations: NEMA 4X, stainless steel.
- B. Provide manual motor switch enclosures as listed below, unless noted otherwise on the Drawings. Indoor dry, outdoor, or wet locations: NEMA 4, die cast zinc.

### PART 3—EXECUTION

#### 3.01 INSTALLATION

- A. Provide disconnect switches where indicated on the Drawings. Maximum mounting height shall be 42 inches above finished floor unless noted otherwise, or acceptable to ENGINEER based on field conditions.
- B. Provide wall switch for each single-phase fractional horsepower motor where indicated on the Drawings.
- C. Disconnect enclosures that house wiring powered from a source separate from the motor power wiring (e.g., MAS units, space heaters) shall have a nameplate installed on the front of the disconnect indicating that power may be present at the motor when the disconnect is in the "Off" position.
- D. Wiring within disconnects shall only be for loads or equipment served by that disconnect. Foreign wiring within disconnect enclosures is not allowed. All wiring within disconnect enclosures shall be landed on lugs or terminals provided by the disconnect manufacturer, or on dedicated terminal strips for instrumentation equipment or field devices. Splices and spring wire connectors are not allowed within disconnect enclosures.
- E. Manual motor switches shall not be installed in corrosive and NEMA 4X locations. Provide disconnect switches.

END OF SECTION

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## SECTION 26 32 13

### STANDBY POWER SYSTEM

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Steel base assembly, natural gas engine, generator, engine-generator set controls, environmental systems.
- B. Related Sections and Divisions:
  - 1. Applicable provisions of Division 01 shall govern work in this section.
  - 2. The following listing of related sections is provided for the convenience of CONTRACTOR and is not necessarily all-inclusive. Other sections of the specifications not referenced below shall also apply to the extent required for proper performance of this work. All other sections of Division 26.

##### 1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- B. Shop drawings shall include the following:
  - 1. Detailed descriptions of equipment to be furnished, including all deviations from these specifications.
  - 2. Detailed layouts of all equipment and ancillary items.
  - 3. The manufacturer shall furnish schematic and wiring diagrams for the generator and an interconnection wiring diagram for the entire standby system. Test reports certified by the manufacturer shall be provided to ENGINEER for the entire system.

##### 1.03 QUALITY ASSURANCE

- A. The generator shall be listed by Underwriters Laboratories, Inc., UL2200, and be certified by the Canadian Standards Association.

##### 1.04 OPERATING CONDITIONS

- A. Engine-generator set shall be capable of continuous standby rating at 1,800 rpm, 0.8 PF, three-phase, 3-wire, 480 volts, at 60 hertz, and shall have a minimum capability of 180 kW, 225 kVA prime and 200 kW, 250 kVA standby.
- B. The generator set manufacturer shall verify the engine is capable of driving the generator with all accessories in place and operating, at the generator set kW rating after derating for the range of temperature expected in service, and the altitude of the installation. Site conditions are 100°F maximum ambient and 900 feet altitude.
- C. Voltage regulation shall be  $\pm 0.5\%$  of rated voltage for any constant load between no load and rated load.

- D. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed  $\pm 0.5\%$ .
- E. Random Voltage Variation: The cyclic variations in RMS voltage shall not exceed  $\pm 0.5\%$  of rated voltage for constant loads from no load to rated load, with constant ambient and operating temperature.
- F. Total Harmonic Distortion: The sum of AC voltage wave-form harmonics shall meet NEMA MG1 and shall not exceed 5% of rated voltage (L-N, L-L, L-L-L), and no single harmonic shall exceed 3% of rated voltage.
- G. Telephone Influence Factor shall be less than 50 per NEMA MG1-22.43.
- H. The engine-generator set shall accept a single step load of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
- I. Motor starting capability shall be a minimum of 791 kVA. The generator set shall be capable of recovering to a minimum of 90% of rated no load voltage following the application of the specified kVA load at near zero power factor applied to the generator set. Maximum voltage dip on application of this load, considering both alternator performance and engine speed changes shall not exceed 25%.

#### 1.05 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

### PART 2-PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. The AC engine-generator set shall be as manufactured by Cummins Power Generation Model C200N6, Kohler.
- B. The Drawings and Specifications were prepared based on Cummins Power Generation with a maximum single-step voltage dip less than 15%. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.

#### 2.02 STEEL BASE ASSEMBLY

- A. The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.

## 2.03 ENGINE

- A. The engine shall be stationary and liquid-cooled for use with natural gas. The design shall be 4-cycle, 6-cylinder, minimum displacement of 677 cubic inches, turbo charged, after cooled as required by engine manufacturer. Engine shall be certified as capable of driving the generator of the rating indicated above on a continuous standby basis for the duration of normal source interruptions.
- B. Engine accessories shall include the following:
  - 1. A 24-volt DC electric starter as required by the engine manufacturer.
  - 2. Replaceable dry element air cleaner with restriction indicator.
  - 3. Positive displacement, mechanical, full-pressure lubrication oil pump, full-flow lubrication oil filters with replaceable elements, pressure relief valve, dipstick oil level indicator, and oil drain valve with hose extension. Provide all lubricants for proper operation of the unit.
  - 4. An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, and accelerating to rated speed.
  - 5. Engine protective devices to indicate alarm and engine shutdown for the following:
    - a. Low coolant temperature alarm.
    - b. Low coolant level alarm and shutdown.
    - c. Low lubrication oil pressure alarm and shutdown.
    - d. High coolant temperature alarm and shutdown.
    - e. Over-speed shutdown.
    - f. Over-crank shutdown.
  - 6. Battery charging alternator, 45 amp minimum, with solid-state voltage regulator.
  - 7. Engine shall be radiator-cooled by engine-mounted radiator system including belt-driven pusher fan, coolant pump, and thermostat temperature control. Rotating parts shall be guarded against accidental contact. The cooling system shall be rated for full-rated load operation in a 104°F ambient condition. Radiator shall be provided with a duct adaptor flange permitting the attachment of air discharge duct directing the discharge of radiator air through the wall. Provide radiator drain extension to the side of the generator. Extension shall include shutoff valve.
  - 8. The equipment supplier shall provide 50% ethylene glycol antifreeze solution to fill engine cooling system.
  - 9. Engine-mounted thermostatically controlled coolant heater to aid in quick starting. The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 104°F in a 40°F ambient, in compliance with NFPA 110 requirements. Heater shall be rated single-phase, 120 volts, 2,500 watts and be disconnected whenever the engine starts. Heater shall be UL 499 listed and labeled. The coolant heater(s) shall include provisions to isolate the heater for replacement of the heater element without draining the coolant from the generator set. CONTRACTOR shall provide proper circuit from normal utility power source.
  - 10. Vibration isolators, spring/pad type, quantity as recommended by the generator set manufacturer.
  - 11. Flexible fuel lines, fuel strainer, and fuel solenoid. CONTRACTOR shall install fuel lines and fuel solenoid per manufacturer's recommendations.

## 2.04 ENGINE EXHAUST SYSTEM

- A. For natural gas generators larger than 150 kW standby, engine emissions shall meet current EPA NSPS Compliant capable Gas engine emission regulations. Engines shall be emission-tested and documented EPA Compliant Capable, and all costs associated with any on-site EPA-required emissions testing shall be included in the Bid. Provide EPA-approval documentation to OWNER prior to final completion.
- B. Exhaust muffler shall be provided for the engine of size as recommended by manufacturer. Muffler shall be of the critical grade-type. Exhaust inlet location shall be selected by CONTRACTOR. Coordinate with Division 23 based on actual installation and project conditions.
- C. Stainless steel flexible exhaust connections shall be provided as required for connection between engine exhaust manifold and exhaust line in compliance with applicable codes and regulations.
- D. Provide an exhaust condensation trap with manual drain valve to trap and drain off exhaust condensation to prevent condensation from entering the engine.
- E. Provide an engine exhaust wall thimble constructed of stainless steel with a thermal barrier as manufactured by GT Exhaust Systems, Inc., Type C (combustible walls), or equal. Refer to the detail on the Drawings for required length of roof thimble. Thermal barrier shall be composed of heavy-duty fibrous glass insulation.
- F. Provide a suitable rain cap at the stack outlet. Provide all necessary flanges and special fittings for proper installation.
- G. Division 23 shall mount and install all exhaust components as shown on Drawings and as required to comply with applicable codes and regulations. All components shall be properly sized to provide operation without excessive back pressure when installed as shown on the Drawings. Coordinate exhaust components and installation requirements with Division 23 contractor based on actual installation and project conditions.
- H. Division 23 shall cover exhaust muffler and all indoor exhaust piping with a proper insulating material in a manner not to interfere with flexible exhaust connection.

## 2.05 BATTERY CHARGER

- A. A UL-listed/CSA-certified 10-ampere voltage regulated battery charger shall be provided for the engine-generator set.
- B. Charger shall be UL 1236-BBHH listed and CSA or CUL certified for use in emergency applications.
- C. The charger shall be compliant with UL 991 requirements for vibration resistance.
- D. The charger shall be capable of charging a fully discharged battery without damage to the charger. It shall be capable of returning a fully discharged battery to fully charged condition within 24 hours. The charger shall be UL labeled with the maximum battery amp-hour rating that can be recharged within 24 hours. The label shall indicate that the charger is suitable for charging of 200 AH batteries in accordance with NFPA requirements.

- E. The charger shall incorporate a 4-rate charging algorithm, to provide trickle charge rate to restore fully discharged batteries, a bulk charge rate to provide fastest possible recharge after normal discharge, an absorption state to return the battery to 100% of charge, and a float stage to maintain a fully charged battery and supply battery loads when the generator set is not operating. In addition, the charger shall include an equalization timer. Charge rates shall be temperature compensated based on the temperature directly sensed at the battery.
- F. The DC output voltage regulation shall be within  $\pm 1\%$ . The DC output ripple current shall not exceed 1 amp at rated output current level.
- G. The charger shall include the following features:
  - 1. Two-line alphanumeric display with programming keys to allow display of DC output ammeter and voltmeters (5% accuracy or better), display alarm messages, and perform programming.
  - 2. LED indicating lamps to indicate normal charging (green), equalize charge state (amber), and fault condition (red).
  - 3. AC input overcurrent, over voltage, and under voltage protection.
  - 4. DC output overcurrent protection.
  - 5. Alarm output relay.
  - 6. Corrosive-resistant aluminum enclosure.

## 2.06 STARTING AND CONTROL BATTERIES

- A. A calcium/lead antimony storage battery set of the heavy-duty starting-type shall be provided. Battery voltage shall be compatible with starting system. The battery set shall be rated no less than 900 CCA and shall be capable of a minimum of three 15-second cranking cycles. A battery rack constructed in conformance with NEC requirements and necessary cables and clamps shall be provided.

## 2.07 GENERATOR

- A. The generator shall be a single prelubricated bearing, self-aligning, 4-pole, two-thirds pitch, brushless, synchronous-type, revolving field with amortisseur windings, and with direct driven centrifugal blower fan for proper cooling and minimum noise. No brushes will be allowed. Generator shall be directly connected to engine fly wheel housing and driven through a flexible coupling to provide permanent alignment. Generator design shall prevent potentially damaging shaft currents.
- B. Insulation shall meet NEMA standards for Class H and shall be UL 1446 listed. The maximum temperature rise shall not exceed 125°C at 40°C ambient.
- C. The generator shall be three-phase, broad-range, reconnectable and shall have 12 leads brought out to allow connection by user to obtain any of the available voltages for the unit.
- D. The generator set shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5% above or below rated voltage.
- E. Generators over 25 kW shall utilize a permanent magnet generator (PMG) to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a



single-phase or three-phase fault at approximately 300% of rated current for not more than 10 seconds.

- F. The subtransient reactance of the alternator shall not exceed 15%, based on the standby rating of the generator set.
- G. Provide a 400-amp mainline circuit breaker with the engine-generator set. Circuit breaker shall meet the requirements specified in Section 26 28 00—Overcurrent Protective Devices.

## 2.08 ENGINE-GENERATOR SET CONTROL

- A. The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification.
- B. The generator set-mounted controls shall include the following features and functions for control switches:
  - 1. Mode Select Switch: The mode select switch shall initiate the following control modes. When in the RUN or MANUAL position the generator set shall start, and accelerate to rated speed and voltage. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
  - 2. EMERGENCY STOP switch: Switch shall be Red “mushroom-head” pushbutton. Depressing the emergency stop switch shall cause the generator set to immediately shut down and be locked out from automatic restarting.
  - 3. RESET switch: The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
  - 4. PANEL LAMP switch: Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.
- C. Generator Set AC Output Metering: The generator set shall be provided with a metering set including the following features and functions:
  - 1. Digital metering set, 1% accuracy, to indicate generator RMS voltage and current (all three phases), frequency, output current, output kW, kWh, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three-phase voltages (line to neutral or line to line) simultaneously.
  - 2. The control system shall log total number of operating hours and total kWh, as well as total values since reset.
- D. Generator Set Alarm and Status Display:
  - 1. The generator set control shall include LED alarm and status indication lamps. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. Functions indicated by the lamps shall include:
    - a. The control shall include green lamps to indicate that the generator set is running at rated frequency and voltage, and that a remote start signal has been received at the generator set. The running signal shall be based on actual sensed voltage and frequency on the output terminals of the generator set.
    - b. The control shall include a flashing red lamp to indicate that the control is not in automatic state and red common shutdown lamp.
    - c. The control shall include an amber common warning indication lamp.

2. The generator set control shall indicate the existence of the warning and shutdown conditions on the control panel. Conditions required to be annunciated shall include:
    - a. Low oil pressure (warning).
    - b. Low oil pressure (shutdown).
    - c. Oil pressure sensor failure (warning).
    - d. Low coolant temperature (warning).
    - e. High coolant temperature (warning).
    - f. High coolant temperature (shutdown).
    - g. High oil temperature (warning).
    - h. Engine temperature sensor failure (warning).
    - i. Low coolant level (warning).
    - j. Fail to crank (shutdown).
    - k. Fail to start/overcrank (shutdown).
    - l. Overspeed (shutdown).
    - m. Low DC voltage (warning).
    - n. High DC voltage (warning).
    - o. Weak battery (warning).
    - p. High AC voltage (shutdown).
    - q. Low AC voltage (shutdown).
    - r. Under frequency (shutdown).
    - s. Overcurrent (warning).
    - t. Overcurrent (shutdown).
    - u. Short circuit (shutdown).
    - v. Overload (warning).
    - w. Emergency stop (shutdown).
    - x. (4) configurable conditions.
  3. Provisions shall be made for indication of four customer-specified alarm or shutdown conditions. All contacts shall be rated for 5 amps at 120 VAC. Relays shall be provided when necessary. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above-specified conditions. The non-automatic indicating lamp shall be red and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.
- E. Engine Status Monitoring:
1. The following information shall be available from a digital status panel on the generator set control:
    - a. Engine oil pressure (psi or kPA).
    - b. Engine coolant temperature (degrees F or C).
    - c. Engine oil temperature (degrees F or C).
    - d. Engine speed (rpm).
    - e. Number of hours of operation (hours).
    - f. Number of start attempts.
    - g. Battery voltage (DC volts).
  2. The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set.
- F. Engine Control Functions:
1. The control system provided shall include a cycle cranking system which allows for user selected crank time, rest time, and number of cycles. Initial settings shall be for three cranking periods of 15 seconds each, with 15-second rest period between cranking periods and a 75-second overcrank lockout per NFPA 110.

2. Manual Run/Stop Control Switch: When the mode control switch is in the MANUAL position and the MANUAL RUN/STOP switch is pressed, the Generator set shall start, bypassing time delay start. If the generator set is running in the MANUAL mode, pressing the RUN/STOP switch shall cause the generator set to shut down after a cool-down at idle period.
3. The control system shall include an engine governor control which functions to provide steady state frequency regulation, as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.
4. The control system shall include sensor failure monitoring logic for speed sensing, oil pressure, and engine temperature that is capable of discriminating between failed sensor or wiring components and an actual failure condition.

G. Alternator Control Functions:

1. The generator set shall include a full wave rectified automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate and be capable of being curve-matched to the engine torque curve with adjustments in the field. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.
2. A microprocessor-based protection device shall be provided to individually monitor all phases of the output current of the generator set and initiate an alarm (overcurrent warning) when load current exceeds 110% (adjustable) of the rated current of the generator set on any phase for more than 60 seconds (adjustable). The device shall shut down and lockout the generator set when output current level approaches the thermal damage point of the alternator (overcurrent shutdown). The protective functions provided shall be in compliance with the requirements of NFPA70 article 445.
3. A microprocessor-based protection device shall be provided to monitor all phases of the output current for short-circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lockout the generator set when output current level approaches the thermal damage point of the alternator (short-circuit shutdown). The protective functions provided shall be in compliance with the requirements of NFPA70 article 445.
4. Controls shall be provided to monitor the kW load on the generator set and initiate an alarm condition (overload) when total load on the generator set exceeds the generator set rating for longer than 5 seconds (adjustable). Controls shall include a load shed control to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.
5. A microprocessor-based AC over and undervoltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% (adjustable) of the operator-set voltage level for more than 10 seconds (adjustable), or with no intentional delay when voltage exceeds 130% (adjustable). Undervoltage shutdown shall occur when the output voltage of the alternator is less than 85%

(adjustable) for more than 10 seconds (adjustable). The system shall monitor individual phases and be connected line to neutral on three-phase 4-wire generator sets and for systems that are solidly grounded.

- H. A common fail contact for remote indication at the SCADA system shall be provided. Two auxiliary generator running contacts shall also be provided for remote indication at the SCADA System and to open the intake and exhaust dampers. All contacts shall be rated for 5 amps at 120 VAC.
- I. Generator control panel shall be mounted a maximum of 5 feet 6 inches above the finished floor. CONTRACTOR shall be responsible for all required coordination.

## 2.09 GENERATOR EMERGENCY SHUTDOWN PUSHBUTTON CONTROL STATION

- A. Furnish a red mushroom head, maintained-type pushbutton control station for manual initiation of a generator emergency shutdown. When the emergency stop pushbutton is pressed, the generator shall shut down and remain shut down until the emergency stop pushbutton is manually reset and the generator is called to run.
- B. The control station shall be labeled "Generator Emergency Shutdown."
- C. The control station shall be provided with a NEMA 12 enclosure and two sets of N.O. and N.C. contacts to monitor the signal at the generator.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. The standby power system shall be installed as shown on the Drawings and in accordance with the manufacturer's recommendations and all applicable codes.
- B. Installation of equipment shall include providing all interconnecting wiring between all major equipment provided for the on-site power system. CONTRACTOR shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.
- C. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site. All connections (e.g., fuel, water, electrical) to generator shall be made with flexible material/fitting to accommodate unit vibration.
- D. Equipment shall be initially started and operated by representatives of the manufacturer.
- E. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.
- F. Maximum generator height, including subbase fuel tank, exhaust piping, silencer, etc., shall be 6 feet 2 inches. CONTRACTOR shall be responsible for all required coordination.

### 3.02 FIELD START-UP AND COMMISSIONING

- A. Provide the services of a qualified factory-trained manufacturer's representative to assist CONTRACTOR in installation and start-up of the equipment specified in this section. The manufacturer's representative shall provide technical direction and assistance to CONTRACTOR in general operation of the equipment, connections and adjustments, and testing of the assembly and components contained therein.
- B. The manufacturer's representative shall provide inspection of the final installation. The manufacturer's representative shall perform site start-up and functional testing of the system. Upon completion of the manufacturer's start-up and testing, the manufacturer shall generate a Certificate of Proper Installation site start-up and test report, as specified in Section 01 91 00–Starting of Systems, documenting all systems checked, as well as any incomplete work remaining and operational deficiencies.
- C. CONTRACTOR shall provide a training session for up to three OWNER's representatives for one normal work day (not including start-up) at a job-site location determined by OWNER. The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of instruction on operation and testing of the assembly and major components within the assembly.
- D. CONTRACTOR shall provide three copies of the manufacturer's site start-up and test report to ENGINEER for review. Once ENGINEER has reviewed the report and all equipment is operating in accordance with the specifications, ENGINEER will make one site visit to check operation of the system. If the system is not ready or does not operate as specified, OWNER shall deduct payment to CONTRACTOR and make payment to ENGINEER for additional travel, expenses, and site visits until the equipment operates as specified. CONTRACTOR shall be responsible for all fuel, and electrical costs required to check operation of the system.

### 3.03 TESTING

- A. In addition to the standard factory tests, there shall be a 4-hour continuous load bank test at the jobsite before connection to load transfer switch, with loads from 10% to 100% of rated capacity to check voltage, frequency, fuel, air cooling, and ventilating systems so that they can be determined adequate for the application. This test shall be accomplished with a portable three-phase resistive load bank. All emergency warning and detection equipment shall be demonstrated to be operable by simulating failures. A signed test report shall be submitted to OWNER and ENGINEER with deficiencies noted, if any. After this test, the generator shall be connected to the site and the operation and maintenance of the unit comprehensively demonstrated to OWNER. Correct phasing between the engine-generator and station shall be checked so that it will handle load. A minimum of two power failures shall be simulated.
- B. In addition to the load bank test above, after the unit is connected to the system, three simulated outages and a 4-hour run period on the actual facility shall also be provided.
- C. CONTRACTOR shall be responsible for all fuel costs for these tests.

END OF SECTION

## SECTION 26 36 24

### SERVICE ENTRANCE-RATED AUTOMATIC TRANSFER SWITCHES

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Provide an automatic transfer switch where shown on the Drawings.
  - 2. The system shall be a completely integrated assembly for automatic, unattended operation and control of the standby power system. System operation shall be as described in the following sections.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.
- B. Shop drawings shall include the following:
  - 1. Detailed descriptions of equipment to be furnished, including all deviations from these specifications.
  - 2. Detailed layouts of all cubicles and equipment.
  - 3. The manufacturer shall furnish schematic and wiring diagrams for the automatic transfer switch and an interconnection wiring diagram for the entire standby system. Test reports certified by the manufacturer shall be provided to ENGINEER for the entire system.

##### 1.03 QUALITY ASSURANCE

- A. The transfer switch shall be listed by Underwriters Laboratories, Inc. and be approved by the Canadian Standards Association.

##### 1.04 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

#### PART 2–PRODUCTS

##### 2.01 ACCEPTABLE MANUFACTURERS

- A. The service entrance-rated automatic transfer switch shall be as manufactured by Cummins Power Generation CXT, ASCO 7000, 400-amp, 3 pole, or equal.

- B. The Drawings and Specifications were prepared based on Cummins Power Generation. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment. CONTRACTOR shall also pay additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.

## 2.02 SERVICE ENTRANCE-RATED AUTOMATIC TRANSFER SWITCHES

- A. One complete service entrance-rated automatic transfer switch shall be provided. Interlocked molded case circuit breakers or contactors are not acceptable. Service entrance-rated transfer switch shall consist of a molded case circuit breaker and an automatic transfer switch. Molded case circuit breaker shall be service entrance-rated, be 100% rated, and be located on the line side of the transfer switch. The circuit breaker shall be integral to the transfer switch and be UL 489 listed.
- B. For transfer switches with overcurrent protective device rated 1,200 amps or higher, provide an Energy Reduction Maintenance Switch (ERMS).
- C. The transfer switch shall be capable of switching all classes of load and shall be rated for continuous duty when installed in a nonventilated enclosure constructed in accordance with Underwriters Laboratories, Inc., Standard UL-1008. The transfer switch shall be provided with a NEMA 1 enclosure.
- D. Provide neutral landing lugs for all automatic transfer switches accepting utility service-entrance conductors. Neutral landing lugs shall be bonded to the ground bus at the utility service entrance, unless otherwise noted.

## 2.03 CONSTRUCTION AND PERFORMANCE

- A. The transfer switch shall be double-throw, actuated by a single electrical operator momentarily energized and connected to the transfer mechanism by a simple overcenter linkage, with a minimum transfer time of 400 milliseconds.
- B. The transfer switch shall have the ability to detect under and over-voltage, under and over-frequency, voltage imbalance, incorrect phase rotation, and phase loss.
- C. The time delay between the opening of the closed contacts and the closing of the open contacts shall allow for voltage decay before transfer.
- D. The transfer switch shall allow the motor and transformer loads to be reenergized after transfer with normal inrush current. The transfer switch shall be capable of transferring successfully in either direction with 70% of rated voltage applied to the switch terminals.
- E. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in position in both the normal and standby positions without the use of hooks, latches, magnets, or springs and shall be silver tungsten alloy. All contacts shall be 100% rated. Separate arcing contacts with magnetic blowouts shall be provided on all transfer switches.
- F. The transfer switch shall be equipped with a safe manual operator designed to prevent injury to operating personnel. The manual operator shall provide the same transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly.

- G. The transfer switch shall be equipped with a digital display that has the ability to monitor load power conditions, network status, review transfer switch events, and adjust transfer switch parameters. The display shall also include a bar graph display that indicates the level of power being supplied to the load as well as three-phase voltage, current, frequency, power factor, and kilowatts.

## 2.04 SEQUENCE OF OPERATION

- A. Engine starting contacts shall be provided to start the standby power source should the voltage of the normal source drop below 80% on any phase after an adjustable time delay of 0.5-3 seconds to allow for momentary dips. The transfer switch shall transfer to standby when 90% of rated voltage and frequency has been reached. After restoration of normal power on all phases to 90% of rated voltage, an adjustable time delay period of zero to 31 minutes shall delay retransfer to allow stabilization of normal power. If the standby power source should fail during this time delay period, the switch shall automatically return to the normal source. After retransfer to normal, the engine-generator shall be allowed to operate at no load for a period of 5 minutes. Two auxiliary contacts rated 25 amps, 120 volts shall be mounted on the main shaft; one closed on normal, the other closed on standby. All relays, timers, control wiring, and accessories shall be front accessible. In addition, one set of relay contacts shall be provided to open upon loss of the normal power supply. All control wire terminations are to be identified by tubular sleeve-type markers.
- B. The automatic transfer switch shall include the following functions. Adjustable time delays and features described below shall be operator adjustable from the front of the transfer switch, and shall not require the use of a laptop, software, or external programming device.
1. Time delay to override momentary normal source power outages to delay engine start signal and transfer switch operation. Adjustable 0.5 to 90 seconds.
  2. Time delay relays to control contact transition time on transfer to either source, adjustable 1 to 300 seconds (Programmed Transition).
  3. Time delay on retransfer to normal. Adjustable 0-31 minutes, with engine overrun to provide fixed 5-minute unloaded engine operation after retransfer to normal.
  4. Test with load-Auto-Test without load selector switch to simulate normal power failure. (Maintained Type).\*
  5. Contact to close on failure of normal source to initiate engine starting or other customer functions.
  6. Contact to open on failure of normal source to initiate engine starting or other customer functions.
  7. Green pilot light to indicate switch in normal position.\*
  8. Red pilot light to indicate switch in standby position.\*
  9. Auxiliary contact closed in normal position.
  10. Auxiliary contact closed in standby position.
  11. Adjustable relay to prevent transfer to standby until voltage and frequency of the standby power source have reached acceptable limits.
  12. Exerciser for the standby power source with 7-day time clock, multiple test schedules, and programmable exceptions for holidays, weekends, etc.

\* Front cabinet door mounted.

- C. When coordinated with circuit breakers, the automatic transfer switch shall have the following short circuit withstand capability:



| Withstand Capability (RMS Amps, Symmetrical) Testing at 480 VAC |                               |                                                   |
|-----------------------------------------------------------------|-------------------------------|---------------------------------------------------|
| Circuit Breaker Ampere Rating                                   | Transfer Switch Ampere Rating | ATS Coordinated with Molded Case Circuit Breakers |
| 400                                                             | 400                           | 65,000                                            |

- D. During the withstand tests, there shall be no contact welding or damage. The tests shall be performed on identical samples without the use of current limiting fuses. Oscillograph traces across the main contacts shall verify that contact separation has not occurred. These procedures shall be in accordance with UL 1008 and testing shall be certified by Underwriters Laboratories or any nationally-recognized independent testing laboratory.
- E. When conducting temperature rise tests to UL 1008, the manufacturer shall include post-endurance temperature rise tests to verify the ability of the transfer switch to carry full-rated current after completing the overload and endurance tests.
- F. As a precondition for approval, the manufacturer of the automatic transfer switch shall verify that their switches are listed by Underwriters Laboratories, Inc., Std. UL 1008 with withstand and close-in values at least equal to the interrupting rating of the circuit breaker and/or fuse that is specified to protect the circuit.

## PART 3–EXECUTION

### 3.01 INSTALLATION

- A. The installation of this system shall comply with the directions and recommendations of authorized factory representatives. These representatives shall offer the supervision necessary for proper installation.
- B. A final inspection and an initial start-up of the system shall be provided by the factory representatives.
- C. A Certificate of Proper Installation, as specified in Section 01 91 00–Starting of Systems, shall be provided by the authorized factory representatives which states that the system is properly installed and does properly function as recommended by the factory and as described herein shall be submitted to ENGINEER.
- D. A test run shall be performed by the authorized factory representatives in the presence of CONTRACTOR and ENGINEER or their representatives; the time of this test run shall be mutually agreed upon by all persons concerned.

### 3.02 STARTUP AND TRAINING

- A. CONTRACTOR shall include 8 hours of start-up by a certified, factory-trained engineer. Start-up services shall include, but not be limited to, inspection of CONTRACTOR installation and functional testing of the ATS assembly. On-site time shall be over-and-above the cost of travel and travel time to the site.
- B. CONTRACTOR shall provide a training session for up to three OWNER's representatives for one normal workday (not including start-up) at a job site location determined by OWNER. The training session shall be conducted by a manufacturer's qualified representative. The

training program shall consist of instruction on operation and testing of the assembly, simulated outages, and review of major components within the assembly.

END OF SECTION

## SECTION 26 43 13

### SURGE PROTECTIVE DEVICES (SPD)

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Service entrance devices.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. ANSI/IEEE C62.41 and C62.45.
- B. NFPA 70 and 75.
- C. UL 1449, most recent issue.

##### 1.03 QUALITY ASSURANCE

- A. Manufacturers of SPDs: Firms regularly engaged in the manufacture of these products of the types and ratings whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) and any and all local codes as applicable to construction and installation of electrical wiring devices, material, and equipment herein specified.
- D. UL Labels: Provide surge protective devices which have been listed and labeled by Underwriters Laboratories.
- E. NECA Standard: Comply with applicable portions of National Electrical Contractor's Association's "Standard of Installation."

##### 1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00—Submittals.
- B. Shop Drawings for Equipment Panels: Include wiring schematic diagram, wiring diagram, outline drawing, and construction diagram as described in ANSI/NEMA ICS 1. Test reports certified by the manufacturer shall be provided to ENGINEER upon request for each model submitted.

## 1.05 WARRANTIES

- A. Manufacturer shall provide a minimum 10-year warranty from the date of Substantial Completion to cover repair or replacement of the device.

## PART 2-PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

- A. The Drawings and Specifications were prepared based on MCG. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes to accommodate other equipment including, but not limited to, upsizing overcurrent protective devices to meet manufacturer recommendations. CONTRACTOR shall also pay additional costs necessary for revisions of Drawings and/or Specifications by ENGINEER.

### 2.02 GENERAL

- A. These specifications describe the electrical and mechanical requirements for high energy SPDs.
- B. The system individual units shall be UL listed under UL1449, latest edition, Standard for Surge Protective Devices (SPD). Surge ratings shall be permanently affixed to the SPD.
- C. Operating Temperature: Operating temperature range shall be -40 to +70°C (-40 to 158°F).
- D. Storage Temperature: Storage temperature range shall be -40 to +85°C.
- E. Relative Humidity: Operation shall be reliable in an environment with 0% to 95% noncondensing relative humidity.
- F. Operating Altitude: The system shall be capable of operation up to an altitude of 13,000 feet above sea level.
- G. Design Life: >15 years.
- H. Operating Voltage: Maximum continuous operating voltage shall be no less than 125% of the nominal rated line voltage.
- I. Power Frequency: SPD power frequency shall be rated for use on 50 and 60 Hertz power systems.
- J. All SPDs shall be MOV type. Noise filtering capabilities shall be provided as an option for the devices specified herein.

### 2.03 SERVICE ENTRANCE DEVICES

- A. The maximum surge current capacity of the specified system, based on the standard IEEE 8/20 microsecond waveform, shall be at least 160 kA per phase. The surge life for WYE models (8/20) shall be at least 10kA for 1,500 occurrences (Lx-N & Lx-G modes) and 30kA for 1,500 occurrences (N-G mode). The surge life for delta models (8/20) shall be at least 20kA for 1,500 occurrences (Lx-G modes) and 20kA for 1,500 occurrences

(Lx-Lx mode). The transient suppression capability shall be bidirectional and suppress both positive and negative impulses. SPD shall have a nominal discharge rating ( $I_n$ ) of 40 kA.

- B. The SPD shall have a minimum Short Circuit Rating (SCCR) of 200 KAIC. The interrupt capability must be confirmed and documented by a recognized independent testing laboratory.
- C. The suppressor shall be designed so as to minimize the internal surge path impedance. Direct point-to-point internal wiring is inherently inductive and not acceptable. Connection to the power service shall be constructed as shown in the manufacturer's installation notes for best performance.
- D. The system shall be constructed using field replaceable plug-in modules. The module shall consist of multiple fuse protected metal oxide varistors. The status of each module shall be locally monitored with a red LED that will illuminate if the module protection is reduced. Protector shall provide redundant protection within each phase module with multiple surge rated fuses per module or one fuse per MOV.
- E. Red and green solid-state LED indicators shall be provided on the hinged front cover to indicate protection status. An illuminated green LED indicates power is present at the protector on all phases, and an illuminated red LED shall indicate that one or more of the modules have reduced protection. Both front panel and internal LEDs are required to provide power and fault indications. Relay operation shall be in a failsafe operating mode, i.e., continuously energized so that power failure, reduced protection, or a break in the remote monitoring line will cause a fault indication at the remote monitor. Neon indicators are not permitted.
- F. Relay alarm contacts shall be provided for remote alarm monitoring capability of unit status. Surge protected normally open and normally closed contacts shall be provided.
- G. The system shall be equipped with an audible alarm which shall be activated when any one or more of the modules has a reduced protection condition. A mute switch shall be provided for the audible alarm.
- H. The SPD shall provide effective energy surge diversion for application in ANSI/IEEE C62.41-2002 location Category C3 environments. Testing shall be per ANSI/IEEE C62.45-2002 using ANSI/IEEE C62.41 Category C3 waveforms and amplitudes.
- I. A NEMA 4 powder-coated steel enclosure with corrosion-resistant hardware shall be provided for the unit. Unless otherwise noted, SPDs installed within distribution or control equipment enclosures do not require a separate enclosure.
- J. Service entrance devices shall be as manufactured by MCG 160M Series, Square D EMA/IMA Series, Eaton SPD Series, or equal.
- K. SPD shall be suitable for use in Type 2 locations.
- L. Unit shall provide maximum ANSI/UL 1449 VPRs for 480Y/277-volt, three-phase systems.
  - 1. L-N = 1200 V.
  - 2. L-G = 1200 V.
  - 3. N-G = 1000 V.
  - 4. L-L = 2000 V.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. The installation and testing of the system shall be in full accordance with the manufacturer's installation and maintenance instructions and all national and local codes.
- B. Each installed device shall be fed by an appropriately sized circuit breaker, per the manufacturer's installation notes, in the protected panel. No SPD shall be installed without an upstream overcurrent device.
- C. Units shall be installed as close as practical to the electrical panel. Low impedance cabling furnished by the manufacturer shall be utilized for installations with lead lengths greater than, or equal to, 5 feet. Low impedance cabling furnished by the manufacturer or appropriately-sized standard cable, if acceptable to ENGINEER, may be utilized for installations with lead lengths less than 5 feet. SPD leads shall be as short as possible.

END OF SECTION

## SECTION 26 51 13

### LIGHTING

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work includes a complete functional lighting system.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. Underwriters Laboratories: Lighting fixtures shall be manufactured in accordance with the standards of the Underwriters Testing Laboratories and shall bear the UL label where practicable. In all cases the lighting fixtures shall be constructed with UL listed components.
- B. Applicable Codes: Fixtures shall be made and installed in accordance with the current version of the National Electrical Code, the Uniform Building Code, the Federal Occupational Safety & Health Act, and other applicable regulations.
- C. Code Compliance: Comply with National Electrical Code (NFPA 70) as applicable to construction and installation of electrical equipment, cable, wire, and connectors.
- D. NEMA/ANSI Compliance: Comply with National Electrical Manufacturers Association, American National Standards Institute, and other standards pertaining to material and construction and testing where applicable.
- E. Lighting Standards:
  - 1. LM-79-08 or latest—IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
  - 2. LM-80-08 or latest—IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
  - 3. NEMA SSL 1-2016 or latest—Electronic Drivers for LED Devices, Arrays, or Systems.
- F. Fire Codes: Where necessary to meet Code requirements, enclosure housings shall be constructed to provide a 1-hour fire rating.

##### 1.03 SYSTEM DESCRIPTION

- A. Intent: It is the intent of these specifications to obtain a completed lighting fixture and lighting controls installation by CONTRACTOR. Completed means cleaned, adjusted, tested, and ready for occupancy and operation in accordance with the above-indexed paragraphs and in accordance with the other sections of these Contract Documents. It is the responsibility of CONTRACTOR to point out discrepancies, errors, and other problems.
- B. All lighting fixtures are to be provided complete with all necessary accessories for a proper installation. Catalog numbers shown are basic fixture types, and additional features, accessories, and options specified, scheduled or required, are to be included for all fixtures provided.

#### 1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals. Shop drawings shall include, but not be limited to, the following:
  - 1. Manufacturer's dimensioned scale drawings showing in complete detail the fabrication of all lighting fixtures including overall and detail dimensions, finishes, prefinishes, metal thickness, fabrication methods, support method, ballasts, drivers, sockets, type of shielding, reflectors, wiring sizes and insulation types, lenses, provisions for relamping, and all other information to show compliance with the Contract Documents.
  - 2. Installation instructions.
  - 3. Certified photometric test data and reports.
  - 4. Shop drawings shall not only clearly indicate the assigned fixture type, but also the equipment location.
  - 5. Submittal should include, but not be limited to, wattage, lumen output, color temperature, and CRI value.

#### 1.05 QUALITY ASSURANCE

- A. Standards: Materials, equipment, and parts, as well as workmanship provided under this section, shall conform to the highest commercial standard as specified and as indicated on Drawings. Fixture parts and components not specifically identified or indicated shall use materials most appropriate to their intended use or function and as such be resistant to corrosion and thermal mechanical stresses encountered in the normal application and function of the fixtures.
- B. Measuring and Testing Equipment: CONTRACTOR shall have available at all times, instruments for the measurement of voltage, luminaire temperature, lighting level, and fixture brightness level.
- C. Manufacturers: Firms regularly engaged in the manufacture of lighting fixtures of the types and ratings for the project, whose products have been in satisfactory use in similar service for not less than 5 years.
- D. Installer: A firm with at least 5 years of successful installation experience on projects with electrical wiring installation work similar to that in this project.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Luminaires and lighting equipment shall be delivered to the project complete, including mounting devices and components necessary for the proper operation of the equipment.
- B. Marking: All equipment must be clearly and boldly identified as to the fixture type and, where practicable, the fixture location.
- C. Timely Purchasing: Luminaires and other appurtenances shall be ordered in a timely fashion and securely stored to be available to meet the project schedule.

#### 1.07 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year



from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

## PART 2-PRODUCTS

### 2.01 LED LUMINAIRES

- A. LED Luminaires shall meet the following technical requirements:
  - 1. Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.
  - 2. Luminaire efficacy shall match or exceed that of the fixture model numbers shown in the fixture schedule on the Drawings.
  - 3. Luminaire Color Rendering Index (CRI) shall match or exceed that of the fixture model numbers shown in the fixture schedule on the Drawings; a minimum of 80 for interior luminaires and a minimum of 70 for exterior luminaires.
  - 4. Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.
  - 5. Luminaire lumen output shall match or exceed that of the fixture model numbers shown in the fixture schedule on the Drawings.
  - 6. Wattage shall be equal to that of the fixture model numbers shown in the fixture schedule on the Drawings.
  - 7. Luminaire color temperature shall match that of the fixture model numbers shown in the fixture schedule on the Drawings.
- B. Luminaire shall be mercury-free, lead-free, and RoHS compliant.
- C. Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.
- D. Lumen output shall not depreciate more than 20% after 10,000 hours of use.
- E. Luminaire and driver shall be provided from a single manufacturer to promote compatibility.
- F. Luminaire shall operate normally for input voltage fluctuations of plus or minus 10%.
- G. Luminaire shall have a maximum Total Harmonic Distortion (THD) of  $\leq 20\%$  at full input power and across specified voltage range.

### 2.02 WIRING

- A. All wiring within lighting fixtures or from the splice with the building wiring shall be as specified in Section 26 05 19-Wire.
- B. Wiring within fixture construction shall be concealed, except where the fixture design or mounting dictates otherwise.
- C. Wiring channels and wireways shall be free from projections and rough or sharp edges throughout and all points or edges over which conductors must pass and may be subject to injury or wear.
- D. Insulated bushings shall be installed at points of entrance and exit of flexible wiring.

## 2.03 LED DRIVERS

### A. General:

1. Provide driver type (non-dimmed, step-dimmed, continuous-dimming, etc.) as indicated in the model numbers in the fixture schedule shown on the Drawings.
2. Driver shall have a minimum rated life of 50,000 hours.
3. Driver shall have a minimum power factor of 0.9 and a maximum crest factor of 1.5 at full input power and across the specified voltage range.
4. Driver shall operate normally for input voltage fluctuations of plus or minus 10 percent.
5. Driver shall have a maximum Total Harmonic Distortion (THD) of  $\leq 20\%$  at full input power and across specified voltage range.
6. Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.
7. Fuse Protection: All luminaires shall have built-in fuse protection. All power supply outputs shall be either fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected per Class 2 UL listing.
8. All fixtures located outdoors shall be provided with surge protection.

## 2.04 MARKING OF FIXTURES

- ### A. Voltage Identification:
- Fixtures designed for voltages other than 110- to 125-volt circuits shall be clearly marked.

## 2.05 EMERGENCY LIGHTING UNINTERRUPTIBLE POWER SUPPLIES (UPS)

- ### A. UPS input shall be 120/277 VAC, 60 Hz, three-wire (Switched Hot, Common, Unswitched Hot) plus ground. Input shall be protected by PCB-mounted, fast-acting fuses sized for UPS load.
- ### B. UPS output shall be 120/277 VAC, 60 Hz, two-wire plus ground, suitable for use with fluorescent, LED, and incandescent fixtures.
- ### C. UPS battery shall be sealed lead calcium. Battery shall be sized appropriately to provide 90 minutes of run time for 91% of rated output lumens.
- ### D. Provide sonic audible alarm option.
- ### E. UPS shall be rated for use in ambient conditions of 68°F to 86°F.
- ### F. UPS output rating shall be minimum 375 watts.
- ### G. UPS shall be equipped with self-diagnostic circuitry. Circuitry shall check different operating parameters during initial start-up, normal standby, and diagnostic stages. If a fault is detected, the fault indicator shall flash to alert maintenance personnel.
- ### H. UPS shall automatically initiate a diagnostic cycle every 28 days to test emergency operation. The self-diagnostic circuitry shall not utilize the lighting load (i.e., the emergency fixture(s)) to cycle and test the unit battery. Instead, a built-in resistive load shall be used, thereby eliminating emergency fixture illumination during diagnostic testing.
- ### I. UPS shall monitor the reference voltage from the line (unswitched) side of the control device. In the event the reference voltage is lost the UPS shall power the emergency fixture(s) regardless of control device position.

- J. UPS shall be capable of being mounted a maximum of 1,000 feet from the emergency fixtures.
- K. UPS shall be UL 924 listed.
- L. Inverter module and battery module shall be housed in a NEMA 1 enclosure.
- M. Three-year warranty on all UPS components shall be included (except batteries).
- N. UPS shall be Isolite Model E3, or equal.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Install fixtures, lenses, etc., after building is enclosed, weathertight, and environmental conditions are nominally the same as expected for the complete spaces. All lamps, glassware, reflectors, and refractors shall be clean and free of chips, cracks, and scratches.
- B. All wall-mounted fixtures and all ceiling-mounted surface fixtures including exit lights, shall be fed through a fixture Stud/Hickey/Nipple assembly and with provisions to prevent fixture turning.
- C. All exterior wall-mounted fixtures shown over doorways shall be mounted centered, 6 inches above doorway, unless otherwise noted.
- D. All fixtures shall be securely and adequately supported and installed.
- E. Surface-mounted fixtures shall be attached to and supported from structural part of the building in a manner acceptable to ENGINEER. Fixtures shall be supported by not fewer than two supports for each fixture. Where fixtures are to be suspended, they shall be mounted on steel channel with the channel supported directly from the structure by a minimum of 3/8-inch rod inside rigid conduit stems. Any fixture which has an individual fixture weight of greater than 25 pounds shall have safety cable installed, in addition to other support means. Cable shall be 3/16-inch airplane cable. All fittings and connectors shall be compression type. Cables must be secured to the building structure and to a point or points on the fixture to protect against falling parts.
- F. Industrial-type fixtures in unfinished areas which are near obstructions such as ducts and pipes shall be suspended so that the bottom of the fixture is no higher than the bottom of the obstruction. All fixtures in each room shall be located at the height of the lowest fixture, but not lower than 8 feet 0 inch above the finished floor. Fixtures shall not be located until the locations of these obstructions are determined, and fixtures shall be accessible after the installation of other equipment.
- G. Metal decking shall not be pierced for fixture support.
- H. All fixture whips shall be constructed of minimum No. 12 AWG conductors.

### 3.02 SUPPORTS

- A. CONTRACTOR Responsibility: CONTRACTOR shall verify all ceiling conditions from the Drawings and provide appropriate mounting accessories for each lighting fixture.
- B. Adequate rigid, sturdy support shall be provided to prevent the possibility of fixture falling. Surface fixtures must be supported with two supports per 4-foot section. All pendants must have swivel aligners located at the top ends; pendants shall be minimum 3/8-inch threaded rod inside 3/4-inch rigid steel conduit, unless specifically indicated otherwise on the Drawings, pendant supports shall be painted on jobsite. Support surface-mounted fixtures from structural members other than ceiling tees by providing Unistrut members spanning main ceiling tees or by mounting directly to structure.

### 3.03 ADJUSTMENT

- A. Focusing/Adjustment: After the installation of lighting fixtures is completed, fixtures so requiring (both interior and exterior units), shall be adjusted after dark under the observation of OWNER.

### 3.04 CLEANING

- A. Before final acceptance by OWNER, all protective (strippable) coatings, dust, finger marks, paint spots, and any other materials deleterious to the appearance or functioning of the lighting fixtures must be removed. Abrasive cleaners are not permitted.

### 3.05 FINAL INSPECTION

- A. Upon completion of the installation, lighting equipment must be in first-class operating order and free from defects in condition and finish:
  - 1. Fixtures shall be completely clean and free from finger marks, dust, plaster, or paint spots.
  - 2. Any reflectors, lenses, diffusers, side panels, or other parts damaged prior to the final inspection, shall be replaced at no expense to OWNER.
  - 3. Housing shall be rigidly installed and adjusted to a neat flush fit with the ceiling.

END OF SECTION

## SECTION 28 46 00

### FIRE ALARM SYSTEM

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work includes providing all labor, equipment, materials, and performance of all operations associated with the installation of the Fire Alarm System as shown on the Drawings and as specified herein to meet the requirements of a complete Fire Alarm System.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. NFPA 72 National Fire Alarm Code.
- B. NFPA 70 National Electrical Code.
- C. ADA.
- D. Underwriters Laboratories.
- E. NFPA 101 Life Safety Code.
- F. NFPA 90.
- G. International Building Code.
- H. International Fire Code.
- I. International Mechanical Code.

##### 1.03 SCOPE

- A. Provide a complete Fire Alarm System. The system shall be UL listed, cross-listed, and compatible for use with individual zone supervision, individual NAC supervision, and incoming and standby power supervision. The project includes providing a system which includes fire alarm control panels, communicators and antennas, manual stations, smoke detectors, audible/visual devices, visual only devices, all wiring, connections to devices, outlet boxes, junction boxes, and all other necessary material for a complete operating system.

##### 1.04 QUALITY ASSURANCE

- A. System Supplier shall be a nationally-recognized company specializing in fire alarm systems. This organization shall employ factory-trained and NICET-certified technicians, and shall maintain a service organization within 100 miles of this project location. The

System Supplier and service organization shall have a minimum of 10 years' experience in the fire protective signaling systems industry.

- B. The System Supplier shall provide the final checkout, contractual service, and testing.
- C. The complete installation shall conform to the applicable sections of NFPA-72, NFPA-101 Local Code Requirements and National Electrical Code.
- D. All items of the complete Fire Alarm System shall be listed as a product of a single fire alarm system manufacturer unless the primary equipment provider or manufacturer provides written documentation of compatibility, and assumes responsibility for compatibility with the control equipment.
- E. All items of the complete Fire Alarm System shall be listed under the appropriate category by Underwriters Laboratories, Inc. (UL), and shall bear the UL label.

#### 1.05 MANUFACTURER PROVIDED SERVICES

- A. A manufacturer-trained service technician shall provide the following installation supervision. This technician shall be certified by the equipment manufacturer and shall have a minimum of two years of service experience in the fire alarm industry.
- B. The technician's name shall appear on equipment submittals and a letter of certification from the fire alarm manufacturer shall be sent to ENGINEER. The manufacturer's service technician shall be responsible for the following items:
  - 1. Pre installation visit to the job site to review equipment submittals and verify method by which the system should be wired.
  - 2. Periodic job site visits to verify installation and wiring of system, and to perform any partial system programming required to permit portions of the existing system to be removed.
  - 3. Upon completion of wiring, final connections shall be made under the supervision of this technician, and final checkout and certification of the system.
  - 4. At the time of final checkout, technician shall give operational instructions to OWNER and/or its representative on the system.
  - 5. All job site visits shall be dated and documented in writing and signed by the Division 26 Contractor. Any discrepancy shall be noted on this document and a copy kept in the system job folder that shall be available to ENGINEER any time during the project.

#### 1.06 QUALIFICATIONS

- A. All equipment shall be supplied by a firm, which specializes in fire alarm and smoke detection systems with a minimum of five years-documented experience. The company shall be an authorized distributor of the proposed equipment.
- B. All work shall be performed by a licensed contractor, who is regularly engaged in the installation and servicing of fire alarm systems.

#### 1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING REQUIREMENTS

- A. Receive equipment at job site; verify applicable components and quantity delivered.

- B. Handle equipment to prevent internal components' damage and breakage, as well as denting and scoring of enclosure finish.
- C. Do not install damaged equipment.
- D. Store equipment in a clean, dry space and protect from dirt, fumes, water, and construction debris and physical damage. Make arrangements with OWNER at the pre-construction conference for storage of equipment on the premises.

#### 1.08 SUBMITTALS

- A. Submit shop drawings and product data sheets in accordance with provisions of Section 01 33 00–Submittals.
- B. Submittals shall be sent to and approved by the authority having jurisdiction prior to submitting to ENGINEER. Include copy of approval letters in submittal to ENGINEER.
- C. Provide wiring diagrams, equipment ratings, dimensions, and finishes for all proposed devices and equipment.
- D. Provide battery calculations to indicate both the Standby and Alarm loads because of various field devices and panel components/module. Battery calculations shall illustrate the minimum battery capacity required and the capacity actually provided. Battery shall contain date of installation and not the manufactured date.
- E. Provide a complete site-specific Fire Alarm System plan and riser diagram including: Point of origin of each circuit (usually a Panel, or a Module within a panel), circuit type and labeling, area served by each circuit, wire/cable type and size, locations of panelboards where primary system power is obtained and the device type circuit(s) to which device is connected, and locations of any End-Of-Line Resistor for each field device. Include room name and number for each device.
- F. Provide “worst-case” notification appliance circuit voltage drop calculation.

#### 1.09 RECORD DRAWINGS

- A. Record Drawings shall include the location of all Fire Alarm System devices with their respective labels and the location of all end-of-line device locations.
- B. Upon completion of the work, and final acceptance by the local authority, CONTRACTOR shall submit Record Drawings to OWNER and ENGINEER under the provisions of Division 01.
- C. CONTRACTOR shall submit a copy of the Fire Alarm System; Record of Completion documentation to OWNER, ENGINEER, and authority having jurisdiction. Included with the Record of Completion documentation shall be a copy of final acceptance testing results.
- D. Record Drawings shall be provided to OWNER in electronic PDF format on a USB flash drive, along with the site-specific fire alarm system program.

## 1.10 OPERATION AND MAINTENANCE DATA

- A. Submit Manufacturer data sheets for all equipment installed.
- B. Include operating, installation, and routine maintenance instructions.
- C. Submit a record copy of site-specific computer software for software-based Fire Alarm Systems.
- D. Include manufacturer letter stating the date of installation on which the system is operational.
- E. Operating instructions shall be mounted in a frame next to the FACP.

## 1.11 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

## PART 2-PRODUCTS

### 2.01 SYSTEM DESCRIPTION

- A. Fire Alarm System: Provide a complete, supervised, power-limited, fire detection and evacuation system.
- B. System Supervision: The fire protective signaling system shall be an electrically-supervised, power-limited system which shall monitor the integrity of circuit conductors and power supplies.
- C. Central Monitoring: Fire alarm system shall be remotely supervised by an OWNER-designated recognized agency. CONTRACTOR shall coordinate with OWNER's Existing Monitoring Agency (Per Mar Security Services, Joshua Sanftner, Office: (608) 237-9687, Cell: (408) 687-9310) for setting up remote monitoring of the new fire alarm control panel. The new fire alarm system shall be interfaced to the following systems utilizing dialer connection, for remote reporting of the various conditions listed below:
  - 1. To an Off-Site Commercial Supervising Station: See below for required relay outputs.
  - 2. The interface between the reporting system(s) listed above and the new fire alarm system shall be configured as follows.
    - a. Required relay (contact) outputs:
      - (1) Fire Alarm: This contact shall actuate in response to any fire alarm status condition, other than sprinkler water flow.
      - (2) Water Flow Alarm: This contact shall actuate only in response to fire alarm status conditions, which are due to sprinkler water flow.
      - (3) Supervisory: This contact shall actuate in response to actuation of any initiating device programed as "supervisory."
      - (4) System Trouble: This contact shall actuate in response to the occurrence of any trouble status condition on the fire alarm system.



- b. CONTRACTOR shall be responsible for coordination of the fire alarm system connections to these system(s), for all wiring and conduit between these system(s), and for all terminations at the fire alarm system end of such interface wiring. All such wiring, raceway, and terminations shall be included in the Base Bid.

## 2.02 ENCLOSURES

- A. All panels and peripheral devices shall be the standard product of a single manufacturer and shall display the manufacturer's name on each component.
- B. Provide cabinets of sufficient size to accommodate the aforementioned equipment.
- C. Cabinet shall be equipped with locks and transparent door panel providing tamperproof enclosure, yet allowing full view of the various lights and controls as required.

## 2.03 INTELLIGENT FIRE ALARM CONTROL PANEL (FACP)

- A. Intelligent FACP shall be installed where shown on the Drawings.
- B. FACP shall be UL 864 listed, latest edition, manufactured by Fire-Lite, Gamewell, Silent Knight, or equal.
- C. The FACP shall allow for loading or editing special instructions and operating sequences as required. The system shall be capable of on-site programming to accommodate facility expansion, building parameter changes, or changes as required by local codes. All software operations shall be stored in a nonvolatile, programmable memory within the FACP. Loss of power shall not erase the instructions stored in memory.
- D. To accommodate and facilitate jobsite changes, initiation circuits shall be individually configurable on-site to provide either alarm/trouble operation, alarm only, trouble only, current limited alarm, no alarm, normally closed device monitoring, a nonlatching circuit, or an alarm verification circuit.
- E. FACP shall be modular, expandable with solid-state, microprocessor-based electronics. It shall display through the front viewing window only those primary controls and displays essential to operation during a fire alarm condition.
- F. The FACP shall meet the following requirements:
  - 1. Support intelligent detection devices.
  - 2. The number of initiating device loops required for the specified quantity of initiating devices, plus one spare loop for each five active loops. Each active loop shall include 5% spare capacity.
  - 3. The number of indicating appliance (speakers) circuits required for the specified quantity speakers, plus one spare circuit for each ten active circuits. Each active circuit shall include 25% spare capacity.
  - 4. The number of indicating appliance (strobe) circuits required for the specified quantity of strobes, plus one spare circuit for each ten active circuits. Each active circuit shall include 25% spare capacity.
  - 5. Printer interface.
  - 6. History log file with a minimum of 1,000 events.
  - 7. Field programmable.
  - 8. Drift compensation.

9. Sensitivity display in percent.
  10. Sensitivity adjustment.
  11. Day/night sensitivity adjustment.
  12. Auto detector test to meet NFPA 72.
  13. Alarm verification with tally counter.
  14. Silent walk test.
  15. Maintenance alerts.
  16. AC fail delay.
- G. The FACP shall provide the ability to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history.
- H. The FACP LCD shall have the capability of displaying the following information relative to the abnormal condition of a point in the system prior to acknowledgement:
1. 40 characters for:
    - a. Point address and loop number (e.g., 555-L5).
    - b. Type of device (e.g., smoke, pull station, water flow).
    - c. Point status (e.g., alarm, trouble).
  2. 40 characters for: Custom location label (e.g., 4th Floor–Room 444).
- I. FACP keyboards or keypads shall not be required to operate the system during fire alarm conditions.
- J. FACP shall have the following software functions:
1. Setting of time and date.
  2. LED testing.
  3. Alarm, trouble, and abnormal condition listing.
  4. Enabling and disabling of each monitor point separately.
  5. Activation and deactivation of each control point separately.
  6. Changing operator access levels.
  7. Walk Test enable.
  8. Running diagnostic functions.
  9. Displaying historical logs.
  10. Point listing.
- K. FACP shall have the following hardware functions:
1. Acknowledge alarm or trouble.
  2. Silence alarm or trouble.
  3. Reset system after alarm.
  4. Connect/disconnect fire department tie.
  5. Provide manual evacuation (drill).
  6. Supervise system.
  7. Allow computer interface.
- L. FACP shall have the following status indicators and displays:
1. Local audible device shall sound during alarm, trouble, or supervisory conditions. This audible device shall also sound during each key-press to provide an audible feedback when the key has been pressed properly. The visual display shall distinguish between alarm, trouble and supervisory conditions.
  2. The following indicators and displays shall be visible through the front viewing window:
    - a. One red system alarm LED.
    - b. One yellow supervisory service LED.

- c. One yellow trouble LED.
  - d. Green "power on" LED.
  - e. Liquid crystal display.
- 3. The liquid crystal display shall be backlit. It shall not be lit during an AC power failure unless an alarm condition occurs or there is keypad activity.
- 4. The following status data shall be available on this display:
  - a. Initiating device circuits.
  - b. Indicating appliance circuits.
  - c. Auxiliary relays.
  - d. Feedback points.
  - e. Primary state of point.
  - f. Zone information.
  - g. Class "A" status.
  - h. Current priority of outputs.
  - i. Disable/Enable status.
  - j. Verification tallies of initiating devices.
  - k. Automatic/Manual control status of output points.
  - l. Acknowledge status.
- M. Controls:
  - 1. The following controls shall be visible through the front viewing window:
    - a. Alarm Acknowledge key.
    - b. Trouble Acknowledge key.
    - c. Alarm Silence key.
    - d. System Reset key.
  - 2. The following controls shall be accessible with the front door open, though not visible, through the front viewing window:
    - a. Supervising Station disconnect/switch.
    - b. Manual evacuation (drill).
    - c. Key pad for data input and microprocessor control.
- N. FACP shall have the capability of supervising all slave modules LEDs for burnout or disarrangement.
- O. Acknowledgement:
  - 1. All events shall have a global acknowledgement.
  - 2. Acknowledge one event at a time from an unacknowledged list of events.
  - 3. After all points have been acknowledged, the LEDs shall glow steadily and the horn shall be silenced. The total number of alarms, supervisory, and trouble conditions shall be displayed along with a prompt to review each list chronologically. The end of the list shall be indicated by an end of list message "END OF LIST."
  - 4. Systems not capable of password-protected manual command operations shall provide key-operated switches for these functions. Function key switches shall be keyed differently from any other keyed switches or locks used within the system.
  - 5. All acknowledge functions shall be behind locked door or pass-code protected. In pass-code protection, if the user has insufficient privilege to acknowledge such conditions, a message shall indicate insufficient privilege, but allow the user to view the points without acknowledging them. Should the user have sufficient privilege to acknowledge, a message shall be displayed informing the user that the condition has been acknowledged.

- P. Silencing:
1. If an alarm condition exists and the "Alarm Silence" button is pressed, all alarm signals shall cease operation. The strobes shall remain active until the system is reset.
  2. If trouble conditions exist in the system and the "Trouble Silence" button has been pressed, the audible trouble signal shall cease, but shall resound at time intervals to act as a reminder that the fire alarm system is not in a normal operating mode. Both the time interval and the trouble reminder signal shall be programmable to suit OWNER's application.
  3. Panel shall be equipped with an alarm silence inhibit function.
- Q. Reset:
1. The system reset button shall be used to return the system to its normal state after an alarm condition has been remedied. The display shall step the user through the reset process.
  2. Should an alarm condition continue to exist, the system shall provide indications that resetting cannot be completed and shall remain in an abnormal state. The horn and the Alarm LED shall remain activated. The display shall indicate the total number of alarms and troubles present in the system along with a prompt to use the acknowledge keys to review the points. These points shall not require acknowledgment if they were previously acknowledged.
- R. Access Levels:
1. There shall be multiple access levels. The lowest access level actions shall not require a passcode. Changes to passcodes shall only be made by authorized personnel.
  2. When a correct passcode is entered, the system shall indicate "Access Granted" to the operator. The new access level shall be in effect until the operator manually logs out or the keypad has been inactive for 5 minutes.
  3. Operator entering an invalid code shall be notified with the message "Incorrect Pass-Code" and shall be allowed up to three chances to enter a valid code. After three unsuccessful tries, the message "Access Denied" shall be displayed. The level shall not be altered, and the operator shall no longer be in the menu option.
  4. Access to a level shall allow the operator to perform all actions within that level plus all actions of lower levels but no actions of higher levels.
  5. The following keys/switches shall have access levels associated with them:
    - a. Alarm Silence.
    - b. System Reset.
    - c. Set Time/Date.
    - d. Manual Control.
    - e. On/Off/Auto Control.
    - f. Disable/Enable.
    - g. Programming functions.
    - h. Clear Historical Alarm Log.
    - i. Clear Historical Trouble Log.
    - j. Walk Test.
    - k. Change Alarm Verification.
  6. Acknowledge keys shall also require privileged access to acknowledge points. If the operator presses an acknowledge key with insufficient access, an error message shall be displayed. The points shall scroll with acknowledge key presses to view the points on the list, but the points shall not get acknowledged in the database.
- S. For maintenance purposes, the following lists shall be available from the point lists menu:
1. All points list by address.

2. Monitor point list.
3. Signal/speaker list.
4. Auxiliary control list.
5. Feedback point list.

T. History Logging:

1. The system shall be capable of logging and storing the last 400 events (alarm and trouble) in a history log. These events shall be stored in a battery-protected random access memory. Each recorded event shall include the time and date of that event's occurrence. Systems not having discrete alarm and trouble logging memory shall include an alternative supervised (e.g., USB drive) historic recording method with battery backup. Real time and date shall accompany all history event recording.
2. History logs shall be capable of being viewed separately or shall be selectable for viewing as a combined history log that displays both alarm and trouble events in chronological order.
3. The following historical alarm log events shall be stored:
  - a. Alarms.
  - b. Alarm Acknowledgment.
  - c. Alarm Silence.
  - d. System Reset.
  - e. Alarm Historical log cleared.
4. The following historical trouble log events shall be stored:
  - a. Trouble conditions.
  - b. Supervisory alarms.
  - c. Trouble acknowledgment.
  - d. Supervisory acknowledgment.
  - e. Alarm Verification tallies.
  - f. Walk Test results.
  - g. Trouble Historical log cleared.

U. FACP shall have Silent Walk Test Function with History Logging:

1. The system shall be capable of being tested by one person.
2. The panel shall have the capability of dividing the system into distinctive walk test groups, a minimum of 8 groups.
3. Should an alarm condition occur from an active point, not in walk test mode, it shall perform operations described above.
4. After testing is considered complete, testing data may be retrieved from the system in chronological order to verify device/circuit activation.

V. Computer Interface:

1. The FACP shall operate as a proprietary local system with the capability of sending status data to and receiving control data from a Central Processing Unit (CPU) at the central reporting stations.
2. The CPU shall monitor all alarms and troubles and shall control selected functions of each FACP.
3. The CPU shall supervise all data communication wiring between the CPU and FACP for opens, shorts, and grounds.

W. Field Programming:

1. The system shall be fully programmable, configurable, and expandable in the field without the need for special tools or PROM programmers and shall not require replacement of memory ICs. All programming may be accomplished through the

standard control panel keyboard, or a keyboard at the printer, or the use of a PC. All programs shall be stored in nonvolatile memory.

2. All programming or reprogramming shall be done by the supplier at no charge until the system is accepted by OWNER.

X. Terminal/Printer Interface:

1. FACP shall be capable of operating remote monitors and/or printers.
2. The output shall be ASCII from an EIA RS-232-C connection with an adjustable baud rate.
3. Each RS-232-C port shall be capable of supporting and supervising up to four remote LCDs and Printers.
4. Data amplifiers shall be used to increase LCD or printer line distance, if required.
5. Each RS-232-C port shall only communicate with one keyboard. The FACP shall support up to five RS-232-C ports.

Y. Intelligent Network:

1. The system shall provide communications with intelligent initiating and control devices individually. These devices shall be individually annunciated at the control panel. Annunciation shall include the following conditions for each point:
  - a. Alarm.
  - b. Trouble.
  - c. Open.
  - d. Short.
  - e. Device missing/failed.
2. All intelligent devices shall have the capability of being disabled or enabled individually.
3. There shall be no limit to the number of detectors, stations, or addressable modules which may be activated or "in alarm" simultaneously.
4. Multiple intelligent devices shall be connected to a single pair of wires. Systems that require factory preprogramming to add or delete devices are unacceptable.
5. The communication format shall be a completely digital poll/response protocol to allow T-tapping of the circuit wiring. A high degree of communication reliability shall be obtained by using parity data bit error checking routines for address codes and check sum routines for the data transmission portion of the protocol. Systems that do not utilize full digital transmission protocol are not acceptable.

- Z. The FACP shall provide a minimum of 6 amps for notification appliances and auxiliary devices. Provisions shall be available to provide additional signal expansion.

## 2.04 INTELLIGENT PERIPHERAL DEVICES

- A. All devices shall be supervised for trouble conditions. The system control panel shall be capable of displaying the type of trouble condition (open, short, device missing/failed). Failure of a device shall not hinder the operation of other system devices.

## 2.05 DEVICE IDENTIFICATION

- A. Each intelligent device shall be uniquely identified by an address code entered on each device at time of installation. The use of jumpers to set address shall not be acceptable. This address, along with the loop number, shall be indicated and be visible from the ground on the device in the field using machine-generated marking.

- B. Location of the end-of-line (EOL) device shall be indicated on the fire alarm system device containing the EOL device.
- C. Device identification schemes that do not use uniquely set addresses, but rely on electrical position along the communication channel are unacceptable. These systems cannot accommodate T-tapping, and the addition of an intelligent device between existing devices requires reprogramming all existing devices beyond the added device.
- D. The system shall verify that the proper type device is in place and matches the desired software configuration.

## 2.06 INTELLIGENT DETECTOR BASES

- A. Either the base or the head shall contain electronic circuits that communicate the detector's status (normal, alarm, sensitivity status, trouble, etc.) to the control panel over two wires. The same two wires shall also provide power to the base and detector.
- B. The base shall be lockable. The locking feature shall be field-removable when not required.
- C. Upon removal of the detector's head, a trouble signal shall be transmitted to the control panel.
- D. The detector base shall be sealed against rear airflow entry.
- E. Each detector's base or head shall contain LED(s) which shall flash when the detector is being scanned by the control panel. The LED(s) shall turn on steady when the detector is in an alarm condition.
- F. Each base shall provide means to allow for function testing of the detector at the detector's location.
- G. The base shall be common with heat detector and smoke-type detectors and shall be compatible with other intelligent detectors, addressable manual stations, and addressable modules on the same circuit.
- H. The detectors shall be plugin units which mount to a common base, and shall be UL 268 approved.
- I. The detector shall be a 24 VDC type, which is compatible with the fire alarm panel and obtains its operating power from the supervisory current in the fire alarm detection loop. The 24 VDC detector shall be reset by actuating the control panel reset switch.
- J. To minimize false alarms, voltage and RF transient suppression techniques shall be employed.
- K. Detectors shall be installed on circuits with alarm verification modules.

## 2.07 INTELLIGENT PHOTOELECTRIC SMOKE DETECTORS

- A. The detectors shall contain no radioactive material.

- B. Detectors shall be of the solid-state photoelectric type and shall operate on the light-scattering photodiode principle using a pulsed infrared LED light.
- C. Smoke detectors shall be listed for sensitivity testing from the control panel. Sensitivity test results shall be logged.
- D. Smoke detectors shall communicate the actual smoke chamber values to the system control panel.
- E. Smoke detectors shall be smoke density measuring devices having no self-contained alarm setpoint (fixed threshold). The alarm decision for each detector shall be determined by the control panel. The control panel shall determine the condition of each detector by comparing the detector's value to the stored value.

## 2.08 PULL STATIONS

- A. Pull stations shall contain circuits that communicate the station's status (alarm, normal) to the control panel over two wires, which also provide power to the pull station. The address shall be field programmable at the station.
- B. Manual stations shall be double-action, constructed of high-impact red Lexan with raised white lettering, and a smooth high-gloss finish.
- C. Station shall mechanically latch upon operation and remain so until manually reset by a master key common to all system locks. Stations which use Allen wrenches or special tools to reset are not acceptable.
- D. The manual station shall be fitted with screw terminals for field wire attachment.

## 2.09 ADDRESSABLE INTERFACE MODULES—GENERAL

- A. Addressable Interface Modules shall receive their 24 VDC power from a separate two-wire circuit provided by an appropriate power supply.
- B. The module shall be available in either a Class B or Class A supervision version.
- C. In the Class B version, the wiring shall be supervised by an end-of-line device.
- D. In the Class A version, the wiring shall be looped back and connected to the module to allow continual operation of the controlled devices even if the wiring sustains a single break.
- E. The interface modules shall be supervised and uniquely identified by the control panel. Device identification shall be transmitted to the control panel for processing according to the program instructions.
- F. Should the interface modules become nonoperational, tampered with, or removed, a discrete trouble signal unique to the device shall be transmitted to and annunciated at the control panel.
- G. The interface modules shall be capable of being programmed for its "address" location on the intelligent device initiating circuit. The interface modules shall be compatible with addressable manual stations and intelligent detectors on the same intelligent initiating circuit.



## 2.10 HORN/STROBE UNITS

- A. Horns shall have Lexan housing with field-adjustable output taps, three taps minimum. Sound pressure level output shall be 87 dB at 10 feet. Horns shall have vandal-resistant Lexan grills and sealed backs to protect the phenolic impregnated cone.
- B. The unit shall be complete with a tamper-resistant Lexan lens with "FIRE" lettering visible from a 180-degree field of view. Strobes installed in open areas such as hallways, open office spaces, and assembly areas shall have an adjustable candela rating range from 15-75 candela. Strobes installed in mechanical areas shall have a peak candela rating of 110 candela. All strobes shall be in compliance with ADA requirements.
- C. Strobe devices installed in NEMA 4X areas shall be installed in a clear Lexan enclosure. Enclosure shall be Model STI-1229 as manufactured by Safety Technology International Inc., or equal.
- D. Horn devices installed in NEMA 4X areas shall be rated at 110 dBA at 10 feet. Horn device shall be model 304GCX as manufactured by Federal Signal Corporation. Horn device shall be powered through the FAS. Provide addressable relay modules and supervisory relays to activate this device from the FACP.
- E. A common horn/strobe device installed in NEMA 4X areas manufactured by System Sensor, SpectraAlert P2RK, or equal.

## 2.11 WIRELESS RADIO AND CELLULAR COMMUNICATIONS

- A. Provide a cellular and radio communications system as manufactured by DMP, model XR550FC, no equal. Fire alarm supplier shall provide cellular communicator model based on cellular provider (Verizon) being used. Radio system shall accept 120 VAC power and be provided with a battery backup. Provide power supply inside radio system enclosure as required. Provide integral or remote-mounted antenna cable and interface cable between FACP and radio. Coordinate with local AHJ for requirements. All programming of the radio and interface with the monitoring agency shall be provided.

## PART 3—EXECUTION

### 3.01 INSTALLATION

- A. The complete installation shall be done in a neat, workmanlike manner in accordance with the applicable requirements of NFPA 70 and the manufacturer's recommendations.
- B. If field conditions require, cover all smoke detection devices with plastic bags immediately after installation to maintain cleanliness.

### 3.02 FIRE ALARM SYSTEM CONFIGURATION

- A. The FACP in the Pump Room shall function as the main panel for the entire site. All alarms and supervisory messages for the entire site shall be annunciated through this panel. Notification of alarms to off-site monitoring agency shall be through this panel.

### 3.03 FIRE ALARM SYSTEM OPERATION

#### A. FACP:

1. Under normal condition, the front panel shall display a system status message with current time and date.
2. Should an abnormal condition be detected, the appropriate LED (Alarm, Supervisory, or Trouble) shall flash. The panel audible signal shall pulse for alarm conditions and sound steadily for trouble and supervisory conditions.
3. In the event of an abnormal condition, the following three characteristics relative to the condition shall be displayed simultaneously in alphanumeric format:
  - a. Custom location label (40 characters minimum).
  - b. Type of device (e.g., smoke, heat, pull station).
  - c. Status (e.g., alarm, trouble).
4. Pressing the appropriate acknowledge button shall acknowledge the alarm or trouble condition.
5. After all points in alarm have been acknowledged, associated LEDs shall glow steady and the panel audible signal shall be silenced. The total number of alarms, supervisory, and trouble conditions shall be displayed along with a prompt to review each list chronologically. The end of the list shall be indicated.
6. Alarm Silencing:
  - a. Pressing the "Alarm Silence" button shall cause all notification appliances programmed for "On-Until-Silenced" to be deactivated. A separate panel-mounted yellow LED shall illuminate to indicate the alarm silenced mode.
  - b. All NACs programmed for "On-Until-Reset" shall remain activated until the system is reset.
7. System Reset:
  - a. The "System Reset" button shall be used to return the system to its normal state after an alarm condition has been remedied.
  - b. In the event an alarm condition continues to exist following system reset, the system shall remain in an abnormal state. System control relays shall not reset. The panel audible signal and the Alarm LED shall remain on. The display shall indicate the total number of alarms and troubles present in the system along with a prompting to review the points. These points shall not require acknowledgment if they were previously acknowledged.
  - c. In the event the alarm silence inhibit function is active, the system shall ignore all key presses. An indication of enabling and disabling the inhibit stator shall be provided as a feedback to the operation.
8. Walk Test System Testing:
  - a. While in the test mode, the system shall display a trouble condition.
    - (1) While in the walk test mode, the activation of an initiating device shall be silently logged as an alarm in the historical log. The panel shall automatically reset after logging the alarm.
    - (2) The momentary disconnection of an initiating device or notification appliance shall be silently logged as a trouble condition in the historical log. The panel shall automatically reset itself after logging of the trouble condition.
    - (3) Integrity of the installation conductors of IDCs and NACs shall be verified by momentarily opening any circuit.
    - (4) Walk Test of ground fault circuit testing shall be verified by operating the Notification Appliances for 4 seconds.
  - b. The Walk Test sequence shall have the capability of activating NACs to signal with a code associated with the alarmed zone. Any momentary opening of initiating or NAC wiring shall cause the notification appliances to sound for 4 seconds to indicate

the trouble condition. The Walk Test feature shall automatically revert to the normal operating mode after 8 hours if it is not manually activated.

9. LED Supervision: All slave module LEDs shall be supervised for burnout or disarrangement. Should a problem occur, the panel shall display the module and the LED location numbers to facilitate location of that LED.
10. Active Status Reminder: Should any alarm, supervisory, or trouble condition be present within the system and the audible signal silenced, the local tone alert shall resound every 8 hours as a reminder that the fire alarm system is not 100% operational.

B. Smoke Detection Operation:

1. The activation of any system smoke detector shall initiate an alarm verification operation whereby the FACP shall reset the activated detector and wait for a second alarm activation. If after 20 seconds and within 1 minute after resetting a second alarm is reported from the same or any other smoke detector, the system shall process the alarm as described previously. If no second alarm occurs within 1 minute, the system shall resume normal operation. The alarm verification shall operate only on single smoke detector alarm. Other activated initiating devices or multiple smoke detector alarms shall be processed and reported immediately. The alarm verification operation shall be selectable by device or zone.
2. The intelligent system shall have the capability of displaying the number of times (tally) a detector has gone into a verification mode.
3. The FACP shall maintain a moving average of the detector's smoke chamber value to automatically compensate (move the threshold) for dust and dirty conditions that could affect detection operations. The system shall automatically maintain a constant smoke obscuration sensitivity for each detector (via the floating threshold) by compensating for environmental factors. Photoelectric detector's smoke obscuration sensitivity shall be adjustable to within 0.3% of either limit of the UL window (0.5% to 4.0%) to compensate for any environment.
4. The system shall automatically indicate when an individual detector needs cleaning. When a detector's average value reaches a predetermined level, a trouble message shall be audibly and visibly indicated at the FACP for the individual detector. Additionally, the LED on the detector base shall glow steady giving a visible indication at the detector's location. If the trouble condition is left unattended and the detector's average value increases to a second predetermined value, another trouble message shall be indicated at the FACP for the individual detector. To prevent false alarms, these trouble conditions shall in no way decrease the amount of smoke obscuration necessary for system activation. For scheduling of maintenance, the control panel shall be able to generate a message indication for any detector approaching a trouble condition because of dirt or contamination.

### 3.04 ALARM SEQUENCE

- A. The system alarm operation subsequent to the alarm activation of any manual station or automatic detection device shall be as follows:
1. All audible alarm notification appliances shall sound with the following characteristics: Temporal code pattern until silenced by the alarm silence switch at the FACP.
  2. All visible alarm notification appliances: Strobes shall display a continuous (synchronized where indicated on the Drawings) pattern until system is reset. Strobe intensities are indicated on the Drawings for adherence with ADA.
  3. Alarm horns and strobes shall be wired and operate independently.
  4. All doors normally held open by door control devices shall release.
  5. A supervised signal to notify the central station is to be activated.

- B. The FACP shall have a dedicated supervisory service LED and a dedicated supervisory service acknowledge switch.
- C. Activation of an auxiliary bypass means shall override the automatic functions either selectively or throughout the system.
- D. The system shall have an alarm list means that shall allow the operator to display all alarms, troubles, and supervisory service conditions with the time of occurrence. This shall allow for the determination of the most recent alarm and may also indicate the path that the fire is taking.

### 3.05 POWER REQUIREMENTS

- A. The FACP shall receive 120 VAC (as noted on the Drawings) from a dedicated circuit. This branch circuit shall have a “breaker lock” to prevent accidentally deenergizing of the power to the fire alarm panel. Circuit breakers shall be red and labeled “FIRE ALARM.”
- B. The FACP shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC main’s power in a normal supervisory mode for a period of 24 hours with 5 minutes of alarm operation at the end of this period. The system shall automatically transfer to the standby batteries upon power failure. All battery charging and recharging operations shall be automatic.
- C. The FACP shall include a disconnect switch for the AC power inside an enclosure near the panel or within the panel itself. This switch shall be labeled “Fire Alarm Power Disconnect.”

### 3.06 SUPERVISION

- A. The system shall contain independently supervised initiating device circuits. The alarm activation of any initiation circuit shall not prevent the subsequent alarm operation of any other initiation circuit.
- B. There shall be supervisory service initiation device circuits for connection of all sprinkler flow and tamper switches. Device activation shall be appropriately annunciated at the FACP.
- C. Auxiliary manual controls shall be supervised so that an “off normal” position of any switch shall cause an “off normal” system trouble.
- D. Auxiliary circuits for addressable relays shall be supervised so that a blown fuse or an open in the circuit shall be visibly and audibly annunciated.
- E. Each independently supervised circuit shall include a discrete visible amber “Trouble” LED to indicate disarrangement conditions per circuit.
- F. The incoming power to the system shall be supervised so that any power failure shall be audibly and visually indicated at the control panel and the remote annunciator. A green “power on” LED shall be displayed continuously while incoming power is present.
- G. The system’s batteries shall be supervised so that a low battery condition or disconnection of any battery shall be audibly and visually indicated at the control panel and the remote annunciator.

- H. The system modules shall be electrically supervised for module placement. Should a module become disconnected, the system trouble indicator shall illuminate and the audible trouble signal shall sound.
- I. The system shall have provisions for disabling and enabling all circuits individually for maintenance or testing purposes.

### 3.07 RACEWAYS

- A. All wiring shall be in a conduit system separate from all other building wiring. Conduit and boxes shall be painted red. See Section 26 05 33—Conduit for specifications.
- B. All wiring shall be installed in minimum 3/4-inch conduit.
- C. Surface access to existing alarm initiating circuits in public areas shall be via UL listed surface metal raceways (minimum equivalent to 3/4-inch conduit) and box extensions.
- D. There shall be no sharp edges with installed materials.

### 3.08 CONDUCTORS

- A. All cable shall be installed according to NEC Article 760.
- B. All cables and wires shall be No. 14 AWG and larger and shall be stranded.
- C. All initiation and notification circuit cabling shall be listed Type FPL.
- D. All wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, disarrangement of any components, any open circuits or grounds in the system, an audible and visual trouble signal shall be activated until the system is restored to normal.
- E. All conductors shall be color-coded. Coding shall be consistent throughout the facility. Green wire shall be used only for equipment ground.
- F. FACP, LCD annunciator, and NAC panels shall be connected to separate dedicated branch circuit from the building emergency panel, maximum 20 amperes. Circuit breaker shall be red and labeled as "FIRE ALARM."
- G. Power wiring for FACP shall be No. 12 AWG.
- H. FACP shall have No. 12 AWG green equipment ground wire. Where fire alarm circuits enter or leave a building, additional transient 75 to 90-volt gas tube protection shall be provided for each conductor.
- I. Leave 8-inch wire tails at each device box and 36-inch wire tails at the FACP and remote annunciator panel(s).
- J. Cable for intelligent detector loops shall be 18 to 12 AWG twisted pair with a shield jacket installed in 3/4-inch conduit. Shield continuity shall be maintained and connected to earth ground only at the control panel. Intelligent detector wiring shall not be in the same conduit

with 120/240 VAC power wiring or other high current circuits. T-taps or branch circuit connections are allowed for all class B intelligent loop circuits.

- K. Cable for RS 485 devices (remote annunciators) shall be twisted shielded pair (Belden 9841, or equal) for the data signal. Power wiring shall be 12 or 14 AWG.
- L. Wiring of alarm horn circuits and alarm strobe circuits shall be No. 14 AWG minimum.
- M. Fire alarm cables shall be held in place at the device box by means of a two-screw connector (do not use squeeze- or crimp-type connectors).
- N. All splices or connections shall be made within approved junction boxes and with approved fittings. Boxes shall be red and/or labeled "FIRE ALARM SYSTEM" by decal or other approved markings.
- O. Strobe wiring shall be 14 AWG minimum or as recommend by manufacturer.
- P. Tray cable is not acceptable for use as fire alarm systems wiring.

### 3.09 DEVICE MOUNTING

- A. Unless otherwise noted on the Drawings, the recommended mounting heights and requirements are as follows:
  - 1. FACP: Mount control panels so all visual indicators and controls are at 60 inches above floor level. Cabinet shall be grounded to either a cold water pipe or grounding rod.
  - 2. Audio-Visual Devices:
    - a. Install flush, semiflush, or surface mount at 6 inches below finished ceiling or at 80 inches from the bottom of the device to the highest level of the finished floor. No devices protruding 4 inches or more shall be installed lower than 80 inches.
    - b. All audio/visual devices shall be installed at the same height throughout the facility.
    - c. For surface mounting, use manufacturer-supplied back boxes and trim plates. Mark each device with its circuit number.
  - 3. Manual Stations:
    - a. The operable part of the manual stations shall be installed not less than 3 1/2 feet (42 inches) and not more than 4 feet (48 inches) above finished floor. All Manual Stations shall be in unobstructed locations. Mark the unit's address on the inside and outside of housing. For surface mounting, use manufacturer-supplied backboxes and trim plates
    - b. All pull stations shall be installed at the same height throughout the facility.
  - 4. Smoke Detectors:
    - a. The location of detectors shown on the Drawings is schematic only. The detectors shall be located according to code requirements.
    - b. Surface mounted detectors shall be installed using backboxes equal to the base's size. Standard octagon and square boxes are not acceptable.
    - c. Detectors shall be located on the highest part of a smooth ceiling so that the edge of the detector is no closer than 4 inches from a sidewall. Ceilings with beams, joists, or soffits that exceed 8 inches in depth require special planning and closer spacing.
    - d. If it is necessary to mount a detector upon a sidewall, the top of the detector shall be located no closer than 4 inches from the ceiling and no further away than 12 inches.

- e. Smoke detectors shall be installed to favor the air flow towards return openings and not located closer than 3 feet from air supply diffusers which could dilute smoke before it reaches the detector. No detectors shall be installed in direct airflow.
- f. Smoke detectors shall be located near the center of the open area which they are protecting, thus providing coverage generally for 15-foot radius.
- g. Mark the address and loop number on each detector's base.

### 3.10 IDENTIFICATION

- A. Attach the label containing the address and SLC designation to:
  - 1. Each addressable detector. Label shall be visible and readable from the floor, 3/16-inch minimum character size (1/4 inch is recommended).
  - 2. Each manual pull station. Label shall be placed on the top part.
  - 3. Each addressable module. Label shall be attached to the faceplate.
- B. Label shall consist of black writing on white or clear background.
- C. All fire alarm boxes shall be painted red and labeled "Fire Alarm" or "FA". When red conduit is used for the fire alarm system installation, there is no need to paint the boxes. Non-factory device boxes shall also be painted red.
- D. All circuits shall be labeled with the name of circuit and the area being served by the circuit.
- E. Wire/cable splices in junction boxes shall be labeled indicating where the wire/cable is coming from and where it is going.
- F. All conductors terminated in control panels shall be labeled.
- G. All labels shall be permanent and machine generated. No handwritten or non-permanent labels shall be allowed. Submit a sample for approval before using any labeling schemes.

### 3.11 FIELD START-UP AND COMMISSIONING

- A. Provide the services of a manufacturer's qualified NICET-certified technician to assist CONTRACTOR in installation and start-up of the equipment specified in this section. The manufacturer's representative shall provide technical direction and assistance to CONTRACTOR in general operation of the equipment, connections and adjustments, and testing of the assembly and components contained therein.
- B. The manufacturer's representative shall provide inspection of the final installation. The manufacturer's representative shall perform site start-up and functional checkout of the equipment. Upon completion of the manufacturer's start-up and checkout, the manufacturer shall generate a site start-up and functional checkout report, documenting all systems checked as well as any incomplete work remaining and operational deficiencies. CONTRACTOR shall provide three copies of the manufacturer's site start-up and functional checkout report to ENGINEER for review.
- C. CONTRACTOR shall be responsible for all costs required to check operation of the system.
- D. The completed fire alarm system shall be fully tested by the manufacturer in accordance with all applicable local codes in the presence of OWNER's representative and the local

Fire Marshal. Upon completion of a successful test, a certification shall be issued in writing to OWNER and CONTRACTOR.

- E. CONTRACTOR shall provide a fire alarm control panel that is communicating properly between the FACP and the monitoring agency.

### 3.12 TRAINING

- A. Upon successful completion of checkout by ENGINEER, a manufacturer's representative shall provide a demonstration of the automated sequences of operation. After this demonstration and acceptance by OWNER, the manufacturer shall provide 4 hours of "hands-on" training for OWNER's operating personnel which shall cover the following topics:
  - 1. Overall System Description and Theory of Operation.
  - 2. Automatic Operation.
  - 3. Manual Operation and Testing of System Devices.
  - 4. Recommended System Check Lists and Log Sheets.
  - 5. Recommended Preventative Maintenance.
- B. Two 4-hour training session for two operators shall be provided. The training session shall be conducted by a manufacturer's qualified representative. Training program shall include instructions on the assembly, controls, protective devices, and other major components. Travel time and expenses to the jobsite shall be over and above the time required to perform the training and shall be included in the Bid.

END OF SECTION



## SECTION 31 23 00

### EXCAVATION, FILL, BACKFILL, AND GRADING

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included: Excavating, filling, backfilling, and grading for this work includes, but is not necessarily limited to:
  - 1. Excavating for footings, foundations, roads, utilities, sidewalks, driveways, parking lots, restoration, and miscellaneous areas.
  - 2. Furnishing and placing all fill and backfill.
  - 3. Provide compaction of all fill and backfill.
  - 4. Furnishing and placing vapor barrier and granular cushion below interior slabs on grade.
  - 5. Furnishing and placing of crushed stone mat below tank slabs and manhole/vault slabs, basement floors, or other structures where required.
  - 6. Rough and finish grading prior to paving, seeding, etc.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. Allowances:
  - 1. CONTRACTOR shall INCLUDE in the Bid the cost of replacing 350 cubic yards of unsuitable foundation material for structures and roads as defined in this section. The unit price shall include the cost of dewatering and slope stabilization and other incidental items associated with this work. Payment to CONTRACTOR for unsuitable foundation material for structures and roads will be adjusted, add or deduct, based upon the actual unsuitable material excavated (more or less than 350 cubic yards) and the unit price for replacing unsuitable foundation material. Volume shall be as measured in the ground. Extra payment will not be made for specified undercutting and filling or gravel bedding material required for placing concrete above water level as required under the concrete specifications. The Bid shall include any removal and replacement of excavated material so indicated on the Drawings or specified herein.
  - 2. CONTRACTOR shall INCLUDE in the Bid the cost of replacing 50 cubic yards of unsuitable foundation material for utility trenches as defined in this section. The unit price shall include the cost of dewatering and slope stabilization and other incidental items associated with this work. Payment to CONTRACTOR for unsuitable foundation material for utility trenches will be adjusted, add or deduct, based upon the actual unsuitable material excavated (more or less than 50 cubic yards) and the unit price for replacing unsuitable foundation material. Volume shall be as measured in the ground. Extra payment will not be made for specified undercutting, filling, or bedding. The Bid shall include any removal and replacement of excavated material so indicated on the Drawings or specified herein.
- D. Payment: All common excavation shall be included in the Lump Sum Bid. Changes which require additions to or deductions from the excavation will be adjusted on the basis of the unit price for changes contained in the Contract.

## 1.02 REFERENCED STANDARDS

- A. Standard specifications, where referenced, shall refer to the State of Wisconsin Department of Transportation, Standard Specifications For Highway and Structure Construction, Current Edition, including all issued supplemental specifications.
- B. ASTM C33—Standard Specification for Concrete Aggregates.
- C. ASTM D698—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
- D. ASTM D1557—Standard Test Methods 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>)).

## 1.03 SUBMITTALS

- A. Submit sources and gradations for materials proposed for use as compacted fill, utility trench backfill, trench bedding and cover material, crushed stone mat, and granular cushion.
- B. Submit samples of materials proposed for use in Paragraph 1.03.A to a soils testing laboratory for analysis of its suitability and for recommendations on moisture content during compaction, compaction methods, or other appropriate information.
- C. Submit sufficient samples of each different type or classification of soil to obtain representative values.

## 1.04 JOB CONDITIONS

- A. The elevations shown for existing work and ground are reasonably correct, but are not guaranteed to be absolutely accurate. No extras will be allowed because of variations between drawings and actual grades.
- B. Soil borings were made and the soils information is included in an appendix to these Specifications. The information contained is not guaranteed to be indicative of conditions to be encountered during construction. It is CONTRACTOR's responsibility to make its own investigations to determine physical conditions at the site, which may affect the work.

## PART 2—PRODUCTS

### 2.01 COMPACTED FILL

- A. All fill and backfill material designated to be compacted fill shall be granular with no stones larger than 4 inches and shall be reasonably well-graded throughout the particle size range. A minimum 65% of the material shall pass the 3/4-inch sieve, and the material shall be capable of being compaction tested in accordance with ASTM D1557, as determined by the Testing Firm. Of that portion of the material passing the No. 4 sieve, not more than 25% shall pass the No. 200 sieve, and material shall have less than 5% clay content. When placing fill during wet weather or in wet areas, this requirement shall be modified to not more than 5% passing the No. 200 sieve. Adequately dewatered areas are not defined as wet areas.

- B. Native material may be used as compacted fill if it meets the above specification. CONTRACTOR shall determine whether native material meets the above specification. CONTRACTOR shall provide all needed fill material whether from on-site or off-site at no additional cost to OWNER.

## 2.02 CRUSHED STONE MAT

- A. Crushed stone mat below tank slabs, manholes, vault slabs and basement floors shall be 3/4-inch clear crushed stone and shall meet all requirements of ASTM C33 size No. 67.

## 2.03 GRANULAR CUSHION

- A. Granular cushion beneath floor slabs-on-grade shall meet requirements of Section 305 of Standard Specifications for WisDOT Base Aggregate Dense, 3/4 inch.

## 2.04 EMBANKMENT FILL

- A. Embankment fill shall contain no stumps, brush, rubbish, or other perishable material. The top 12 inches of the earth embankment shall be earthy material free from large stones.

## 2.05 CONCRETE FILL

- A. Concrete fill shall be Class X concrete as defined in Section 03 30 00—Cast-In-Place Concrete or flowable fill as defined in this section.

## 2.06 CLAY FILL

- A. Clay fill shall contain at least 25% clay minerals (material finer than 0.002 mm).

## 2.07 FLOWABLE FILL

- A. Flowable fill shall be a self-compacting, self-leveling, material consisting of a mixture of fine aggregate and filler (as needed), water, and cementitious materials (Portland cement, fly ash, granulated blast furnace slag) that is in a flowable state at the time of placement meeting the requirements of the National Ready Mixed Concrete Association Guide Specification for Controlled Low Strength Materials (CLSM). The flowable fill shall be proportioned by the ready mixed concrete supplier on the basis of field experience and/or laboratory trial mixtures to produce a cohesive and nonsegregating mixture which has the following properties:
  - 1. Minimum compressive strength: 50 psi.
  - 2. Maximum compressive strength: 150 psi.
- B. CONTRACTOR shall submit the following information well in advance of fill placement to avoid any delay in construction:
  - 1. Gradation of fine aggregate.
  - 2. Design mix.
  - 3. Previous test results with 7- and 28-day compressive strengths.
  - 4. Certified mill test results for cement identifying brand, type, and chemistry of cement to be used.
  - 5. Brand, type, principle ingredient, and amount of each admixture if used.

## 2.08 TRENCH BEDDING MATERIAL

- A. Bedding material shall be hard and durable and shall be made by crushing sound limestone or dolomite ledge rock, or crushed gravel aggregate. Bedding material shall conform to the requirements of ASTM C33 and shall conform to gradations shown in the following table. No native soil shall be used for bedding material.

PERCENTAGE BY WEIGHT PASSING INDICATED SIEVE

| Size | 2 1/2<br>IN | 2<br>IN | 1 1/2<br>IN | 1<br>IN | 3/4<br>IN | 1/2<br>IN | 3/8<br>IN | No.<br>4 | No.<br>8 | No.<br>16 | No.<br>30 | No.<br>100 | No.<br>200 |
|------|-------------|---------|-------------|---------|-----------|-----------|-----------|----------|----------|-----------|-----------|------------|------------|
| 57   |             |         | 100         | 95-100  |           | 25-60     |           | 0-10     | 0-5      |           |           |            |            |
| 67   |             |         |             | 100     | 90-100    |           | 20-50     | 0-10     | 0-5      |           |           |            |            |
| 8    |             |         |             |         |           | 100       | 85-100    | 10-30    | 0-10     | 0-5       |           |            |            |
| 9    |             |         |             |         |           |           | 100       | 85-100   | 10-40    | 0-10      | 0-5       |            |            |
| 10   |             |         |             |         |           |           | 100       | 85-100   |          |           |           | 10-30      |            |

- B. All rigid sanitary sewer pipe and related appurtenances shall be bedded and covered in accordance with the Class B bedding detail as shown on Drawing 01-975-43A. Bedding material shall conform to Size No. 8 or No. 9. With pipes greater than 15 inches, Size No. 57 may be used.
- C. Concrete and other rigid pipe used in nonsanitary sewer applications may be bedded using the Class C bedding detail as shown on Drawing 01-975-43A. Bedding material shall conform to Size No. 8 or No. 9. With pipes greater than 15 inches, Size No. 57 may be used.
- D. Ductile and cast iron pipe shall be bedded in accordance with Class C bedding detail as shown on Drawing 01-975-43A, or the Type 4 laying condition of AWWA C600. Bedding material shall conform to Size No. 57, No. 8, or No. 9. Where ductile iron pipe is polyethylene encased, bedding material shall conform to Size No. 8 or No. 9.
- E. Thermoplastic sanitary sewer pipe and related appurtenances shall be bedded and covered in accordance with the Thermoplastic Pipe Bedding Detail on Drawing 01-975-43A. Bedding material shall conform to Size No. 8 or No. 9. With pipes greater than 15 inches, Size No. 57 may be used.
- F. All other sanitary sewer pipe and related appurtenances shall be bedded and covered in accordance with the Class B bedding detail as shown on Drawing 01-975-43A. Bedding material shall conform to Size No. 8 or No. 9. With pipes greater than 15 inches, Size No. 57 may be used.
- G. PVC water main or force main shall be bedded and covered in accordance with the Thermoplastic Pipe Bedding Detail on Drawing 01-975-43A or in accordance with the Type 4 laying condition of AWWA C605. HDPE water main or force main shall be bedded and covered in accordance with the Thermoplastic Pipe Bedding Detail on Drawing 01-975-43A or in accordance with ASTM D2774. Bedding material shall conform to Size No. 8 or No. 9. With pipes greater than 15 inches, Size No. 57 may be used. No native materials may be used.
- H. Bedding material for copper water services shall conform to Size No. 9 or No. 10.

## 2.09 TRENCH COVER MATERIAL

- A. Material which is to be placed from the bedding material to 1 foot above the top of the pipe shall be termed cover material. All trenches shall be backfilled by hand to 1 foot above the top of the pipe with cover material. Cover material shall be deposited in the trench for its full width on each side of the pipe, fittings and appurtenances simultaneously in 6-inch layers and shall be compacted using hand tamping bars and/or mechanical tampers. Use special care in placing cover material to avoid injury to or movement of the pipe. Cover material shall consist of durable granular particles ranging in size from fine to a maximum size of 3/4 inch. Unwashed bank run sand and crushed bank run gravel will be considered generally acceptable cover material. Cover material shall generally conform to the following gradation specifications:

COVER MATERIAL GRADATION

| Sieve Size | Percentage by Weight Passing |
|------------|------------------------------|
| 1 inch     | 100                          |
| 3/4 inches | 85 to 100                    |
| 3/8 inches | 50 to 80                     |
| No. 4      | 35 to 65                     |
| No. 30     | --                           |
| No. 40     | 15 to 30                     |
| No. 200    | 5 to 15                      |

- B. Native trench materials may be used for cover material if they substantially conform to the above gradation specifications and a suitable credit is extended to OWNER.
- C. All bedding materials may be substituted for cover material when requested by CONTRACTOR except where polyethylene encasement is used. In such case, only those bedding materials specifically noted for polyethylene encasement may be used.
- D. Material that is to be placed from the bedding material around and to 1 foot above the top of all pipes shall be termed cover material. Except as otherwise specified, (a) cover material shall consist of durable granular particles ranging in size from fine to coarse in a substantially uniform combination, (b) unwashed bank-run sand and crushed bank-run gravel will be considered generally acceptable for cover material, (c) no stones larger than 3/4 inch in their greatest dimension shall be allowed in the cover material, and (d) native materials may be used if they conform to the above specifications. Cover material for copper piping shall be Size No. 10. Cover material for PVC pressure or other thermoplastic piping may be Size No. 10.

## 2.10 TRENCH BACKFILL MATERIAL

- A. Backfill shall be that material placed between the top of cover material up to subgrade for placement of restoration materials. Backfill for storm inlets shall be bedding material.
- B. When the type of backfill material is not otherwise specified or shown on the Drawings, CONTRACTOR may backfill with the excavated material, provided that such material consists of loam clay, sand, gravel, or other materials which, in the opinion of Geotechnical Engineer, are suitable for backfilling.

- C. All backfill material shall exceed a temperature of 35°F and be free from frost, cinders, ashes, refuse, vegetable or organic matter, boulders, rocks, stone, frozen lumps, or other material which in the opinion of Testing Firm is unsuitable. From 1 foot above the top of the pipe to the trench subgrade, well-graded material containing stones up to 8 inches in their greatest dimension may be used, unless otherwise specified. Care should be taken in backfilling so as not to damage the installed pipe.
- D. In refilling the trench, if there is not sufficient material excavated therefrom suitable for refilling, CONTRACTOR shall, without extra compensation, furnish the deficiency. Where indicated on the Drawings, fill shall be provided over projecting conduits. Such fill shall be free of large boulders, and the top 6 inches shall be of suitable material to fit the adjoining ground.
- E. When called for on the Drawings, in the Specifications, or requested by ENGINEER, backfill material shall be granular and shall consist of durable particles ranging in size from fine to coarse in a substantially uniform combination. Sufficient fine material shall be present to fill all the voids in the coarse material. No stones over 3 inches or clay lumps shall be present. Unless otherwise allowed by ENGINEER, granular backfill shall generally conform to the following gradation specification:

#### GRANULAR BACKFILL

| Sieve Size | Percentage by Weight Passing |
|------------|------------------------------|
| 3 inches   | 100                          |
| 2 inches   | 95 to 100                    |
| No. 4      | 35 to 60                     |
| No. 200    | 5 to 10                      |

### PART 3—EXECUTION

#### 3.01 GENERAL

- A. Prior to all excavating, CONTRACTOR shall become thoroughly familiar with the site and site conditions.

#### 3.02 PROTECTION

- A. CONTRACTOR shall provide all necessary sheeting, shoring, or other soil retention systems including all labor, material, equipment, and tools required, or as necessary to maintain the excavation in a condition to provide safe working conditions, to permit the safe and efficient installation of all items of Contract work, and to protect adjacent property. CONTRACTOR shall be held liable for any damage which may result to property from excavation or construction operations. Sheeting, shoring, and other soil retainage systems shall be withdrawn or removed in a manner so as to prevent subsequent settlement of structures, utilities, and other improvements.
- B. Design of sheet piling and other soil retaining systems shall be the sole responsibility of CONTRACTOR. Where such systems are shown on the Drawings, no parameters such as embedment depth, section profile, presence or lack of walers, etc., nor system type or suitability shall be inferred. CONTRACTOR is responsible for designing and providing a fully functional system compatible with construction and site requirements.

- C. Nothing in this specification shall be deemed to allow the use of protective systems less effective than those required by the Occupational Safety and Health Administration (OSHA) and other applicable code requirements.

### 3.03 FINISH ELEVATIONS AND LINES

- A. CONTRACTOR is responsible for establishing finish elevations and lines.
- B. Where lasers are used, CONTRACTOR shall check the Work against intermediate grade stakes. Prior to initial use of the laser, CONTRACTOR shall set up laser on ground surface and check line and gradient controls. Lasers not functioning properly shall be immediately removed.
- C. If existing property stakes, not within the limits of the trench or street slope limits, are removed or damaged by CONTRACTOR, CONTRACTOR shall bear the cost of replacement. Replacement shall be made by a legal survey performed by a licensed Land Surveyor hired by OWNER. Cost for survey shall be deducted from the Contract Price.

### 3.04 COMMON EXCAVATION

- A. After the site has been cleared and stripped, the site shall be cut and filled to the indicated subgrade as shown or specified.
- B. All excavated material that does not meet the specification for compacted fill or embankment fill or meets the specification but is not required for backfill or fill shall be classified as excess material and shall be removed from the site and disposed of at CONTRACTOR's expense.
- C. All material other than suitable bearing soil or bedrock, as determined by the Testing Firm, shall be removed from under concrete to be poured on ground.
- D. Excavation for all footings, foundation walls, pits, etc., shall be large enough to provide adequate clearance for the proper execution for the work within them.
- E. Excavations scheduled to extend below groundwater shall not be started until the area has been dewatered. See Section 31 23 19—Dewatering.
- F. No footings or slabs shall bear on the top 2 feet of existing soil. Where planned subgrade is within 2 feet of existing grade, remove soils to 2 feet below existing grade and backfill with compacted fill up to subgrade elevation.
- G. When excavations reach subgrade elevations as shown on the Drawings or as specified herein, the Testing Firm will observe the bottom material. Where, in the opinion of the Testing Firm, unsuitable foundation material is found at the level of the subgrade, unsuitable foundation material shall be removed and replaced with material and placing methods as specified under compacted fill and backfill.
- H. Excavations that are undercut beneath the foundation shall extend beyond the perimeter of the foundation 1 foot plus a distance at least equal to the depth of undercut below footing grade.
- I. CONTRACTOR shall backfill and compact all overexcavated areas.

- J. All street excavation shall be performed as called for in Section 205 of the Standard Specifications and as herein modified.
- K. The following items of Work shall be included in common excavation:
  - 1. The excavation to subgrade elevations as detailed in the Drawings including road bed areas, terraces, sidewalks, bike paths, driveways, and other miscellaneous surface improvements.
  - 2. Removal (and stockpiling, if the use of salvaged topsoil is required) of topsoil from all cut areas and fill areas within a 1:1 slope of finished street, sidewalks, bike paths, driveways, and other miscellaneous surface improvements.
  - 3. The preparation, grading, compaction, and proof-rolling of subgrade areas for roadbed, sidewalks, bike paths, driveways, and other miscellaneous surface improvements to the elevations detailed on the Drawings.
  - 4. Excavation and grading required to realign and/or create ditch lines and drainage ways to route drainage to or from storm facilities as shown on the Drawings, or as necessary to maintain positive drainage.
  - 5. Removal of temporary backfill placed in new utility trenches above the subgrade.
  - 6. The removal and disposal of all undesirable and surplus materials.
- L. Common excavation may be completed as part of utility construction prior to initiating general street excavation activities.
- M. All subgrade areas in streets and parking lots, including utility trench restoration areas, shall be proof-rolled with a heavily loaded triaxle dump truck or other similar equipment requested by Testing Firm prior to the placement of any fill materials or base course. OWNER and Testing Firm must be present during proof-rolling to review the Work necessary for the stabilization of any unstable areas identified. Base course placed on unstable or yielding foundation or subgrade shall be removed and then replaced at CONTRACTOR's expense following excavation below subgrade of the affected area.
- N. Saw cuts shall be made in existing pavement, driveways, curb and gutter, and sidewalks to allow restoration to neat straight lines. Saw cuts damaged during construction shall be recut prior to beginning restoration.
- O. CONTRACTOR shall be responsible for making its own determination of the common excavation quantity when compiling the Lump Sum Bid.

### 3.05 UTILITY TRENCH EXCAVATIONS

- A. Caution In Excavation: CONTRACTOR shall proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures may be determined and shall be held responsible for the repair of such structures when broken or otherwise damaged because of carelessness on its part.
- B. Subsurface Exploration: When determined that it is necessary to explore and excavate to determine the location of existing underground facilities, CONTRACTOR shall make explorations and excavations for such purposes. If CONTRACTOR is asked to perform additional Work in making the explorations and excavations, extra compensation will be allowed as specified In the General Conditions.



- C. The trench shall be dug so that the utilities can be laid to the alignment and depth specified. Unless otherwise allowed by ENGINEER, trenches shall not be excavated more than 100 feet in advance of pipe laying. Common excavation shall include all excavation except rock. Included in common excavation shall be removal of street paving of all types, existing structures, existing improvements and trees smaller than 4 inches in diameter measured 4 feet above the ground, all as necessary to complete the pipe installation.
- D. The trench shall be finished to the depth necessary to provide a uniform and continuous bearing and support for the pipe on the bedding material provided at every point between bell holes. Any part of the bottom of trench excavated below the specified grade shall be corrected with bedding material, thoroughly compacted in place. The bedding shall be shaped and finished with hand tools to fit the bottom quadrant to the pipe.
- E. If unstable soil conditions are encountered at subgrade, CONTRACTOR shall replace the unstable soil with special bedding. CONTRACTOR shall be allowed extra compensation for the special bedding, unless the unstable soil conditions are caused by CONTRACTOR's failure to adequately dewater the trench, in which case CONTRACTOR shall bear the entire cost.
- F. All excavated material shall be piled in a manner that will not endanger the Work. Stockpiles not for immediate backfilling shall have silt fences placed around their perimeter for erosion control. The Work shall be conducted in such a manner that pedestrian and motor traffic is not unnecessarily disrupted. Fire hydrants, valve boxes and manholes shall be left unobstructed. Gutters shall be kept clear or other satisfactory provisions made for street drainage, and natural water courses shall not be obstructed.
- G. Excavated material designated by ENGINEER as being undesirable for backfilling and all surplus excavated material shall be immediately removed as excavation progresses. All such material shall be disposed of in an environmentally safe manner in accordance with local, state, and federal regulations. No such materials shall be disposed of in wetlands, floodplains, or other environmentally sensitive areas. Disposal sites are also subject to approval of OWNER. All undesirable and surplus material disposed of must be leveled off and graded to rough elevations as determined by OWNER. Appropriate erosion control measures shall be provided and maintained at disposal sites until disposal is complete and the disposal site is permanently stabilized.
- H. CONTRACTOR shall remove bituminous pavement and road surface as a part of the trench excavation. The width of pavement removed shall be the minimum possible, and acceptable, for convenient and safe installation of utilities and appurtenances.
- I. All bituminous pavement shall be cut on neat, straight lines and shall not be damaged beyond the limits of the trench.
- J. Where it is necessary to trench through concrete pavement, a strip shall be sawed and removed in such a manner as not to disturb the remainder of the pavement. Paving and undermining of existing concrete pavement shall be prevented by CONTRACTOR. If CONTRACTOR unnecessarily removes or damages pavement or surfaces beyond limits acceptable to ENGINEER, such pavement and surfaces shall be replaced or repaired at the expense of CONTRACTOR.
- K. All trees, shrubs, and improved areas outside the excavation shall be protected from damage.

- L. Pipe shall be placed only on dry foundations.
- M. Excavation shall include all necessary incidental work such as tunneling, sheet piling, shoring, underpinning, pumping, bailing, transportation, and all fill and backfilling.
- N. CONTRACTOR shall excavate whatever materials, are encountered as required to place at the elevations shown, all pipe, manholes, and other work as required to complete the project as shown.
- O. The excavation at the crossing of all underground utility services in place shall be as narrow as practicable. All underground services shall be protected from damage and maintained in service at their original location and grade during the process of the work. Any damage to underground services shall be replaced or repaired at no cost to OWNER or to the owner of the service. The present underground services shown on the Drawings are located in accordance with available data. Encountering these services at a different location or encountering services not shown shall not release CONTRACTOR from the above-stated conditions.
- P. Any water, drainage, gas, sewer, or electric lines encountered in the excavation that are not to be disturbed shall be properly underpinned and supported. Any service connections encountered that are to be removed shall be cut off at limits of the excavation and capped in accordance within the requirements of or permits governing such removals. Any permits required for this work will be obtained by OWNER upon request of CONTRACTOR.
- Q. CONTRACTOR shall be responsible for determining and providing the minimum width necessary to provide a safe trench in accordance with current OSHA standards and all other applicable standards. The top width of trench excavation shall be kept as narrow as is reasonably possible and acceptable to minimize pavement damage. Pay items related to maximum trench widths shall not limit CONTRACTOR's responsibility to provide safe trench conditions.
- R. Width of Trench—Rigid Pipe: The width of trench below the outside top of the pipe shall be as shown in the following table for the sizes listed. A minimum clearance of 8 inches between the outside of the pipe barrel and the trench wall at the pipe spring line shall be maintained to allow for bedding and haunching. If sheeting is used and is going to remain in place, the trench width shall be measured as the clear distance between inside faces of the sheeting. Otherwise, the trench width shall be based on the width between stable trench walls after sheeting is removed.

MAXIMUM WIDTH OF TRENCH BELOW TOP OF PIPE

| Nominal Pipe Diameter<br>(Inches) | Trench Width<br>(Inches)       |
|-----------------------------------|--------------------------------|
| 4                                 | 30                             |
| 6                                 | 30                             |
| 8                                 | 36                             |
| 10                                | 36                             |
| 12                                | 36                             |
| 15                                | 36                             |
| 18 and larger                     | Pipe O.D. Plus 16 (Minimum 36) |

- S. Where the width of trench below the outside top of the pipe barrel cannot be otherwise maintained within the limits shown above, CONTRACTOR, at its own expense, shall furnish an adequate pipe installation for the actual trench width which will meet design conditions. This may be accomplished by furnishing higher class bedding, a stronger pipe, concrete cradle, cap or envelope or by driving sheeting prior to excavation to subgrade. Removal of sheeting below the top of the pipe, if allowed by ENGINEER, shall be gradual during backfilling.
- T. If the maximum trench width is exceeded for any reason other than by request of ENGINEER, the concrete cradle, cap, sheeting, bedding or the stronger pipe shall be placed by CONTRACTOR at its own expense. Where the maximum trench width is exceeded at the written request of ENGINEER, the concrete cradle, cap, sheeting, bedding or stronger pipe will be paid for on the basis of the price bid.
- U. Width of Trench—Thermoplastic and Ductile Iron Pipe: The trench width for flexible pipe shall be minimum three times the pipe outside diameter or the maximum trench width specified for rigid pipe, whichever is greater. A minimum clearance of 8 inches between the outside of the pipe barrel and the trench wall at the pipe spring line shall be maintained to allow for bedding and haunching.
- V. Special bedding shall consist of stone material and filter fabric as described herein. Where the bottom of the trench at subgrade is found to be unstable or of unsuitable material, which should be removed, CONTRACTOR shall excavate and remove such unstable or unsuitable material to the trench width and to a depth of 2 feet. The excavated area shall be lined with filter fabric, Mirafi 140 N, US Fabrics US 120NW, Propex Geotex 401, or equal, and backfilled with bedding material in maximum 12-inch layers. At subgrade the filter fabric shall be wrapped over the special bedding with an 18-inch overlap. Bedding material shall then be placed over the special bedding to support the piping. See Dewatering and Excavation to Subgrade sections for additional conditions.
- W. If soil conditions require it, concrete cradle or encasement shall be placed around the pipe as shown on Drawing 01-975-43A. Excavation shall be carried below the grade line to a depth requested by ENGINEER and concrete cradle or encasement placed. Before the concrete is placed, the pipe shall be laid to line and grade, blocked and braced, and the joint made. The cradle shall then be placed, taking care not to disturb the pipe. Concrete shall have a minimum 28-day compressive strength of 4,000 psi. Concrete cradle shall not be used for thermoplastic piping. See Trench Width section for additional conditions.
- X. Open-cut trenches shall be sheeted and braced as required by any governing federal regulations including OSHA, state laws, and municipal ordinances; and as may be necessary to protect life, property, improvements or the Work. Underground or aboveground improvements to be left in place shall be protected and, if damaged, shall be repaired or replaced at the expense of CONTRACTOR.
- Y. Sheeting and bracing which is to be left in place must be removed for a distance of 4 feet below the present or proposed final grade of the street, road, or land, whichever is lower. Trench bracing, except that which shall be left in place, may be removed after backfilling has been completed or has been brought up to such an elevation as to permit its safe removal.
- Z. Portable Trench Box: Whenever a portable trench box or shield is used, special precautions shall be taken so as not to pull already jointed pipe apart or leave voids around the pipe wall. Whenever possible, the bottom edge of the box shall be kept at a level approximately even

with the top of pipe. Cover material shall be placed to at least the top of pipe before moving the box ahead.

- AA. All trenches shall be backfilled using specified material so that excessive lengths of trench are not left open. In general, the backfilling operation shall proceed so that no more than 100 feet of trench is open behind the pipe laying operation.
- BB. Backfill shall be left below the original surface to allow for placement of restoration materials including pavement, base course, concrete, topsoil, sod, plus any pavement replacement specified in accordance with the Asphaltic Paving section herein. When settlement occurs, CONTRACTOR shall restore the surface improvements at its expense to maintain the finished surface.

### 3.06 PREPARATION OF SUBGRADE

- A. After the site has been cleared, stripped, and excavated to subgrade, thoroughly compact subgrade to the requirements specified for compacted fill below. Scarify and moisture condition the subgrade as recommended by the Geotechnical Engineer.
- B. Remove all ruts, hummocks, and other uneven surfaces by surface grading prior to placement of fill.
- C. ENGINEER may request the excavation of unsuitable materials in areas of unstable subgrade. The excavation of such materials, except in areas where CONTRACTOR has completed utility construction or placed street fill, shall be measured by ENGINEER for payment.
- D. The excavation and replacement of unstable utility trench backfill and/or street fill placed by CONTRACTOR shall be at CONTRACTOR's expense.
- E. Base course placed on unstable foundation shall be removed and replaced at CONTRACTOR's cost following excavation of the affected area.
- F. Where requested by ENGINEER in the field, excavation below subgrade areas shall be lined with geotextile material as specified in Section 31 32 19–Geotextiles and backfilled with 3-inch crushed stone dense graded base as specified herein.
- G. Geotextile shall be placed where requested by ENGINEER to stabilize street subgrade areas. Fabric shall be as specified in Section 31 32 19–Geotextiles. Vibratory compaction shall not be used in the compaction of base course in areas where geotextile fabrics are used.

### 3.07 COMPACTED FILL AND BACKFILL

- A. All fill and backfill, except as otherwise specified, shall be compacted fill placed to within 4 inches of the bottom of the topsoil or to the bottom of the structure or other improvement.
- B. Unless otherwise noted, structures with a top slab shall not be backfilled until the slab is in place and has reached its specified 28-day strength.
- C. In fill areas above existing grade around structures, compacted fill shall be placed within a minimum of 10 feet from the structure.

- D. No fill shall be placed under water or over unsuitable subgrade conditions.
- E. All fill and backfill, except embankment fill and clay fill, shall be compacted as follows:
  - 1. Class 1 Compaction: This class of compaction shall apply to all fill areas under buildings, structures, piping, bituminous roadway and parking areas, curb and gutter, and backfill within 10 feet of structure walls. All compacted material shall be placed in uniform layers not exceeding 8 inches in loose thickness prior to compaction. Each layer shall be uniformly compacted to a dry density at least 95% of the maximum dry density as determined by a laboratory compaction test at the optimum moisture content (ASTM Test Designation D1557). Compaction shall be obtained by compaction equipment appropriate for the conditions.
  - 2. Class 2 Compaction: This class of compaction shall be used in excavated areas beyond 10 feet of structures without any piping or adjacent foundations. Material for backfill shall be granular material as specified above. The material shall be deposited, spread, and leveled in layers generally not exceeding 12 inches in thickness before compaction. Each layer of the fill shall be compacted to at least 90% of the maximum dry density (testing same as Class 1). Compaction shall be obtained by compaction equipment appropriate for the conditions.
- F. No frozen material shall be placed nor shall any material be placed on frozen ground.
- G. Four inches of clay fill shall be placed and compacted to at least a firm consistency in areas to be seeded or sodded prior to placement of topsoil.

### 3.08 EMBANKMENT FILL

- A. Embankment fill may be placed in fill areas to be seeded or sodded if no piping exists in the fill and the areas are at least 10 feet from any structure.
- B. Embankment fill shall be deposited, spread, and leveled in layers generally not exceeding 12 inches in thickness before compaction. Each layer shall be compacted to the degree that no further appreciable consolidation is evidenced under the action of the compaction equipment. The required compaction shall be obtained for each layer before any material for a succeeding layer is placed thereon. Compaction shall be obtained using the hauling and leveling equipment, and in addition, tamping rollers, pneumatic-tired rollers, vibratory rollers, or other types of equipment required to produce the desired results.

### 3.09 CONCRETE FILL

- A. In areas where there is inadequate room for compaction equipment and in other areas as shown or specified, Class X concrete shall be used as fill material.

### 3.10 PLACING GRANULAR CUSHION AND VAPOR BARRIER

- A. When subgrade is prepared for slab-on-grade areas, CONTRACTOR shall place the vapor barrier and granular cushion.
- B. Specific location of vapor barrier (whether directly under slab or under granular cushion) shall be as shown on the Drawings.

### 3.11 PLACING CRUSHED STONE AND GEOTEXTILE FABRIC

- A. The same day that the subgrade is exposed, place geotextile fabric on subgrade, and place 12 inches of crushed stone mat below tank slabs, manholes, vault slabs, and basement floors. Compact in place.
- B. Geotechnical fabric shall extend up the side edge of the stone mat and extend across the top of the stone to a minimum of 12 inches past the edge of base slab.

### 3.12 PIPE BEDDING AND COVER

- A. Immediately prior to placing the pipe, the trench bottom shall be shaped by hand to fit the entire bottom quadrant of the pipe. If pipe is of the bell and spigot type; bell holes shall be provided to prevent the bell from supporting the backfill load. Bell holes shall be large enough to permit proper making of the joint, but not larger than necessary to make the joint. All adjustments to line and grade must be done by scraping away or filling in bedding material under the body of the pipe. Any fill used must be bedding material. If necessary to obtain uniform contact of the pipe with the subgrade, a template shall be used to shape the bedding material. All pipe shall be placed on bedding material at least 4 inches thick. See Drawing 01-975-43A. Bedding material shall then be placed and tamped into place up alongside the pipe in maximum 6-inch layers shovel slicing the bedding material under the haunches to provide firm contact with the pipe. CONTRACTOR shall perform all necessary excavation and shall furnish all necessary material to provide this bedding.
- B. Trenches shall be kept water-free and dry during bedding, laying, and jointing. CONTRACTOR shall provide, operate, and maintain all pumps or other equipment necessary to drain and keep all excavation pits and trenches and the entire subgrade area free from water under any and all circumstances that may arise.

### 3.13 TRENCH BACKFILL CONSOLIDATION

- A. All trenches shall be consolidated as specified in this section for the entire depth and width of the trench.
- B. Consolidation shall be achieved by use of smooth surface vibratory compactors or backhoe operated hydraulic compactors for granular materials and rotating sheepsfoot type mechanisms for loam/clay soils. The lift height shall not exceed 8 inches for walk behind, hand operated, vibratory compactors and sheepsfoot. Lift height shall not exceed 24 inches for self-propelled vibratory drum or backhoe operated hydraulic compactors. Smaller lift heights shall be provided as necessary to achieve the degree of compaction specified.
- C. Unless specified otherwise, backfill material beneath paved areas or future paved areas and within 5 feet of paved areas or future paved areas shall be consolidated as follows: Within 3 feet of the surface 95% of maximum dry density, below 3 feet from the surface to 1 foot above the pipe 90% of maximum dry density, as determined by the modified Proctor Test (ASTM D1557).
- D. Unless otherwise specified, backfill material placed in all other areas shall be compacted to the point where no additional consolidation can be observed from the compaction and backfill equipment being used.

- E. Backfill material not meeting the compaction specification shall be recompactd by CONTRACTOR at no cost to OWNER. Cost for additional testing on recompactd material shall be at CONTRACTOR's expense.

#### 3.14 GRADING

- A. CONTRACTOR shall perform all rough and finish grading required to attain the elevations shown on the Drawings.
- B. Grading Tolerances:
  - 1. Rough Grade: Buildings, parking areas, and sidewalks— $\pm 0.1$  feet.
  - 2. Finish Grade: Granular cushion or crushed stone mat under concrete slabs— $\pm 0.03$  feet.
  - 3. Lawn areas away from buildings, parking areas, and sidewalks— $\pm 0.25$  feet.

#### 3.15 MAINTENANCE OF SURFACE

- A. CONTRACTOR shall maintain all backfilling, resurfacing, repaving, and other surface improvements constructed under this Contract. CONTRACTOR shall, upon proper notice from OWNER, make all repairs in surfaces of trenches and excavations. All expenses incurred by OWNER and/or CONTRACTOR in making repairs and all expenses in maintaining trench and excavation surfaces shall be at the expense of CONTRACTOR regardless of the material used in backfilling trench excavations. OWNER reserves the right to make all emergency repairs necessary to make safe all streets and walks at the expense of CONTRACTOR regardless of the material used in backfilling trench excavations. A maintenance guarantee fund, if specified, will be withheld from the final amount due CONTRACTOR for a period of 6 months, after acceptance of the Work, to provide such maintenance.
- B. CONTRACTOR shall be responsible for controlling dust dispersion during utility and street construction. Remedial actions required as a result of inadequate dust control shall be CONTRACTOR's responsibility. To control dust, CONTRACTOR shall apply calcium chloride or ammonium lignin sulfonate in 12 to 14% solution or other dust control palliative acceptable to OWNER. Prior to application of dust palliative, the street shall be graded smooth.

#### 3.16 COMPACTION TESTING

- A. Compaction tests shall be done by the Testing Firm. Location and frequency of the tests shall be as recommended by the Testing Firm and paid for by OWNER.

END OF SECTION

## SECTION 31 23 19

### DEWATERING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Removal of groundwater to allow belowgrade construction.
  - 2. Site grading to prevent surface water from entering the excavation.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. Payment:
  - 1. The expense for making all extra excavations necessary to prevent water from interfering with the proper construction of the work and for forming all dams or diversions, digging of sumps or pump wells, bailing, and installation and pumping of wells shall be borne by CONTRACTOR.
  - 2. The cost for removal of groundwater and surface water shall be included in the prices bid for the work. No separate payment will be made for dewatering whether accomplished by use of sumps and pumps, well point systems, deep wells, or any other method.
  - 3. Any permits necessary for the dewatering operations shall be obtained and paid for by CONTRACTOR.

##### 1.02 REFERENCES

- A. Wisconsin Administrative Code Chapter NR 141.
- B. See Division 01, Section 01 41 00–Regulatory Requirements for permit requirements and water, erosion, and sediment control.

##### 1.03 SYSTEM REQUIREMENTS

- A. CONTRACTOR shall, at its own expense, keep the excavation clear of water while structures, mains, and appurtenances are being built, utilities are being installed, and fill and backfill are being compacted. Under no conditions shall the work be laid in or under water. No water shall flow over the work until the joints are complete or the concrete has set.
- B. Wherever necessary, CONTRACTOR shall excavate in advance of the completed work, lead the water into sumps or pump wells, and provide erosion control measures to prevent water or sediment damage.
- C. CONTRACTOR's dewatering system shall perform so that the soils within the trench will not be destabilized by hydrostatic uplift pressures from adjacent groundwater. If conditions warrant, CONTRACTOR shall furnish and install well point systems or deep wells.



- D. Dewatering shall be sufficient to lower the piezometric level to at least 2 feet below the bottom of the excavation. Additional lowering shall be provided as necessary to create a stable subgrade.
- E. In areas where rock is encountered, the water level shall be kept at or below top of rock, but at least 6 inches below bottom of concrete. Additional rock shall be removed as needed to provide clearances.
- F. The control of groundwater shall be such that softening or heaving of the bottom of excavations or formation of "quick" conditions or "boils" shall be prevented.
- G. Dewatering systems shall be designed and operated so as to prevent the migration or removal of soils.

#### 1.04 QUALITY ASSURANCE

- A. All dewatering shall be done in accordance with applicable federal, state, and local code requirements.
- B. In particular, groundwater observation wells shall be provided and subsequently abandoned in accordance with NR 141. CONTRACTOR shall complete all observation well construction and abandonment forms as required by NR 141 and shall submit the forms to OWNER within 15 days of construction or abandonment activities.

### PART 2-PRODUCTS

NOT APPLICABLE

### PART 3-EXECUTION

#### 3.01 DEWATERING

- A. Dewatering shall be started, and the water level shall be lowered as specified herein prior to beginning excavation and shall be continued until structure, main, or appurtenance has been completed and fill has been placed and compacted to final grade.
- B. CONTRACTOR shall provide at least two groundwater observation wells near each area to be excavated to aid CONTRACTOR in determining whether the minimum specified requirements have been met prior to excavation. The observation well shall be a minimum 2-inch-diameter slotted PVC pipe. The observation well shall be installed and backfilled in such a way as to allow an accurate determination of actual groundwater levels. The observation well shall be properly abandoned after use unless specified otherwise.
- C. CONTRACTOR shall provide all necessary materials and equipment to keep the excavation free from water during construction. CONTRACTOR shall at all times have on hand sufficient pumping equipment and machinery in good working condition for all ordinary emergencies, including power outages, and shall have available at all times competent workers for the operation of the pumping equipment. The dewatering systems shall not be shut down between shifts, on holidays or weekends, or during the work stoppages.

- D. CONTRACTOR shall meet all requirements of applicable WDNR permits for construction pit or trench dewatering.
- E. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted fill or backfill, and prevent floatation or movement of all structures and pipelines.

### 3.02 PROTECTION

- A. CONTRACTOR shall take all necessary precautions during the dewatering operation to protect adjacent structures against subsidence, flooding, or other damage. The dewatering system shall be installed and operated so that the groundwater level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property. Any such facilities and structures damaged shall be repaired or replaced to the satisfaction of their owner.
- B. In areas where continuous operation of dewatering pumps is required, CONTRACTOR shall avoid noise disturbance to nearby residences to the greatest extent possible by using electric-driven pumps, or intake and exhaust silencers or housing to minimize noise from engine-driven generators or engine-driven pumps.

END OF SECTION

## SECTION 31 25 00

### SLOPE PROTECTION AND EROSION CONTROL

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Erosion control devices.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 PAYMENT

- A. All costs associated with slope protection and erosion control shall be included in CONTRACTOR's Bid. This work shall include, but is not limited to, erecting fence, excavation, placing posts, backfilling, attaching woven wire and geotextile fabric; placing ditch checks; installing sediment traps; removing the fence at completion of project; cleaning and repairing; removing or spreading accumulated sediment to form a surface suitable for seeding; replacing silt fence and damages caused by overloading of sediment material or ponding of water adjacent to silt fence; and furnishing labor, tools, equipment, and incidentals necessary to complete the work in accordance with the Contract.

##### 1.03 REFERENCES

- A. Wisconsin Department of Natural Resources Conservation Practice Standards–Construction Site Erosion and Sediment Control (Conservation Practice Standards).
- B. Erosion Control Product Applicability List (PAL) for Multi-Modal Applications (PAL) Wisconsin Department of Transportation.
- C. Dane County Erosion Control and Stormwater Management Manual (<https://wred-lwrd.countyofdane.com/assistance/ec-manual>).

##### 1.04 REGULATORY REQUIREMENTS

- A. Where land disturbance activities do not exceed one acre, CONTRACTOR shall maintain site conditions where erosion and pollution are controlled.

##### 1.05 QUALITY CONTROL

- A. Construct and maintain erosion sediment control measures in accordance with the Conservation Practice Standards.
- B. Check facilities weekly and after any rainfall event, and make needed repairs within 24 hours.

## PART 2–PRODUCTS

### 2.01 EROSION CONTROL PRODUCTS

- A. Erosion control products shall be as listed in the *Erosion Control Product Acceptability List (PAL)* of the Wisconsin Department of Transportation. Contractors may obtain copies of the PAL and PAL qualification procedures from the WisDOT Bureau of Highway Construction.

### 2.02 EROSION MATS

- A. Erosion mat products shall be selected from the PAL in conformance with criteria specified in Conservation Practice Standard 1052 (Nonchannel Erosion Mat) and 1053 (Channel Erosion Mat).
- B. Unless designated on the Drawings or specified, CONTRACTOR may furnish any prequalified erosion mat product of the class and type listed in the PAL.
- C. A 300 mm by 300 mm sample of a product proposed for erosion mat may be required to verify that it is prequalified. When a sample is required, it shall be accompanied by the manufacturer's literature for the proposed product.

### 2.03 SILT FENCE

- A. Silt fence shall conform to Conservation Practice Standard 1056–Silt Fence and as shown on Drawing 01-975-111A. Silt fence shall conform to Table 2 of Conservation Practice Standard 1056.
- B. Furnish wrapping on each roll of fabric to protect the fabric from ultraviolet radiation and from abrasion during shipping and handling. Keep geotextile dry until installed.

### 2.04 SOIL STABILIZER

- A. Soil stabilizer shall be Type A or Type B. Type A is either a cementitious soil binder added to wood cellulose fiber mulch or a bonded fiber matrix. Type B is a water soluble anionic polyacrylamide meeting requirements specified in Conservation Practice Standard 1050–Land Application of Anionic Polyacrylamide. CONTRACTOR shall provide soil stabilizer products from the PAL.

### 2.05 INLET PROTECTION

- A. Inlet protection shall conform to Conservation Practice Standard 1060–Storm Drain Inlet Protection for Construction Sites. Manufactured bags shall conform to Table 1 of Conservation Practice Standard 1060.

### 2.06 STONE TRACKING PADS AND TIRE WASHING STATION

- A. Stone tracking pads and tire washing stations shall conform to Conservation Practice Standard 1057–Stone Tracking Pad and Tire Washing.

## 2.07 DITCH CHECKS

- A. Ditch checks shall conform to Conservation Practice Standard 1062–Ditch Check (Channel).

## 2.08 MULCHING

- A. Mulching for construction sites shall conform to Conservation Standard Practice 1058–Mulching for Construction Sites.

## 2.09 VEGETATIVE BUFFER FOR CONSTRUCTION SITES

- A. Vegetative buffer shall conform to Conservation Standard Practice 1054–Vegetative Buffer for Construction Sites.

## 2.10 TEMPORARY SEEDING

- A. Temporary seeding for construction site erosion control shall conform to Conservation Standard Practice 1059–Seeding for Construction Site Erosion Control.

## 2.11 BEDDING DIKE

- A. Where shown on the Drawings or requested by ENGINEER in the field, CONTRACTOR shall install clay bedding dikes to prevent groundwater from flowing continuously through the bedding material installed for the sanitary sewer. Bedding dikes shall be 4 feet long and shall extend from the bottom of the trench excavation to within 2 feet of the ground surface and 1 foot beyond the normal trench width on both sides of the trench.

## 2.12 GEOTEXTILE FABRIC

- A. See Section 31 32 19–Geotextiles for fabric under stone, as required.

## 2.13 SEDIMENT TRAPS AND SEDIMENT BASINS

- A. Sediment traps and sediment basins shall conform to WDNR Technical Standards Sediment Trap No. 1063 and Sediment Basin No. 1064.

## 2.14 CONCRETE WASHOUT FACILITY

- A. CONTRACTOR shall provide a temporary concrete washout facility in accordance with the National Pollutant Discharge Elimination System (NPDES). Concrete washout facility shall be located a minimum of 50 feet from any storm drain inlet, open drainage facility, water body, construction traffic, and access area. Provide appropriate signage to inform equipment operators of the washout location.

## 2.15 DUST CONTROL

- A. Dust control shall conform to WDNR Technical Standard Dust Control on Construction Sites No. 1068.

## PART 3-EXECUTION

### 3.01 GENERAL

- A. Install erosion control devices before any soil disturbance or construction activities begin.
- B. Proceed carefully with construction adjacent to stream channels to avoid washing, sloughing, or deposition of materials into the stream. If possible, the work area should be diked off and the volume and velocity of water that crosses disturbed areas be reduced by means of planned engineering works (diversion, detention basins, berms).
- C. Unless noted on Drawings, do not remove trees and surface vegetation.
- D. Stage Construction grading activities to minimize the cumulative exposed area. Conduct temporary grading for erosion control per WDNR Technical Standard Temporary Grading Practices for Erosion Control No. 1067.
- E. Expose the smallest practical area of soil at any given time through construction scheduling. Make the duration of such exposure before application of temporary erosion control measures or final revegetation as short as practicable. CONTRACTOR shall limit section area of disturbance in channels to a maximum of 300 feet per crew. In general, it is expected that streambank stabilization measures will be installed within 5 days of initial disturbance.
- F. CONTRACTOR shall provide a "qualified" inspector to inspect erosion control and sediment controls once in place. Inspector shall have prior experience with and knowledge of installation and maintenance of erosion and pollution controls. Unless stricter requirements are mandated by DNR or by any local permits, project site erosion control inspection shall be conducted every seven days and after each one-half-inch rainfall or greater. CONTRACTOR shall maintain hard copies of the inspection reports for the duration of the Project.
- G. Any necessary repairs to erosion and sediment control facilities shall be provided within 24 hours to all corrective measures noted on the inspection reports to address pollution issues. CONTRACTOR shall submit to OWNER a written notice stating the times, dates and actions taken to rectify the defective erosion and sediment controls.
- H. CONTRACTOR shall also make any necessary additions for erosion and sediment control as may result from on-site conditions or the progress of the Work or as may be required by DNR or OWNER.
- I. Disturbed areas shall be stabilized with temporary or permanent measures within 14 calendar days of the soil disturbance or redistribution.
- J. All temporary erosion and sediment control measures shall be removed within 30 days after final stabilization is achieved or after the temporary measures are no longer needed. All sediment accumulated in temporary and permanent facilities shall be removed and properly disposed of and the area restored.
- K. Immediately stabilize stockpile and surround stockpiles as needed with silt fence or other perimeter control if stockpiles will remain inactive for 7 days or longer.
- L. Sweep and clean up all sedimentation and trash that moves off-site due to construction activity or storm events before the end of the same workday.

- M. Temporary restrooms are to be located a minimum of 50 feet away from any storm drain inlet, open drainage facility, or water body. The location of the temporary rest rooms must be approved by OWNER. Sanitary waste shall be collected from portable units provided by CONTRACTOR a minimum of two times per week to avoid overflowing and maintain sanitary conditions around the unit.
- N. All petroleum products stored on-site shall be stored in adequate containers. All fueling sources shall have spill kits immediately available. All hazardous storage areas must be placed in areas away from stormwater flow patterns and storm sewer basins and inlets.
- O. Concrete trucks shall not be permitted to wash out or discharge surplus concrete or drum wash water on the site. Specific areas for this activity shall be designated by CONTRACTOR and provided with adequate siltation basins and other facilities so that discharge is contained and cleansed before entering the site storm sewer system.
- P. The vegetative growth associated with temporary and permanent seeding, sodding, vegetative channels, etc. shall be maintained periodically and supplied with adequate water and fertilizer nutrients. If necessary, the vegetative cover shall be removed and reseeded as needed.
- Q. The conditions of the construction site for the winter shut down period shall address proper sediment and erosion control early in the fall growing season so that slopes and other bare earth areas may be stabilized. Stabilization shall be land applied soil stabilizer Type B and/or erosion mat urban Class I, Type B for non-channel. Erosion mat Class II, Type B shall be used for channel use. Soil stabilizers and erosion mat shall be in accordance with the Wisconsin Department of Transportation erosion control and stormwater product acceptability lists to provide a stable, temporary, and/or permanent vegetative cover. All areas to be worked beyond the end of the growing season must incorporate soil stabilization measures.
- R. Disturbed areas and areas used for storage of materials and equipment that are exposed to precipitation shall be inspected for evidence of, or the potential for pollutants entering the drainage system. Erosion and sedimentation control measures shall be observed to review that they are operating correctly. Where discharge locations or points are accessible they shall be inspected to ascertain whether erosion control measures are effective in preventing significant impact to receiving waters and adjacent properties. Locations where vehicles enter or leave the site shall be inspected for evidence of off-site sediment tracking.
- S. Make provisions for watering following seeding or planting of disturbed areas whenever more than seven consecutive days of dry weather occur.

### 3.02 EROSION MAT

- A. Erosion mats shall be installed in accordance with manufacturer's requirements and with Conservation Practices Standards 1052 and 1053.
- B. Place erosion mats immediately after seeding operations have been completed. Before mat placement, remove all material or clods over 1 1/2 inches in diameter and all organic material or other foreign material which may interfere with the mat bearing completely on the soil.

- C. Any small stones or clods which prevent contact of the mat with the soil shall be pressed in the soil with a small lawn-type roller or by other means. The mat shall have its lateral edge so impressed in the soil so as to permit runoff water to flow over it.
- D. The matting strips shall be rolled on or laid in direction of flow. Spread mat evenly and smoothly in a natural position without stretching and with all parts bearing on soil. Place blanket with netting on top. Overlap adjacent strips at least 4 inches. Overlap strip ends at least 10 inches. Make overlaps with upgrade section on top.
- E. Bury upgrade end of each strip of fabric or blanket at least 6 inches in a vertical slot cut in the soil and press soil firmly against the imbedded fabric or blanket.
- F. Anchor mats in place with vertically driven staples, driven until their tops are flush with the soil. Space staples on 3-foot centers along mat edges and stagger space at 3-foot centers through the center. Place staples at 10-inch centers at end or junction slots.
- G. Reseed areas damaged or destroyed during erosion mat placing operations as specified for original seeding.
- H. Dispose of surplus excavated materials during erosion mat placing operation as specified for original seeding.
- I. Following mat placement, uniformly apply water to the area to moisten seed bed to 2-inch depth and in a manner to avoid erosion.
- J. Maintain erosion mat and make satisfactory repairs of damage from erosion, traffic, fires, or other causes until Work is accepted.

### 3.03 SILT FENCE

- A. Silt fence shall be constructed in conformance with the criteria specified in Conservation Practice Standard 1056–Silt Fence.
- B. Remove sediment from behind silt fences and sediment barriers before sediment reaches a depth that is equal to one-half of the fence and/or barrier height. Repair breaks and gaps in silt fence and barriers immediately.

### 3.04 SOIL STABILIZER

- A. Soil Stabilizer Type A shall be applied with conventional hydraulic seeding equipment. CONTRACTOR shall take care so that surrounding surfaces, structures, trees, and shrubs are not over-sprayed. Before Work is accepted any over-spray must be satisfactorily cleaned from surfaces. The finished application shall be 3/16-inch to 1/4-inch thick. For permanent slope applications, CONTRACTOR shall sow seed separately before applying the soil stabilizer so that the seed has direct contact with the soil.
- B. Soil Stabilizer Type B shall be applied with conventional hydraulic seeding equipment or by dry spreading. CONTRACTOR shall apply material at the manufacturer's recommended rate. For permanent slope applications, CONTRACTOR shall apply an approved mulch when the soil stabilizer is applied or after it is applied to protect the seed.



### 3.05 INLET PROTECTION

- A. All storm drains that are or will be functioning during construction shall be provided with inlet protection. Inlet protection shall be provided in conformance with the criteria specified in Conservation Practice Standard 1060–Storm Drain Inlet Protection for Construction Sites.

### 3.06 STONE TRACKING PADS AND TIRE WASHING

- A. Tracking pads (tire washing stations as required) shall be installed in accordance with the criteria in Conservation Practice Standard 1057–Stone Tracking Pad and Tire Washing.
- B. Surface water must be prevented from passing through tracking pads. Flows shall be diverted away from tracking pads and conveyed under and around them such as with culverts.
- C. Any sediment tracked onto a road shall be removed before the end of each day. Flushing sediment shall not be allowed.

### 3.07 DITCH CHECKS

- A. Ditch checks shall be provided in conformance with the criteria specified in Conservation Practice Standard 1062–Ditch Checks.

### 3.08 MULCHING

- A. Mulching shall be provided in conformance with the criteria specified in Conservation Practice Standard 1058–Mulching for Construction Sites.

### 3.09 VEGETATIVE BUFFER

- A. Vegetative buffer shall be provided in conformance with the criteria specified in Conservation Practice Standard 1060–Vegetative Buffer for Construction Sites.

### 3.10 SEEDING FOR EROSION CONTROL

- A. Temporary seeding for erosion control shall be provided in conformance with the criteria specified in Conservation Practice Standard 1059–Seeding for Construction Site Erosion Control.

### 3.11 SEDIMENT TRAPS AND SEDIMENT BASINS

- A. Sediment traps for erosion and sedimentation control during interim construction stages shall be installed in accordance with the criteria in Conservation Practice Standard 1063–Sediment Trap and sediment basins with the criteria in Conservation Practice Standard 1064–Sediment Basin. They shall be constructed prior to any disturbances and shall be placed so they function during all phases of the Work.

END OF SECTION

## SECTION 31 32 19

### GEOTEXTILES

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: Geotextiles for areas below structures, at perforated drain pipe trenches, pressure relief valves, below base course, and below riprap.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

#### PART 2–PRODUCTS

##### 2.01 MATERIALS

- A. Geotextile for areas below structures for use at perforated drain pipe trenches and pressure relief valves and as specified elsewhere, shall be Mirafi 140N, or equal.
- B. Geotextile below base course shall be Mirafi 600X, or equal.

#### PART 3–EXECUTION

##### 3.01 INSTALLATION

- A. Geotextile shall be installed in accordance with manufacturer's recommendations.
- B. Geotextile shall be lapped a minimum of 24 inches.
- C. If extensive areas of unstable subgrade are encountered on street areas, ENGINEER may request the furnishing and installation of construction fabric to obtain the necessary subgrade support for the roadway structure. Vibratory compaction shall not be used in the compaction of base course in areas where construction fabrics are used.
- D. CONTRACTOR shall protect the construction fabric from exposure to the sun until installation. Construction fabric shall be covered with stone or soil immediately upon placement.

END OF SECTION

## SECTION 32 11 23

### DENSE-GRADED BASE

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Dense-graded base for streets, roads, and parking areas.
  - 2. Paths, sidewalks, driveways, and miscellaneous areas as shown on the Drawings or specified.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 MEASUREMENT AND PAYMENT

- A. Payment: Payment for dense-graded base shall be made at the Unit Price Bid and shall include all labor, materials, and work necessary for complete installation. Payment will be made based on weight tickets delivered with each truckload of dense-graded base. Payment for base course foundation for sidewalk, concrete and asphalt driveways, and driveway aprons will be considered incidental to those items.

##### 1.03 REFERENCES

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction, current edition, including all issued supplemental specifications.

##### 1.04 DEFINITIONS

- A. Street or road shall include streets, roads, driveways, sidewalks, paths, gravel roads, and parking lots.

##### 1.05 SUBMITTALS

- A. Submit sieve analysis for proposed materials in accordance with Section 01 33 00—Submittals.

##### 1.06 DRAINAGE DURING CONSTRUCTION

- A. CONTRACTOR shall comply with the provisions of Section 205.3.3 of the Standard Specifications.

##### 1.07 QUALITY MANAGEMENT PROGRAM

- A. CONTRACTOR shall comply with the provisions of Section 730 of the Standard Specifications.

## PART 2–PRODUCTS

### 2.01 AGGREGATES

- A. Aggregate for dense-graded base shall consist of crushed stone and shall meet the requirements of Sections 301 and 305 of the Standard Specifications. The material furnished shall be uniformly graded and shall conform to ASTM C33.
- B. Dense-graded base shall conform to the requirements for 3/4-inch dense-graded base, 1 1/4-inch dense-graded base, or 3-inch dense-graded base or as otherwise specified or indicated on the Drawings.
- C. Dense-graded base for top layer of shoulders and for beneath sidewalks, driveways, and paths shall meet the requirements of 3/4-inch dense-graded base unless indicated otherwise on the Drawings.
- D. Salvaged Asphalt Pavement Base:
  - 1. Where indicated on the Drawings, CONTRACTOR shall salvage existing asphaltic pavement for use as dense-graded base for street construction and/or restoration. Work shall be completed in accordance with Section 305 and Section 325 of Standard Specifications as amended herein.
  - 2. Pulverized asphalt millings shall consist of asphalt pavement that has been pulverized in place to the full depth of existing pavement. Pulverized millings shall be graded and compacted to the grades established prior to placement of new asphaltic pavement. Ninety-seven percent of pulverized millings shall pass a 2-inch screen with all material less than 4 inches in its longest dimension.
  - 3. Reclaimed asphalt millings shall consist of asphalt pavement that has been milled and transported for use as base course for street construction and/or restoration. One hundred percent of salvaged millings shall pass a 1 1/4-inch screen.

## PART 3–EXECUTION

### 3.01 PREPARATION

- A. The subgrade shall be graded and rolled to provide uniform density and shall comply with the profile and cross sections contained in the Drawings. All street subgrade in cut areas and all areas to receive fill shall be proof-rolled in the presence of OWNER or ENGINEER with a heavily loaded triaxle dump truck or similar equipment prior to the placement of any fill materials or base course. The subgrade shall be prepared in accordance with Section 211 of the Standard Specifications.

### 3.02 CONSTRUCTION

- A. CONTRACTOR shall comply with the provisions of Section 305.3 of the Standard Specifications.
- B. Dense-graded base grade shall be set to allow placement of thickness of asphaltic pavement shown or specified.
- C. Depth of dense-graded base shall be provided according to the typical sections or details provided on the Drawings.

- D. Where typical sections or details are not provided, depth of dense-graded base for streets and roadways shall be the existing depth or 12 inches, whichever is greater, and depth of base course for sidewalks, driveways, or paths shall be minimum 4 inches.
- E. The top 4 inches of dense-graded base course for streets and roadways shall be 1 1/4-inch dense grade base. The remaining base course shall be 3-inch dense grade base. The term Breaker Run Stone where referred to in the Drawings, WisDOT Specifications, and Bid, shall mean 3-Inch Crushed Stone Dense Graded Base, unless otherwise stated.
- F. For excavation below subgrade, 3-inch dense graded base shall be placed on a geotextile fabric, if included, and backfilled to the depth of the excavation below subgrade.
- G. Dense-graded base shall be placed directly on subgrade areas or on top of salvaged asphaltic millings unless otherwise indicated on the Drawings.
- H. Each layer of dense-graded base shall be wetted and rolled to provide maximum compaction in accordance with Section 305 of the Standard Specifications.
- I. The finished dense-graded base shall be fine graded in preparation for paving.
- J. After final grading, CONTRACTOR shall maintain the dense-graded base until asphaltic paving work has been completed.
- K. All gravel surfaces damaged during construction shall be replaced. The depth of aggregate shall match existing or 12 inches, whichever is greater.
- L. Dense-graded base shall be uniformly compacted to a dry density at least 95% of the maximum dry density as determined by a laboratory compaction test at the optimum moisture content (ASTM Test Designation D1557 Modified Proctor Method). Compaction shall be obtained by compaction equipment appropriate for the conditions and the material placed.

END OF SECTION

## SECTION 32 11 26

### HOT MIX ASPHALT PAVING

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work includes hot mix asphalt (HMA) paving, tack coat, and casting adjustments and other miscellaneous items.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 MEASUREMENT AND PAYMENT

- A. Payment: Payment for HMA paving shall be considered incidental to the project and included in the Lump Sum Bid.

##### 1.03 REFERENCES

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction, current edition, including all issued supplemental specifications.

##### 1.04 SUBMITTALS

- A. Prior to the commencement of paving, mix designs and aggregate sieve analysis shall be submitted to ENGINEER for approval in accordance with Section 01 33 00—Submittals.
- B. Provide documented observations, records, mixture adjustments, and test results daily. CONTRACTOR shall record process adjustments and Job Mix Formula changes.
- C. Submit copies of the running average calculation sheets for blended aggregate, mixture properties, and asphalt contents along with mixture adjustment records to ENGINEER each day.
- D. Submit test records and control charts to ENGINEER in a neat and orderly manner within 10 days after paving is complete.

#### PART 2—PRODUCTS

##### 2.01 HMA PAVEMENT

- A. Asphaltic pavement shall be HMA Pavement LT 58-28 S for both lower layer and upper layer.
- B. Aggregate shall conform to the requirements of Section 460.2.2 of the Standard Specifications. Aggregate for both lower layer and upper layer shall be 12.5 mm (1/2 inch nominal). Aggregates for upper layers less than 1.75 inches thick shall be 9.5 mm (3/8 inch nominal).

- C. Materials for tack coat shall conform to the requirements of Section 455.2.5 and shall be MS-2, SS-1, SS-1h, CSS-1 or CSS-1h.

### PART 3-EXECUTION

#### 3.01 ALLOWABLE REMOVAL OF PAVEMENT

- A. CONTRACTOR shall remove asphalt pavement and road structure as a part of the Common Excavation. The width of pavement removed shall be the minimum possible and acceptable for convenient and safe installation of structures, utilities, and appurtenances.
- B. All asphalt pavement shall be cut on neat, straight lines and shall not be damaged beyond the limits of the excavation. Should the cut edge be damaged, a new cut shall be made in neat, straight lines parallel to the original cut encompassing all damaged areas. Pavement removal shall be extended to a seam or joint if seam or joint is within 3 feet of damaged pavement.

#### 3.02 TACK COAT

- A. CONTRACTOR shall provide tack coat between all layers of new asphalt and on existing pavement to be overlaid with new asphalt. Tack coat shall meet the requirements of Section 455 of the Standard Specifications.
- B. In situations where traffic must be maintained, tack coat shall not be placed on the traveled half of the street until traffic can be switched to the new pavement.

#### 3.03 JOINTS

- A. Joints between old and new pavements or between successive day's work shall be constructed and treated as to provide a thorough and continuous bond between the old and new mixtures. Transverse construction joints shall be constructed by cutting the material back for its full depth so as to expose the full depth of the course. Where a header is used, the cutting may be omitted provided the joint conforms to the specified thickness. These joints shall be treated with tack coat material applied with a hose and spray nozzle attachment to fully coat the joint surface.
- B. The longitudinal joint shall be made by overlapping the screed on the previously laid material for a width of not more than 2 inches and depositing a sufficient amount of asphaltic mixture so that the finished joint will be smooth and tight. Longitudinal joints in the upper layer shall at no time be placed immediately over similar joints in the lower layer beneath. A minimum distance of 12 inches shall be permitted between the location of the joints in the lower layer and the location of similar joints in the upper layer above.
- C. All costs for furnishing and applying tack coat to butt joints as specified above shall be considered incidental.

#### 3.04 FINISHING ROADWAY

- A. The finished dense graded base course shall be fine-graded in preparation for HMA paving. Dense graded base course ramps at all existing pavement shall be removed to provide a full

depth butt joint. Dense graded base course around manhole castings and valve boxes shall be hand-trimmed and compacted with a vibratory plate compactor.

- B. This item shall include all of the following preparatory and finishing items and any other incidental items of work required for construction. Asphaltic ramps around manholes on existing lower layer to receive upper layer shall be removed. Asphaltic ramps shall be installed at all manholes and at all butt joints in areas to receive lower layer only.
- C. Finishing roadway shall be considered incidental to HMA paving.

### 3.05 TESTING HOT MIX ASPHALT

- A. ENGINEER may require samples of HMA pavement for testing. CONTRACTOR shall cut samples from the finished pavement where marked by ENGINEER and patch the sample area. Samples for sieve analysis and asphalt content will be taken by ENGINEER prior to placement.
- B. The minimum required density for HMA pavement shall be as indicated in Table 460-3 of the Standard Specifications.

### 3.06 HOT MIX ASPHALT PAVING

- A. HMA paving work shall include the construction of plant-mixed hot mix asphalt pavement in the areas shown on the Drawings. All work shall be performed in accordance with Sections 450, 455, 460, and 465 of the Standard Specifications.
- B. Prior to commencement of paving operations, CONTRACTOR shall examine the finished road bed. CONTRACTOR shall notify ENGINEER of any areas of suspected instability.
- C. The pavement structure for streets, roads, driveways, and paths shall be in accordance with the typical sections shown on the Drawings.
- D. Where standard sections are not provided, the minimum pavement structure shall be as follows:
  - 1. 2 1/4 inches of asphaltic concrete lower layer for street, roadway, and parking lot construction.
  - 2. 1 3/4 inches of asphaltic concrete upper layer for street, roadway, and parking lot construction.
  - 3. 2 1/2 inches of upper layer material for bike paths, sidewalks, and asphalt driveways.
- E. Pavement thickness for trench restoration shall match adjacent pavement thickness or minimum thickness as specified for street construction, whichever is greater.

END OF SECTION



## SECTION 32 16 13

### CONCRETE CURB AND GUTTER, SIDEWALKS, DRIVEWAYS, AND DRIVEWAY APRONS

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work includes concrete curb and gutter, sidewalks, driveways, and driveway aprons, and base course foundation for sidewalks, driveways, and driveway aprons as shown on the Drawings.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 MEASUREMENT AND PAYMENT

- A. All costs of the Work shall be included in the Lump Sum Bid.

##### 1.03 REFERENCES

- A. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction, current edition, including all issued supplemental specifications.
- B. AASHTO M148 Standard Specifications for Liquid Membrane–Forming Compounds for Curing Concrete.

##### 1.04 QUALITY ASSURANCE

- A. Unless otherwise specified, all curb and gutter, sidewalks, driveway, and driveway apron construction shall meet the requirements of the Standard Specifications.

##### 1.05 QUALITY MANAGEMENT PROGRAM

- A. For concrete curb and gutter, sidewalks, driveways, and driveway aprons, CONTRACTOR shall comply with the provisions of Section 716 of the Standard Specifications for Class II concrete.
- B. For concrete pavement, CONTRACTOR shall comply with the provisions of Section 715 of the Standard Specifications for Class I concrete.

#### PART 2–PRODUCTS

##### 2.01 CONCRETE

- A. All concrete shall conform to Section 501 of the Standard Specifications for Grade A or A-FA air entrained concrete with a minimum 28-day compressive strength of 4000 psi.

## 2.02 CURING COMPOUND

- A. Liquid curing compounds shall conform to the requirements of the Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete, AASHTO Designation M148, Type 2, White Pigmented.

## PART 3—EXECUTION

### 3.01 BASE PREPARATION—CURB AND GUTTER

- A. The dense graded base beneath the curb and gutter shall be trimmed or filled as necessary to provide a full depth of curb and gutter as detailed. In the absence of a detail, the dense graded base depth shall be to the adjacent street subgrade with a minimum of 4 inches. Prior to placement of concrete, the dense graded base shall be thoroughly compacted and moistened.

### 3.02 BASE PREPARATION—SIDEWALKS AND DRIVEWAYS

- A. The subgrade shall be thoroughly compacted and finished to a trim, firm surface. All soft or unsuitable material shall be removed and replaced with suitable material.

### 3.03 BASE COURSE

- A. Base course beneath curb and gutter, sidewalks, and driveways shall comply with Section 32 11 23—Dense-Graded Base.

### 3.04 FORMS

- A. Forms shall be of metal and of sufficient strength to resist distortion or displacement. Metal forms shall be used to construct a curb and gutter cross section as shown on the Drawings. Forms shall be full depth of the required work. Facing boards, if used, shall be built so as to obtain the cross section called for on the Drawings. Forms shall be securely staked and held firmly to line and grade. Forms shall be cleaned thoroughly and oiled before reuse. Where machines are used, concrete mixture shall be controlled to prevent distortion from sloughing.
- B. All curved curb and gutter shall form smooth curves and shall not be a series of chords. Radius forms shall be used for all curved curb and gutter where the radius of curvature is 100 linear feet or less.

### 3.05 PLACING AND FINISHING CONCRETE

- A. Unless otherwise specified, concrete shall be placed in accordance with the Standard Specifications.
- B. Concrete shall be thoroughly vibrated to remove all voids. The exposed surface shall be thoroughly troweled and finished with a brush at right angles to vehicular or pedestrian traffic. All edges shall be rounded with a 1/4-inch-radius edger. Honeycombed areas shall be pointed and rubbed with mortar to provide a void-free surface.
- C. Before final finishing, a 10-foot straight edge shall be used to check the surface. Any areas showing a variation of more than 1/4 inch from the straight edge shall be corrected. Final

finishing shall be delayed a sufficient time so that excess water and grout will not be brought to the surface.

- D. Concrete for sidewalk shall be placed to a minimum thickness of 5 inches, except at driveways and alleys, which shall have a minimum thickness of 7 inches. Driveways, driveway aprons, and curb ramps shall have a minimum thickness of 7 inches. The concrete shall be thoroughly vibrated to remove all voids. The surface of the driveway or sidewalk shall be thoroughly troweled and finished with a brush at right angles to the driveways or sidewalk line.

### 3.06 REJECT SECTIONS

- A. At locations shown on the Drawings, the curb and gutter shall be warped so as to reject the flow of water. The transition from a standard section to a reject section shall not be abrupt but shall be a minimum of 10 feet in length. The reject section shall conform to the Detail Drawings.

### 3.07 JOINTING--SIDEWALKS AND DRIVEWAYS

- A. Concrete sidewalk shall be segmented into 5-foot-long rectangular blocks with tooled joints. Concrete driveways shall be segmented into uniform rectangular blocks with tooled joints at a maximum spacing of 10 feet in each direction. The joint must extend at least one-fifth of the total thickness of concrete. The edges of the sidewalk along forms and joints shall be rounded with an edging tool of 1/4-inch radius. All joints shall be at right angles to the centerline of the sidewalk.
- B. Concrete driveways shall be jointed in approximately square sections. The depth of the joint and the finishing of the edges shall be the same as for concrete sidewalk.

### 3.08 EXPANSION JOINTS

- A. A 1/2-inch-thick asphaltic expansion joint filler shall be placed at sidewalk-driveway intersections, between sidewalks and buildings, between back of curb and sidewalk, at intersection between new or existing curb and gutter, around all castings, and at maximum 96-foot intervals in sidewalks.

### 3.09 SLOPE

- A. Sidewalk cross slope shall be 1.5 percent unless otherwise noted in the Drawings or requested by ENGINEER.

### 3.10 CURING

- A. As soon after finishing operations as the free water has disappeared, the concrete surface shall be sealed by spraying on it a uniform coating of curing material in such a manner as to provide a continuous water impermeable film on the entire concrete surface.
- B. The material shall be applied to form a uniform coverage at the rate of not less than one-half gallon per 100 square feet of surface area.
- C. Within 30 minutes after the forms have been removed, the edges of the concrete shall be coated with the curing compound applied at the same rate as on the finished surface.

### 3.11 PROTECTION OF CONCRETE

- A. CONTRACTOR shall erect and maintain suitable barricades to protect the new concrete. Where it is necessary to provide for pedestrian traffic, CONTRACTOR shall, at their own cost, construct adequate crossings. Crossing construction shall be such that no load is transmitted to the new concrete.
- B. Any part of the work damaged or vandalized prior to final acceptance shall be repaired or replaced at the expense of CONTRACTOR in a manner satisfactory to ENGINEER.
- C. Pedestrian traffic shall not be permitted over new concrete prior to 72 hours after application of curing material. Vehicular traffic shall not be permitted over newly placed concrete until a minimum compressive strength of 3,000 psi has been achieved.

### 3.12 CONCRETE TESTING

- A. Concrete testing shall be in accordance with Section 03 30 00—Cast-In-Place Concrete.

END OF SECTION

## SECTION 32 92 19

### SEEDING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Preparation of Subsoil.
  - 2. Topsoil.
  - 3. Seeding, Mulching or Erosion Mat, and Fertilizing.
  - 4. Maintenance.
- B. Except for paved, riprapped, or built-up areas, all areas of the site which are disturbed and areas noted on the Drawings shall be seeded. Prior to seeding, disturbed areas shall be graded to subgrade for placement of topsoil. Surfaces on 3-to-1 slope or less may either be seeded.
- C. CONTRACTOR shall proceed with restoration of property and cleanup of all disturbed areas concurrently with the installation of utilities and street construction.
- D. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 MEASUREMENT AND PAYMENT

- A. Payment: Payment for topsoil, seeding, fertilizer, mulching, erosion mat, and maintenance of restored areas shall be included in the Lump Sum Bid. One percent of the total Contract price shall be retained following project completion until a uniform 2-inch growth of vegetation is established over all restored areas.

##### 1.03 REFERENCES

- A. FS O-F-241–Fertilizers, Mixed, Commercial.
- B. Standard Specifications: Unless otherwise indicated, Standard Specifications shall refer to the State of Wisconsin Department of Transportation, Standard Specifications for Highway and Structure Construction, current edition, including all issued supplemental specifications.

##### 1.04 QUALITY ASSURANCE

- A. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

##### 1.05 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.

- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

## PART 2–PRODUCTS

### 2.01 SEED MIXTURE

- A. Seed materials shall conform to Section 630 of the Standard Specifications for No. 40 Seed.
- B. Weed content shall not exceed 0.5% in mixture.

### 2.02 SOIL MATERIALS

- A. Topsoil shall consist of salvaged topsoil or hauled-in topsoil in accordance with Section 625 of the Standard Specifications.

### 2.03 ACCESSORIES

- A. Erosion mat shall be in accordance with the WisDOT Erosion Control Product Acceptability List (PAL).
- B. Fertilizer shall be in accordance with Section 629 of the Standard Specifications for Type A fertilizer. Fertilizer shall be provided for seed locations.
- C. Water shall be clean, fresh, and free of substances or matter which could inhibit vigorous growth of grass.
- D. CONTRACTOR shall be responsible for watering in accordance with Section 630 and Section 631 of the Standard Specifications.

## PART 3–EXECUTION

### 3.01 GENERAL

- A. CONTRACTOR shall proceed with restoration of property and cleanup of all disturbed areas concurrently with the installation of utilities and street construction.

### 3.02 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of this section.

### 3.03 PREPARATION OF SUBSOIL

- A. Prepare subsoil to eliminate uneven areas and low spots. Maintain lines, levels, profiles, and contours. Make changes in grade gradual. Blend slopes into level areas.
- B. Remove foreign materials, weeds, and undesirable plants and their roots. Remove contaminated subsoil in accordance with local, state, and federal regulations.

- C. Scarify subsoil to a depth of 3 inches where topsoil is to be placed. Repeat deep (> 12 inches) subsoiling or cultivation in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

#### 3.04 PLACING TOPSOIL

- A. Place topsoil in accordance with Section 625 of the Standard Specifications.
- B. Spread topsoil to a minimum depth of 6 inches over area to be seeded. Rake until smooth.
- C. Place topsoil during dry weather and on dry unfrozen subgrade.
- D. Remove vegetable matter and foreign nonorganic material from topsoil while spreading.
- E. Grade topsoil to eliminate rough, low or soft areas, and to provide positive drainage.
- F. Manually spread topsoil around trees, plants, and buildings to prevent damage.
- G. Leave stockpile area and site clean and raked, ready to receive landscaping.
- H. Engineered topsoil placement of 24 inches by CONTRACTOR is required within bioretention basin areas except as noted otherwise.

#### 3.05 FERTILIZING

- A. Apply fertilizer in accordance with Section 629 of the Standard Specifications.
- B. Apply fertilizer after smooth raking of topsoil and prior to installation of seed.
- C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.
- D. Mix fertilizer thoroughly into upper 2 inches of topsoil.
- E. Lightly water to aid the dissipation of fertilizer.

#### 3.06 SEEDING

- A. Apply seed in accordance with Section 630 of the Standard Specifications. Apply evenly in two intersecting directions. Rake in lightly or roll the seeded area after seeding.
- B. Planting season shall be between April 15 and June 15, or between August 15 and October 15.
- C. Do not sow immediately following rain, when ground is too dry or during windy periods.
- D. Seeding shall be maintained by CONTRACTOR until grass is well established. Grass is well established when it covers the entire seeded areas to a height of 2 inches.
- E. Place erosion control mats per Section 31 25 00–Slope Protection and Erosion Control.

### 3.07 MAINTENANCE

- A. Seeding shall proceed concurrently with the main construction. Seeding shall be maintained by CONTRACTOR until grass is well established. Grass is well established when it covers the entire seeded areas to a height of 2 inches.
- B. Mow grass at regular intervals to maintain at a maximum height of 2 1/2 inches. Do not cut more than one-third of grass blade at any one mowing.
- C. Immediately remove clippings after mowing.
- D. Water to prevent grass and soil from drying out.
- E. Roll surface to remove minor depressions or irregularities.
- F. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
- G. Immediately reseed areas which fail to show adequate catch. Bare spots shall not exceed 5 square feet in area and not exceed 3% of the total seeded areas.
- H. Protect seeded areas with warning signs during maintenance period.
- I. Immediately reseed areas which do not show a satisfactory stand of established grass.
- J. Correct damage resulting from erosion, gullies, rills, or other causes by filling with topsoil, tamping, refertilizing, and reseeding if damage occurs prior to acceptance of work.
- K. Maintain seeded lawns for not less than 60 days after substantial completion.
- L. If seeded in fall and not given full 60 days of maintenance, or if not considered acceptable at that time, continue maintenance the following spring until acceptable lawn is established.
- M. Maintain lawns by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading, and replanting as required to establish a smooth acceptable lawn free of eroded or bare areas.

END OF SECTION



## SECTION 32 94 00

### TREES, PLANTS, STONE MULCH, AND EDGING

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. Trees and Plants.
  - 2. Stone Mulch.
  - 3. Plastic Edging.
  - 4. Maintenance.
  - 5. Tree Pruning.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 QUALITY ASSURANCE

- A. Nursery Qualifications: Company specializing in growing and cultivating the plants with 3 years' experience. Plant materials shall be free of disease and hazardous insects.
- B. Installer Qualifications: Company specializing in installing and planting the plants with 3 years' experience.
- C. Tree Pruner Qualifications: Company specializing in pruning trees with proof of Arborist Certification.

##### 1.03 WARRANTY

- A. All plant material is to be fully guaranteed throughout the correction period. Only those plants that are alive and normally healthy for the first year will be accepted. Unaccepted material shall be removed and replaced by CONTRACTOR at no cost to OWNER during the next suitable growing season.
- B. Replacement plants shall be the same size and species as specified, planted in the next growing season, with a new warranty commencing on date of replacement.

#### PART 2–PRODUCTS

##### 2.01 PLANT MATERIALS

- A. Plant names shall conform to those given in Standardized Plant Names, 1942 Edition, American Joint Committee on Horticultural Nomenclature. All plants shall be true to name and legibly tagged as to name and size. Federal or other governmental certificates of inspection shall accompany all shipments as required.
- B. Plant materials, methods, etc. shall conform to the latest edition of ANSI Z60.1.

- C. CONTRACTOR shall have investigated the sources of supply and shall be satisfied that CONTRACTOR can supply the listed plants in the size, variety and quality specified before submitting a Bid. Failure to do so will not relieve CONTRACTOR of the responsibility for furnishing and installing all plant materials in strict accordance with the Contract Documents.
- D. All material shall be the highest quality. Plants shall have typical growth habit for their species. Plants shall be sound, healthy, vigorous, and free from insect pests, plant diseases, and injury. One sided plants and plants taken from tightly planted nursery rows will be rejected.
- E. All plants shall equal or exceed measurements specified, measured before pruning with branches in normal position. Height and spread refers to main body of plant and not from tip to tip of branches and roots. Trees shall have a well-defined central leader.
- F. Trees with multiple leaders, unless specified, will be rejected. Trees with a damaged, cut, or crooked leader, included bark, abrasion of bark, sunscald, disfiguring knots, insect damage, mold, or prematurely opened buds are cause for rejection.

## 2.02 FERTILIZER

- A. Fertilizer shall be equal to Milorganite (6-2-0), or equal, uniform in composition and free-flowing. Fertilizer that becomes caked or otherwise damaged, making it unsuitable for use, will not be accepted. Rate of application shall be as recommended by nursery.

## 2.03 MULCH MATERIALS

- A. Stone Mulch: Stone mulch shall be 1 1/2-inch decorative landscape stone.

## 2.04 ACCESSORIES

- A. Edging: Black Diamond by Valley View Industries; commercial edging by COL-MET, or equal. Plastic edging shall have a minimum 4-inch side wall and 1-inch-diameter head and shall have a V-lip configuration for added stiffness and anchor-holding power.
- B. Membrane: 20-mil-thick, water-permeable polyolefin fabric.
- C. Wrapping Materials: Burlap or other commercial-grade tree wrap.
- D. Stakes: Softwood lumber, pointed end or mild steel angle, galvanized, pointed end.
- E. Cable, Wire, Eye Bolts: Noncorrosive, of sufficient strength to withstand wind pressure and resulting movement of plant life.
- F. Tree Protectors: Rubber sleeves over cable to protect tree stems, trunks, and branches.

## PART 3—EXECUTION

### 3.01 PLANTING

- A. Plants should be planted on the day of delivery. If this is not possible, protect the stock not planted. Plant material shall be kept in the shade, well protected with soil, wet moss or other

acceptable material, and shall be well watered. Plants shall not be bound with wire or rope at any time to avoid damaging the bark or breaking branches.

- B. Plants shall be lifted and handled from the bottom of the ball only. Plants moved with a ball will not be accepted if the ball is cracked, loose, or broken before or during the planting operations.
- C. Fertilizer shall be delivered to site in original, unopened containers, each bearing manufacturer's guaranteed analysis. Packaged materials shall be stored off ground and protected from moisture.
- D. CONTRACTOR shall coordinate planting Work with installation of sod and the construction of other site features.
- E. CONTRACTOR shall take precautions to provide that equipment and vehicles do not disturb or damage existing site grading, walks, drives, utilities, plants, etc., and shall replace and/or return to original condition any damage caused by CONTRACTOR's negligence at no cost to OWNER.
- F. CONTRACTOR shall maintain plantings immediately upon installation of plants and continue until acceptance, including watering, weeding, removal of dead material, resetting of plants to proper grade and plumb position, and other necessary operations.
- G. Plants shall be alive and in good, healthy, and flourishing condition of growth at the end of the correction period.
- H. Any plant installed under this Contract that is dead or not in a vigorous, thriving condition shall be removed from the site and replaced at CONTRACTOR's cost as soon as conditions permit during the normal planting season. In case of any questions regarding the condition of a rejected plant, CONTRACTOR may elect to allow such plant to remain through another complete growing season. If at that time, the rejected plant is found to be dead or in an unhealthy or badly impaired condition, it shall be replaced. One replacement after acceptance shall constitute fulfillment of CONTRACTOR's guarantee for the particular plant replaced. All replacements shall be plants of the same kind and size as specified originally. CONTRACTOR shall make all necessary repairs required because of plant replacements. Such repairs shall be done at no extra cost to OWNER. Plants shall be replaced, mulched, wrapped, fertilized, pruned, and restored to original condition at no extra cost to OWNER.
- I. Plant pits shall be excavated with vertical sides. These holes shall be no deeper than the depth of the ball, container, or root system when the plant is at its proper grade. Set plants vertical.
- J. Place topsoil in holes around roots or balls, mixed with fertilizer and peat moss or compost. Topsoil around roots shall be compacted and watered. After plant pit is backfilled, shallow basin shall be formed with ridge of soil to facilitate watering.
- K. Place plants where indicated on the Drawings. Position plants for appearance.
- L. Remove nonbiodegradable root containers and twine.
- M. Soil excavated from plant pits that is similar in nature to topsoil and is determined to be suitable for planting soil shall be thoroughly mixed with one part of peat to five parts of

existing soil. Very poor soils of clay, gumbo, gravel, hard-pan, or other soils injurious to plants shall not be used.

- N. If quantity of soil excavated from planting pits is not adequate for planting, CONTRACTOR shall furnish imported planting soil consisting of partially decomposed vegetable matter of natural occurrence. Such soil shall be black, clean, low in content of mineral or woody material, mildly acidic, fertile and friable. This soil shall be mixed with one part of peat to five parts of soil. Peat shall be a domestic product consisting of partially decomposed vegetable matter of natural occurrence; black, clean, granulated, or shredded.
- O. Deciduous trees and shrubs shall be planted from September 15 to December 1 and from April 1 to June 1. All trees and shrubs shall be planted to provide the maximum growing time allowable under the Contract Times. At the option and on full responsibility of CONTRACTOR, planting operations may be conducted under unseasonable conditions without additional compensation or change to warranty.
- P. CONTRACTOR shall stake out on the ground the location of all plants before excavation is begun, and review layout with OWNER. Plants installed at incorrect locations shall be relocated by CONTRACTOR at no expense to OWNER.
- Q. CONTRACTOR shall excavate the plant pit, centered at the location stake, cylindrical in shape with vertical sides and flat or saucer-shaped bottom. Planting soil for backfilling shall be kept separate from excavated subsoil. Pit shall be large enough to provide at least 12 inches of planting soil backfill around and beneath the root system. Where surface or subsurface conditions prevent digging a plant pit to specified dimensions, obtain approval from landscape architect to modify location or pit dimensions.
- R. The root ball shall be centered in the plant pit resting on 12 inches of planting soil well-tamped. The plant hole shall be backfilled with planting soil placed in layers around the root ball. Each layer shall be hand-tamped in place in a manner to avoid injury to roots and ball. When approximately two thirds of the plant hole has been backfilled, the hole shall be filled with water to allow the soil to settle around the roots. Top of root ball shall be 1 inch above surrounding grade. The cord or wire securing burlap at base of tree shall be cut, with the burlap folded back.
- S. Just prior to observation for acceptance, CONTRACTOR shall prune all plantings. The amount of pruning will be limited to the minimum necessary to remove dead or injured twigs and branches to compensate for loss of roots as a result of transplanting operations. Pruning shall be done in such a manner as not to change the natural habit or shape of the plant.
- T. CONTRACTOR shall promptly remove any soil, peat, or similar material that has been brought onto paved areas by planting operations, keeping those areas clean at all times, and shall remove all debris resulting from planting operations from the site.
- U. Replacement plantings shall match existing plant type, with minimum 4-year nursery growth.

### 3.02 INSTALLATION OF ACCESSORIES

- A. Place edging around stone mulch and planting areas where shown on the Drawings. Install edging using stakes at approximately 4 feet on center.
- B. Place membrane (weed barrier) in all areas to receive stone.

C. Wrap deciduous shade and flowering tree trunks and place tree protectors.

### 3.03 TREE PRUNING

A. Each tree and shrub shall be pruned in accordance with good horticulture practice to preserve natural character of plant and to facilitate growth.

### 3.04 MULCH

A. Place stone mulch to 3-inch depth over membrane in all areas indicated on the Drawings.

### 3.05 MAINTENANCE

A. Maintain plant life for 3 months after date of substantial completion.

B. Neatly trim plants where necessary.

C. Immediately remove clippings after trimming.

D. Water to prevent soil from drying out.

E. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions.

F. Apply pesticides in accordance with manufacturer's instructions.

END OF SECTION

## SECTION 33 00 10

### BURIED PIPING AND APPURTENANCES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. All underground piping, valves, and appurtenances of every description.
  - 2. Excavation, dewatering, and backfilling for all work under this section unless otherwise noted.
  - 3. Concrete foundations and anchor bolts for all equipment furnished under this section.
  - 4. Underground piping connections to all equipment, whether furnished under this section or not.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.
- C. Measurement and Payment: Payment for all work, including materials, equipment, and miscellaneous items necessary to complete the installation, will be made at the Lump Sum Bid for buried piping and appurtenances.

##### 1.02 REFERENCED SPECIFICATIONS

- A. WisDOT Specifications in the Standard Specifications shall refer to the State of Wisconsin Department of Transportation, Division of Highways, Standard Specifications for Highway and Structure Construction, Latest Edition, including the Effective ASP 6.
- B. Conservation Practice Standards in the Standard Specifications shall refer to the Wisconsin Department of Natural Resources Conservation Practice Standards—Construction Site and Sediment Control.

##### 1.03 CODES AND STANDARDS

- A. Comply with the requirements of:
  - 1. Wisconsin Administrative Code SPS 365—Fuel Gas Appliances and applicable standard(s).
  - 2. NFPA 54—National Fuel Gas Code (Current Edition).
  - 3. Polyethylene gas distribution piping shall be installed in accordance with CFR 49, Part 192, Subpart G (mains), Subpart H (service lines), applicable codes and regulations, and ASTM D2774.
- B. Before any polyethylene fusion welding is performed, CONTRACTOR shall submit certification that the welders to be used on this project have successfully demonstrated proper welding procedures in accordance with the Code of Federal Regulations, Title 49, Part 192, Section 192.285.
- C. ENGINEER and OWNER reserve the right to test the work of any welder employed on the project, at CONTRACTOR's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project.

## 1.04 SUBMITTALS

- A. Shop Drawings: General arrangement drawings of 3 inches or larger exterior (belowground) ductile iron piping shall be submitted to ENGINEER for approval. Drawings shall include proposed materials, length, location, and elevation of pipe, fittings, pipe restraint, valves, and appurtenances.

## PART 2—PRODUCTS

### 2.01 MATERIALS OF CONSTRUCTION

- A. All materials used in the manufacture, assembly, and painting of piping and valves in contact with water shall be compatible with potable water supplies and in contact with chemical feed systems shall be compatible with the chemicals being used. All glues, solvents, solders, etc., shall likewise be compatible. For instance, no lead-base solders shall be used. All materials in contact with water to be used for potable water supplies shall be National Sanitation Foundation (NSF)-approved.
- B. Size and Type:
  - 1. All materials shall conform to the size and type shown on the Drawings or called for in the specifications.
  - 2. In joining two dissimilar types of pipe, standard fittings shall be used when available. In the event standard fittings are not available, the method of joining shall be standard selected by CONTRACTOR and submitted for review by ENGINEER.
- C. Materials provided shall be suitable for the conditions in which they are being installed and used. CONTRACTOR shall review installation requirements of the Contract with material suppliers and incorporate any additional installation requirements necessary to meet the required use within the price bid for the Work.
- D. All pipe and materials used in performance of the Work shall be clearly marked as to strength, class, or grade. Pipe and materials not so marked shall be subject to rejection.
- E. When requested by ENGINEER, material suppliers shall furnish certificates of compliance indicating that all tests required by various Standards have been conducted and that the test results comply with the Standards.
- F. Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be selected by CONTRACTOR and submitted for review by ENGINEER.

### 2.02 UNDERGROUND UTILITY STRUCTURES

- A. Valve Boxes:
  - 1. A valve box shall be provided for fire hydrant auxiliary valves and for valves in the main. The valve box shall be centered and plumb over the wrench nut of the valve with the box cover flush with the finished ground elevation. Solid 4-inch concrete blocks shall be placed under the base of valve boxes so that the bottom of the base is about 2 inches away from contact with the valve bonnet. A Gate Valve Adaptor by Adaptor Inc., or equal, shall be provided. The valve box shall not transmit shock or stress to the valve.

2. Valve boxes shall be made of cast iron conforming to ASTM A48. The castings shall be free from blowholes, porosity, hard spots, shrinkage defects or cracks, or other injurious defects and shall have a normal smooth casting finish. The castings shall be thoroughly coated with a 1 mil minimum thickness bituminous coating. Valve boxes shall be 5 1/4 inches in diameter. Valve boxes shall have a maximum length of 7 feet when extended without extension sections. Extensions shall be provided for deeper mains.
3. Valve boxes shall consist of a base section, tubular mid and top sections, both with cast threads by which one can be telescoped on the other, extension sections if required, and a circular drop cover unless indicated otherwise.
4. Valve boxes shall be installed in accordance with Drawing 01-975-64A.
5. Valve boxes shall be Tyler/Union 6850 Series, 4 inches through 12 inches, or equal. Extension heights shall be provided as required. Lids shall be marked for appropriate use. CONTRACTOR shall verify that all valve boxes are large enough to accommodate all operating nuts and wrenches. Provide one "Tee" valve key operator for each valve manhole and one for each tank with tank or channel drain.

## 2.03 BURIED PIPING

### A. Ductile Iron Piping and Fittings:

1. Unless otherwise shown or specified, all underground piping 3 inches in diameter or larger shall be ductile iron conforming to AWWA C151/A21.51 with mechanical joints or push-on joints. Unless otherwise shown or specified, all piping shall be minimum Special Thickness Class 53 with a water hammer allowance of 100 psi. Additional pipe wall thickness shall be furnished as required by AWWA C150 for buried piping with the depth of cover as shown on the Drawings when using laying condition 4 of AWWA C600 or the Class C Bedding Detail as shown on Drawing 01-975-43A.
2. Each pipe and fitting shall have the class or nominal thickness, country where cast, casting period, manufacturer's mark, the year in which the pipe was produced, and the letters DI or DUCTILE cast or stamped thereon. Improper or incomplete marking will be cause for rejection of the pipe or fitting.
3. CONTRACTOR shall furnish certification data representing each class of pipe or fitting furnished. The certification report shall clearly state that all pipe and fittings furnished meet the appropriate AWWA specification. Ductile iron pipe shall consist of pipe centrifugally cast in metal or sand-lined molds. Pipe wall shall be homogeneous from inside to outside and shall be completely free of laminations, blisters, or other imperfections. Defects may be removed at the factory only.
4. Except as otherwise specified, underground pipe shall have mechanical joints or push-on joints conforming to AWWA C110 and C111, as well as AWWA C153 (compact), with vulcanized styrene butadiene rubber gaskets conforming to AWWA C111. Gaskets that include metal locking segments vulcanized into the gasket to grip the pipe and provide joint restraint are not acceptable. Bolts on mechanical joints shall be ASTM A242 high-strength low-alloy steel, conforming to AWWA C111 and ANSI A21.11. Certificate to that effect shall be provided.
5. For ductile iron pipe systems requiring pressure testing, restrained joints shall be provided in accordance with Part 3—Execution. Mechanical joints shall be restrained with MEGALUG® Series 1100 or 1100 SD, by EBAA Iron Sales, Inc., UNIFLANGE Series 1400 by Ford Meter Box Co., Inc., or equal, restraint. Push-on joints for ductile iron piping shall be restrained with MEGALUG® Series 1700 or 1100 HD, by EBAA Iron Sales, Inc., UNIFLANGE Series 1450 by Ford Meter Box Co., Inc., Flex-Ring or Lok-Ring by American Cast Iron Pipe Company, TR Flex by U.S. Pipe Company, or equal.



- a. Pipe restraint fittings shall be provided as follows:
    - (1) For ductile iron pipe with ductile iron mechanical joints MEGALUG® Series 1100 or 1100SD by EBAA Iron Sales, Inc.; Series D SLDE or SSLD by Sigma; Series 3000 or 3000S by Star Pipe Products; or equal.
    - (2) For ductile iron pipe with ductile iron push on joints MEGALUG® Series 1100HD or 1700 by EBAA Iron Sales, Inc; Series SLDEH or SSLDH by Sigma; Series 3100P or 3100S by Star Pipe Products; Flex Ring or Lok Ring by American Cast Iron Pipe Company; TR Flex by U.S. Pipe Company; or equal.
    - (3) For PVC pipe with ductile iron mechanical joint fittings–MEGALUG® Series 2000 PV, 1100SV, or 2000SV by EBAA Iron Sales, Inc.; Series D SLCE or PVM by Sigma; Series 1000C or 4000 by Star Pipe Products; or equal.
    - (4) For PVC pipe with PVC push on joints (not solvent welded)–MEGALUG® Series 1100HV, 1900, or 2800 by EBAA Iron Sales, Inc.; Series SLCEH, PWP (greater than 12-inch only), or D PWP (12 inches or less) by Sigma; Series 4100P by Star Pipe Products; or equal.
  - b. Gland body, wedges, and wedge actuating components shall be ductile iron conforming to ASTM A536 Grade 65 45 12. Bolts and tie rods shall be high strength low alloy steel conforming to AWWA C111.
  - c. Gaskets that include metal locking segments vulcanized into the gasket to grip the pipe to provide joint restraint are not acceptable.
6. Joint restraint is not required for gravity sewers and drains.
  7. Underground pipe shall have mechanical joint ductile iron fittings conforming to AWWA C110 and C111 or AWWA C153 compact fittings with a minimum rated working pressure of 150 psi. Gaskets for fittings shall be as specified for underground piping.
  8. All ductile iron fittings shall be American Cast Iron Pipe, Tyler Union, U.S. Pipe, or equal, and shall be made in the United States of America.
  9. Unless otherwise specified, all exterior ductile iron piping and fittings shall be cement-mortar lined and asphaltic-coated inside. Cement-mortar lining shall be in accordance with AWWA C104. Unless otherwise specified, underground piping and fittings shall be shop primed or asphaltic-coated outside. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings.
  10. For potable water systems, the outside pipe coating shall comply with AWWA C151. Lining and coatings shall be suitable with potable water systems. The asphaltic coating shall be applied over the cement lining on the inside of the pipe and directly on the outside of the pipe. The coatings shall be smooth and impervious to water without any tendency to scale off.
  11. All buried ductile iron piping and appurtenances shall be polyethylene encased in accordance with AWWA C105. Polyethylene encasement shall be Class C (carbon black) and shall be minimum 8 mil thickness. Tape for securing the film shall be a thermoplastic material with a pressure sensitive adhesive face capable of bonding to metal, asphaltic coating, and polyethylene. Tape shall have a minimum thickness of 8 mils and a minimum width of 1 inch. The polyethylene film envelope shall be as free as is commercially possible of gels, streaks, pinholes, particles of foreign matter, and undispersed raw materials. There shall be no other visible defect, such as holes, tears, blisters, or thinning out at folds.
  12. Tapping and Bonding:
    - a. In cases where corporation stops are to be tapped into mains, pipe wall thickness shall be furnished as specified in AWWA C151 to provide four threads or pipe saddles shall be furnished as approved by manufacturer.
    - b. Cable bond conductor or electrobond conductivity straps shall be installed on all ductile iron piping to maintain electrical continuity across joints. Continuity across

valves and fittings shall be made with multiple conductivity straps connected in series. Lead-tipped gaskets or bronze wedges will not be allowed.

13. Exterior Joints, Fittings, and Gaskets: Joints, fittings, and gaskets shall have the same rated working pressure of the pipe in which they are installed but no less than a minimum rated working pressure of 150 psi.

B. Copper Water Tubing:

1. Copper tubing installed within trenches shall be Type K soft annealed seamless copper tubing and shall conform to the Specifications of ASTM B88. All other copper shall be Type K hard copper conforming to ASTM B88.
2. Fittings shall be of the flared or compression type. Unions shall be extra heavy three-part unions only. Joints shall not be used under floor slabs.
3. The name or trademark of the manufacturer and a mark indicating the type shall be permanently and plainly marked on tubing.
4. Fittings for copper tubing shall be copper alloy meeting the requirements of AWWA C800-14. The maximum lead content shall be 0.25%. They shall have uniformity in wall thickness and strength and shall be free from any defect that may affect their serviceability.
5. Each fitting shall be permanently and plainly marked with the name or trademark of the manufacturer.
6. Shutoff valves shall be placed on each branch for all underground piping.

C. Solid Wall PVC:

1. Polyvinyl chloride (PVC) pipe shall meet the requirements of ASTM D3034 for pipe sizes 4 inches through 15 inches and ASTM F679 for pipe sizes 18 inches through 60 inches.
2. PVC material for ASTM D3034 pipe shall have cell classification 12454 or 12364 as defined in ASTM D1784 with minimum modulus of elasticity of 400,000 psi. Pipe stiffness shall be minimum 46 psi when tested in accordance with ASTM D2412. Pipe shall have a maximum standard dimension ratio (SDR) of 35.
3. PVC material for ASTM F679 pipe shall have cell classification 12454 or 12364 as defined in ASTM D1784 with a minimum modulus of elasticity of 500,000 psi. Pipe stiffness shall be a minimum 115 psi when tested in accordance with ASTM D2412.
4. Pipe and fittings shall be the product of one manufacturer, and the manufacturer shall have experience records substantiating acceptable performance of the pipe and fittings to be furnished. The minimum wall thickness of fittings shall be the same as the pipe to which it connects.
5. Acceptance of piping and fittings shall be subject to tests conducted in accordance with ASTM D3034 and/or ASTM F679.
6. Fittings such as saddles, elbows, tees, wyes, and others shall be of material and construction corresponding to and have a joint design compatible with the adjacent pipe. Approved adapters shall be provided for transitions to other types of pipe.
7. Joints shall be of the elastomeric type for pipes 4 inches or larger and elastomeric or solvent cement for pipes less than 4 inches.
8. Elastomeric joints shall be a bell and spigot joint conforming to ASTM D3212 sealed by a rubber gasket conforming to ASTM F477 so that the assembly will remain watertight under all conditions of service, including the movements resulting from the expansion, contraction, settlement, and deformation of the pipe. Bells shall be formed integrally with the pipe and shall contain a factory-installed positively restrained gasket.
9. Solvent cement joints shall be assembled using solvent cement obtained from the pipe manufacturer, which conforms to the requirements of ASTM D2564.
10. The assembled joint shall pass the performance tests as required in ASTM D3212.

D. Gravity Sanitary Sewer Service Branches and Laterals:

1. Branches (tees and wyes) shall be of the same material as the main except for reinforced concrete pipe used for sanitary sewer. For reinforced concrete pipe, special branches shall be furnished and installed to accept the lateral. Such special branches are subject to review by ENGINEER.
2. If a different thermoplastic material is specified for laterals than for the main line, appropriate solvent welds, fittings, transition couplings, and other appurtenances shall be provided to effect a water tight seal.
3. Fittings for laterals shall be of the same material as the lateral pipe unless special fittings are needed for transition between material types or sizes or standard fittings are not manufactured.
4. Where the wye or tee branches and laterals are of dissimilar materials, CONTRACTOR shall provide a transition coupling for the connection.
5. All fittings used, including type of jointing, are subject to review by ENGINEER.

E. Miscellaneous Pipe:

1. Piping needed for repair or reconstruction of existing utilities and appurtenances shall be of the same type and strength as the existing. The type of jointing used in repair and reconstruction shall be reviewed by ENGINEER. Special fittings shall be furnished and installed as necessary for repair, reconstruction, or connection of existing facilities.
2. All special fittings on or for connection to utilities shall be specifically built for the type of gasket used. Special fittings shall have joints of the same type as the utility to which the connection is being made.

F. Tracer Wire:

1. Provide minimum 10-gauge solid insulated copper tracer wire with buried thermoplastic pressurized pipe. Wire shall be continuous, terminate, and be accessible at valve boxes, manholes, fire hydrants, or at test stations as specified below. Tracer wire shall be located 12 inches above the top of the pipe. Any splices in copper wire shall be made with a 3M™ DBR/Y-6 splice kit, or equal.
2. Tracer wire test stations shall be SnakePit magnetized tracer boxes by Copperhead Industries, or equal. Tracer box shall be corrosion-resistant brass wire lugs and wax pad to cover wire connection. Cover shall be color-coded according to APWA standards for fluid conveyed. Provide SnakePit Lite Duty Box in unpaved areas and Roadway Box in paved areas. Provide Rhino Triview Marker Posts, or equal, at all test stations. Provide custom decals to identify fluid in piping. The tracer wire shall be accessible at a minimum of every 500 feet along the pipeline and at horizontal bends in piping. The tracer wire shall run into and up the sides of all manholes and be secured near the casting. Test stations shall be placed as required between manholes to comply with the minimum 500-foot tracer wire accessibility requirement.
3. CONTRACTOR shall perform continuity testing of all tracer wire in the presence of OWNER.

2.04 VALVES (VALVES FOR UNDERGROUND SERVICE ARE SPECIFIED IN DIVISIONS 23 AND 40)

- A. Valves for natural gas service shall conform to Section 23 05 23—General-Duty Valves for HVAC Piping.
- B. Valves shall conform to Section 40 05 00—Piping and Appurtenances.

## 2.05 FIRE HYDRANTS

- A. Fire hydrants provided under these Standard Specifications shall conform to AWWA C502 for Dry Barrel Fire Hydrants. Hydrants shall have the following features:

|                            |                                                                                                                                         |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Bury Length                | Approximately 7 1/2 feet to traffic flange.                                                                                             |
| Nozzle Size                | One 4 1/2-inch- and two 2 1/2-inch-diameter openings.                                                                                   |
| Nozzle Threads             | National standard fire hose coupling screw threads.                                                                                     |
| Drain Port                 | Drain port at base of hydrant barrel. Plug drain port when hydrant installed in area where groundwater level may rise above drain port. |
| Size of Main Valve Opening | 5 1/4-inch-diameter minimum. The hydrant lead connection shall be minimum 6-inch-diameter mechanical joint.                             |
| Torque Requirements        | Hydrant shall comply with AWWA C502 even if greater than 5-foot bury.                                                                   |
| Lubrication                | Nontoxic and providing proper lubrication for a temperature range of -30°F to +120°F.                                                   |

- B. Hydrants shall have permanent markings identifying the manufacturer by name, initials, insignia, or abbreviations in common usage, and designating the size of the main valve opening and the year of manufacture. Markings shall be so placed as to be readily discernible and legible after hydrants have been installed.
- C. CONTRACTOR shall furnish certification to ENGINEER that the hydrant and all material used in its construction conform to the applicable requirements of AWWA C502 and the supplementary requirements thereto.
- D. All joints on fire hydrant leads shall be made using pipe restraint specified herein. Approximately 1/2 cubic yard of bedding stone shall be placed from the bottom of the trench around the hydrant elbow and up the hydrant barrel. Bedding stone shall be wrapped completely in filter fabric to prevent the in migration of fine materials.
- E. CONTRACTOR shall furnish all necessary fittings in the fire hydrant lead to install the fire hydrant in a plumb condition at locations shown on the Drawings and at the specified depth of bury. The pumper nozzle of all fire hydrants shall be installed with the nozzle pointing toward the street. ENGINEER reserves the right to alter the location of fire hydrants from that shown on the Drawings.
- F. Hydrants shall be installed as shown on Drawing 01-975-65A.
- G. Fire Hydrant:
1. Fire hydrant shall be Waterous W-67 Pacer, or equal.
  2. Hydrant to be painted red.
  3. Provide restrained joint system from auxiliary valve in road box back to tee.
  4. Connect hydrant to auxiliary valve with 2-foot length of pipe.
  5. Provide drain port at base of hydrant barrel. Plug drain port when hydrant installed in area where groundwater level may rise above drain port.

## 2.06 CONCRETE

- A. All concrete poured under this Contract, unless shown or specified otherwise, shall conform to the requirements of Division 03.

## 2.07 AGGREGATE SLURRY (FLOWABLE) BACKFILL

- A. Aggregate slurry (flowable) backfill shall consist of fine and coarse aggregate conforming to ASTM C33. Coarse aggregate shall be size number 67 and fine aggregate shall be size number 4. The material shall be mixed with water to provide an approximate 3-inch slump. The mix shall be deposited in the trench from ready-mix concrete transit mix trucks and shall be consolidated using concrete vibrators or vibratory plate compactors.

## PART 3—EXECUTION

### 3.01 INSTALLATION

- A. Underground Piping:
  - 1. Utility lines shall be laid and installed to the lines and grades specified with valves, fittings, manholes, and other appurtenances at the specified locations; spigots centered in bells; and all manholes and riser pipes plumb. Water main shall be installed at the depth indicated. Gravity sewer mains and laterals shall maintain a minimum 6 feet of cover but shall be deep enough to provide service to buildings. Water main shall be installed to within (plus or minus) 0.1 feet of designed grades. Sanitary and storm sewer and laterals shall be installed to within (plus or minus) 0.03 feet of designed grades. Service lines shown on the Drawings are approximate. Staking shall be completed in conformance with Division 01.
  - 2. Deviations Occasioned by Underground Facilities: Wherever significant obstructions not shown on the Drawings are encountered during the progress of the Work, CONTRACTOR shall proceed in accordance with the General Conditions to notify owners and protect the facilities. Existing items unnecessarily damaged during the performance of the Work shall be repaired and replaced at the expense of CONTRACTOR.
  - 3. Prior to commencing pipe laying, CONTRACTOR shall notify ENGINEER of the intended date for starting Work. ENGINEER may request at CONTRACTOR's expense the removal and relaying of pipe which was installed prior to notification of ENGINEER.
    - a. Proper implements, tools, and facilities shall be provided and used by CONTRACTOR for the safe and convenient prosecution of the Work. All pipe, fittings, and appurtenances shall be carefully lowered into the trench piece by piece with a crane, rope, or other suitable tools or equipment, in such manner as to prevent damage to materials. Under no circumstance shall pipe be dropped or rolled into the trench.
    - b. Materials shall be as shown on the Drawings or as specified herein.
  - 4. Material Inspection: CONTRACTOR shall inspect the pipe, fittings, and appurtenances for defects when delivered to the jobsite and prior to lowering into the trench. Defective material shall be removed from the jobsite. All material shall be clean and free of deleterious substances prior to use in the Work.
  - 5. Pipe Length:
    - a. All existing joints exposed during construction that are to remain in place shall be restrained.
    - b. All joints shall be restrained assuming fitting orientation as noted, 200 psi test pressure, a 1.5 factor of safety, Type CL native soil backfill, standard bedding, compaction of backfill at 80% standard proctor, AASHTO T-99 (Type 4 trench condition), and a 5-foot bury. Lengths shall be adjusted for other conditions and fittings. For other fittings and for more specific requirements, see the Drawings.

6. Water main shall be installed in accordance with AWWA C600 for iron pipe, AWWA C605 for PVC pipe, and AWWA M55 for HDPE pipe. All plugs, caps, tees, hydrants, bends, and other fittings for water mains shall be provided with restrained joints.
7. PVC sewer and plant drain piping shall be installed in accordance with ASTM D2321. Except where noted or specified, PVC or other thermoplastic pressure piping shall be installed in accordance with ASTM D2774.
8. Plumbing system shall be installed and tested in accordance with local and state plumbing code requirements and applicable portions of 2015 International Building Code. Where requirements conflict, the stricter standard shall apply.
9. CONTRACTOR shall lay all gravity pipe to the line and grade shown on the Drawings with bell ends uphill wherever possible. If not possible, CONTRACTOR shall lay pipe to the line and grade shown on the Drawings with bell ends in the direction of laying. Water piping and chemical solution piping shall have a minimum of 6 1/2 feet of cover. Unless shown otherwise, drainage piping shall clear floor slabs or footings by a minimum of 6 inches.
10. Any pipe or fittings cracked in cutting or handling or otherwise not free from defects shall not be used. Pipe must be kept clean of mortar, cement, clay, sand, or other material. When PVC piping is installed during hot weather, it shall be laid in the trench with slack or permitted to cool to ground temperature before it is cut to length for making final connections. PVC expansion joints shall be provided where needed.
11. At times when pipe laying is not in progress, the open ends of pipe shall be closed with plugs to prevent the entry of foreign material. Acceptable plugs include Foreman Nite Caps by APS, mechanical joint cap or plug, bladder plug, or test plug. All foreign material shall be removed from the pipe prior to acceptance.
12. The locations and elevations of existing piping and manholes are approximate. Where necessary, existing piping shall be exposed by CONTRACTOR to confirm location and elevation before installing new piping. Any changes in pipe location or elevation shall be approved by OWNER.
13. General Excavation:
  - a. Pipe Laying:
    - (1) All pipe shall be laid accurately to the line and grade as designated. Preparatory to making pipe joints, all surfaces of the portions of the pipe to be joined or of the factory made jointing material shall be clean and dry. Lubricants, primers, adhesives, and other joint material shall be used and installed as recommended by the pipe or joint manufacturer's specifications. The jointing materials or factory fabricated joints shall then be placed, fitted, joined, and adjusted in such a workmanlike manner as to obtain the degree of watertightness specified. Pertinent specifications from the joint and pipe manufacturer which outline procedures to be followed in making the joint shall be furnished to ENGINEER.
    - (2) Wyes, tees, and special fittings shall be installed as called for on the Drawings, or as requested by ENGINEER. Wyes, tees, and special fittings, shall, in general, be jointed with the same type of joint as used in the pipe.
    - (3) In joining two dissimilar types of pipe, manufactured adapters and fittings shall be used. Adapters and fittings shall be configured to maintain invert elevations at same level.
    - (4) Joint deflections shall not exceed the limits established by the pipe manufacturer for the pipe and joint being used.
    - (5) Joints that are damaged because of carelessness, improper handling, or failure to prevent imperfections in manufacture shall be subject to rejection and gaskets shall be subject to rejection whenever they show surface cracking, tears, or splice separation.

- (6) At times when pipe laying is not in progress, the open ends of pipe shall be closed with plugs to prevent the entry of foreign material. All foreign material shall be removed from the pipe prior to acceptance.
  - (7) After placing a length of pipe in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with specified backfill material tamped around it except at the bells.
  - (8) Pipe shall be brought home by using a cross member and levers or jacks. It will not be permissible to push pipe home with motor powered excavation equipment.
  - (9) Force main and water main shall be installed in accordance with AWWA C600 for iron pipe, AWWA C605 for PVC pipe, and AWWA M55 for HDPE pipe. All plugs, caps, tees, hydrants, bends, and other fittings for water mains and force mains shall be provided with restrained joints.
- b. Sewer Service Branch and Lateral Installation:
- (1) CONTRACTOR shall furnish and install sanitary sewer and storm sewer branches, laterals, and leads as shown on the Drawings or requested by ENGINEER. Under normal circumstances, service laterals will be installed within the right of way or easement to serve all existing buildings and all platted lots. In certain cases, only wye or tee branches will be installed to vacant lots. Service laterals shall consist of a branch fitting at the main and extension of the specified lateral pipe to the end of lateral as called for and requested. All necessary fittings shall be furnished and installed to complete the installation as shown on Drawing 01-975-75A. All necessary fittings shall be furnished and installed to complete installation of storm sewer leads as shown on Drawing 01-975-41A.
  - (2) Wye or tee branches: Wherever shown on the Drawings or requested by ENGINEER, wye or tee branches shall be provided for use in making sanitary sewer service and storm sewer inlet connections. Unless specified otherwise on the Drawings, wye or tee branches for sanitary sewer service lateral connections to single family residences shall be 4-inch diameter. All other sanitary sewer service lateral connections shall be 6 inches. Wye or tee branches for storm sewer inlet connections shall be of the size called for on the Drawings, 12 inches minimum.
  - (3) Sanitary sewer service branches shall be turned so that the branch is at an angle of 30 degrees or 45 degrees from the horizontal.
  - (4) Sanitary Sewer Service Laterals: Under normal conditions and unless otherwise shown on the Drawings or requested by ENGINEER, all service laterals shall be Standard Laterals, Type 1, as shown on Drawing 01-975-75A. Service laterals of Types 2 through 6 may be requested by ENGINEER to meet field conditions.
  - (5) It is the general intent to install Modified Laterals, Type 2, 4, or 5 for service to homes that presently have shallow or no basements or where the depth to groundwater at the end of lateral is shallow. Types 3 and 6 risers are only to be provided where shown on the Drawings.
  - (6) Installation and Testing Requirements: Except for those branches that are to be used on storm sewers or for extending sanitary sewer service laterals, wye and tee branches shall be closed with airtight stoppers blocked to withstand air test pressures.
  - (7) The ends of all laterals shall be plugged and blocked to resist air test pressures. All plugs shall be manufactured to fit the pipe used and shall be

- watertight. The ends of all laterals shall be marked as shown on Drawing 01-975-75A using flagging tape and 2 by 4 markers.
- (8) Unless otherwise provided for in the Drawings, each service lateral shall have a tracer wire installed from the main to the property line or the location of the connection to the existing service, whichever is greater or applicable, and as shown on Drawing 01-975-76A. The tracer wire shall be 10-gauge solid copper with no splices. The wire shall be secured to the pipe with duct tape at a minimum of 3-foot intervals. The ends of the tracer wire shall be brought to the ground surface and stored in an access terminal box, DWS–Tracer Wire Access Box, or equal, at a location selected by OWNER. Eighteen inches of additional wire length shall be coiled at the location of the terminal box. CONTRACTOR shall confirm the method of installation is compatible with OWNER's means of detecting the location of the service lateral. Each tracer wire shall be tested by CONTRACTOR to confirm it accurately provides the location and depth of the sewer lateral.
  - (9) A complete and accurate tabulation of length, depth, and location of all branches, risers, and laterals shall be kept by CONTRACTOR on cards available from ENGINEER. Measurements shall be made from the nearest downstream manhole. Lateral installation to meet these Standard Specifications and field conditions are the responsibility of CONTRACTOR. Problems occurring because of failure to provide proper installation or proper records shall be corrected by CONTRACTOR at its expense.
  - (10) No installed lateral shall be backfilled until ENGINEER has been notified that the lateral is complete and reasonable time is allowed for observation of the Work.
- c. Water Service Lateral Installation:
- (1) Water service laterals requiring reconstruction and new service laterals shall be installed in accordance with AWWA C600 and as shown on Drawing 01-975-66A. CONTRACTOR shall perform all excavation, backfill, and other Work necessary for a complete installation. The service tubing shall be continuous and shall be placed at a minimum depth of 6.5 feet. Each service shall include a corporation stop at the main, copper service tubing, curb stop, curb box, couplings, and all other appurtenances necessary for a complete installation. Where existing services in the street are being reconstructed, the new service shall be connected to the existing service at the property line unless otherwise shown or specified. Taps in the main shall be at an angle of 45 degrees above the horizontal.
  - (2) OWNER reserves the right to make taps and connections to the new mains prior to backfilling by CONTRACTOR. CONTRACTOR shall delay backfilling until OWNER has completed its Work.
  - (3) All curb boxes on new services shall be marked by placing a 4-foot long 2 by 4 adjacent to it. The 2 by 4 shall project 1 foot above existing ground and shall be painted blue.
14. Valve Boxes: The valve box shall be centered and plumb over the wrench nut of the valve with the box cover flush with the finished ground elevation. Solid 4-inch concrete blocks shall be placed under the base of valve boxes so that the bottom of the base is about 2 inches away from contact with the valve bonnet. The valve box shall not transmit shock or stress to the valve.



### 3.02 FIELD QUALITY CONTROL

- A. CONTRACTOR shall include the cost of all televising, testing, cleaning, and disinfection in the price bid.
- B. Work shall be tested as specified in this section. Unless indicated in writing before testing begins, tests shall be witnessed by ENGINEER and others as necessary. Test results shall be recorded, and reports or appropriate certificates shall be submitted to ENGINEER in triplicate.
- C. New piping shall be tested. Prior to conducting the pressure and leakage test, CONTRACTOR shall backfill the trench for its full depth. All bends and special connections to the main shall be adequately blocked and tied prior to the test. Any damage caused to the main or its appurtenances during performance of these tests shall be corrected by CONTRACTOR at its expense. Should underground piping fail test, CONTRACTOR shall be responsible for removal and replacement of backfill, and relay new pipe if necessary, to repair the defective pipe. Under no circumstances shall defects be sealed from the interior of the pipe, and only where specifically allowed by ENGINEER, shall defects be sealed from the exterior of the pipe. Piping, interior or exposed, shall be subject to test before being covered with insulation or paint. Piping and appurtenances shall be watertight or airtight and free from visible leaks.
- D. Piping shall be flushed or blown out after installation prior to testing. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge and other equipment, materials, and facilities necessary to complete the specified tests. CONTRACTOR shall provide all temporary sectionalizing devices and vents for testing.
- E. Pressure Tests:
  - 1. Pressure tests shall be performed as required by AWWA C600 and AWWA C605, unless otherwise noted herein.
  - 2. When test medium for piping is water, all air shall be removed from piping by flushing, opening vents, loosening flanges, utilizing equipment vents and/or installation of corporations at high points in system. Test pumping equipment used shall be centrifugal pumps or other pumping equipment that will not place shock pressures on the main. Power plunger pumps will not be permitted for use on closed pipe systems. Pumps shall be disconnected during test periods. Presence or absence of air will be determined during pressurization of the piping system.
  - 3. The test pressure in all lines shall be held for two hours, during which time the leakage allowance shall not exceed that specified. In case repairs are required, the pressure test shall be repeated until the pipeline installation conforms to the specified requirements. Pumps, air compressors, instrumentation, and similar equipment shall not be subjected to the pressure tests.
  - 4. During performance of the hydrostatic pressure test, water main shall be subjected to a minimum pressure of at least 50% above normal working pressure with a minimum pressure 125 psi. Force main shall be tested to 200% of normal operating pressure in the main, but to no more than the pressure rating of the pipe.
  - 5. CONTRACTOR shall keep a record of all tests performed. These records shall show the individual lengths of main tested and test results.
  - 6. Where connections are made to existing mains, it shall be the responsibility of CONTRACTOR to provide the necessary hydrostatic tests on all new mains installed. This may necessitate, but is not limited to, the installation of temporary valves and

- restraint to isolate the new system from the existing system. All materials, Work, and equipment necessary for this Work shall be furnished by CONTRACTOR at its expense.
7. All testing of pipelines shall proceed concurrently with installation. CONTRACTOR is encouraged to conduct daily preliminary testing of its Work.
  8. Water from disinfection testing shall not be discharged to a stream, creek, river, storm sewer tributary thereto, or to a navigable water without first neutralizing the chlorine residual in the water and complying with local, state, and federal laws thereto.
  9. Gauges used for testing shall have increments as follows:
    - a. Tests requiring a pressure of 10 psi or less shall use a testing gauge having increments of 0.10 psi or less.
    - b. Tests requiring a pressure of greater than 10 psi by less than or equal to 100 psi shall use a testing gauge having increments of 1 psi or less.
    - c. Tests requiring a pressure of greater than 100 psi shall use a testing gauge having increments of 2 psi or less.

| Fluid Abbreviation<br>or Name | Minimum<br>Test Pressure<br>in psi | Test<br>Medium | Leakage<br>Allowance<br>Designation |
|-------------------------------|------------------------------------|----------------|-------------------------------------|
| Potable Water                 | 150                                | Water          | "A" <sup>(1)</sup>                  |

<sup>(1)</sup> Leakage allowance designation "A" shall mean not more than 0.002 gallons per hour per inch diameter per 100 feet of buried pipe for all piping except buried mechanical joint pipe. Buried mechanical joint pipe shall meet the leakage specifications of AWWA C600.

- F. Prior to making final connection between new and existing piping, new piping shall be tested as specified above.

### 3.03 DISINFECTION

- A. CONTRACTOR shall disinfect and flush the potable water system before it is put online. Water main shall be disinfected according to AWWA C651.
- B. In accordance with the requirements of AWWA C651, at least one set of samples shall be collected from every 1,200 feet of new water main, plus one set from the end of the line and at least one set from each branch.
- C. CONTRACTOR shall obtain water samples and arrange for analysis of water in potable systems for bacteria in accordance with Option A of Section 5.1 of AWWA C651. Copies of test results shall be submitted to OWNER and ENGINEER.
- D. CONTRACTOR shall furnish all water and other materials, equipment, and labor necessary to disinfect all new water mains and all existing water mains disturbed by construction. CONTRACTOR shall notify OWNER to observe disinfection test and shall coordinate and bear cost for necessary laboratory testing and shall provide safe bacteriological sample results to OWNER prior to placing the water main in service. Sampling and testing shall be scheduled to complete the Work within the Contract Times. Items of material for testing shall be furnished in the size and quantity necessary to properly complete the test. Interruption or delay of CONTRACTOR's Work progress caused by testing and sampling shall not be cause for extra payment under the Contract nor shall they be cause for extension of Contract Time.

### 3.04 CLEANING

- A. All equipment and materials shall be clean before installation.
- B. Upon completion of the work, all improvements disturbed by CONTRACTOR's operations shall be repaired or replaced. Broken concrete, rubble fill, and other excess material shall be removed from the site and wasted.
- C. All waste disposal areas and all areas used for the storage of materials or the temporary deposit of excavated earth shall be leveled off, cleaned up, and returned to condition that existed prior to construction. All surplus material, tools, and equipment shall be removed, and the premises shall be left free of everything of the kind.
- D. All pipes and manholes shall be flushed until clean, and all debris and mud shall be removed.

### 3.05 DEMOLITION

- A. All exterior piping removals, including manholes and appurtenances and abandonment, shall be by CONTRACTOR. The locations and elevations of existing piping are approximate. Where necessary, existing piping shall be exposed before installing new piping. Any changes in pipe location or elevation shall be reviewed by ENGINEER.
- B. CONTRACTOR shall remove or abandon all existing piping and appurtenances as noted. Unless otherwise shown or specified, piping and appurtenances to be removed shall become the property of CONTRACTOR and shall be removed from the site for salvage or disposal. Unless otherwise shown or specified, piping shown or specified to be abandoned shall have each end plugged with concrete or nonshrink grout. Nonshrink grout shall be as specified in Division 03. Wherever excavations cross piping to be abandoned, piping shall be removed to the limits of the excavation and the ends shall be filled as specified above.
- C. Valve boxes and exposed valves and operators on piping to be abandoned shall be removed. All concrete surfaces to remain shall be patched as required to provide a smooth surface. Repiping and connections to new piping shall be as specified for new piping.
- D. It is the responsibility of CONTRACTOR to remove the items listed below, including piping and appurtenances, as specified, and patch all holes resulting therefrom unless specified or shown otherwise. The intent of these specifications is to require that the removal of materials, patching of all existing holes, and repiping be done in a workmanlike manner. All costs shall be included in the Lump Sum Bid.

END OF SECTION

## SECTION 33 11 34

### DEEP WELL TURBINE PUMP

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation one deep well turbine pump of the line shaft-type complete with pump bowl assembly, column and shaft assembly, head assembly, and electric motor. The pump and appurtenances shall be furnished by the same supplier.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. AIEE–American Institute of Electrical Engineers Standard.
- B. ANSI–American Nation Standards Institute Standard.
- C. API 5L–Specification for Line Pipe.
- D. API 5LX–Specification for High-Test Line Pipe.
- E. ASTM A48–Standard Specification for Gray Iron Castings.
- F. ASTM A53–Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
- G. ASTM A106–Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
- H. AWWA C200–Steel Water Pipe 6-inch and Larger.
- I. AWWA C654–Disinfection of Wells.
- J. AWWA E102–Submersible Vertical Turbine Pumps.
- K. AWWA E103–Horizontal and Vertical Line-Shaft Pumps.
- L. HI–Hydraulic Institute Standard.
- M. IEEE–Institute of Electrical and Electronics Engineers Standard.
- N. NEC–National Electrical Code.
- O. NEMA–National Electrical Manufacturers Association Standard.
- P. NEMA MG1, Part 31–National Electrical Manufacturers Association Standards Publication Motors and Generators, Definite-Purpose Inverter-Fed Polyphase Motors.

Q. NSF 372–Drinking Water System Components-Lead Content.

1.03 SUBMITTALS

A. Shop Drawings:

1. Shop drawings showing complete base assembly and casing position shall be submitted to ENGINEER for review and approval.
2. Submittals for motors shall include data sheets from motor manufacturer. Data sheets from the pumping equipment manufacturer or supplier are not acceptable.

B. Factory Test and Acceptance:

1. All pumps shall be factory tested in accordance with AWWA E103 standard running test and discharge head hydrostatic test requirements plus the requirements of these specifications. Tests shall be made with the field motor and starter type matching that of the project.
2. Test points shall include shutoff head, rated head, plus at least three other points as required for accurate curve plotting. Test data shall be obtained and computations made so that field head-discharge curves, field wire to water efficiency curve, and field power consumption in kWh per 1,000 gallons at the performance point are submitted to ENGINEER. All starter settings for the factory testing shall also be provided.
3. Pump heads shall not include velocity head or internal pump friction heads, and these heads shall not be included in performance curves. Test results shall be corrected to show field performance at the speed at which the unit will operate with 480 volts at the motor terminals.
4. ENGINEER shall be furnished three certified copies of all test data, calculations showing losses not included in the shop tests, field performance curves, and computations and curves showing field power consumption by the motor and bhp load on the motor.
5. The pump shall meet the requirements of 2011 Hydraulic Institute Standards Acceptance Grade 1U. Acceptance Grade 1U has the following tolerances:

| Test Parameter | Guarantee Requirement | Tolerance Band (1U) |
|----------------|-----------------------|---------------------|
| Rate of Flow   | Mandatory             | 0% to +10%          |
| Total Head     | Mandatory             | 0% to +6%           |

6. Acceptance is achieved when either test flow or head (or both) are within the defined tolerance band.
7. Shipment shall not be made until the factory test data is acceptable.

C. Certificate of Proper Installation: Prior to the start-up of the well pump and motor system, CONTRACTOR shall provide written certification that CONTRACTOR, the authorized pump and motor representatives, manufacturer's representatives, and pertinent subcontractors have completed testing and verification of each component associated with the pump, motor system, associated starting system, and they approve start-up of the system (pump, motor, and starter).

1.04 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Electrical equipment shall conform to the standards of the AIEE, ANSI, NEMA, and the NEC. Pumps shall conform to applicable sections of HI.

2. Except as otherwise specified, the units shall conform to AWWA E103 and the requirements of the 2015 International Building Code.

B. Certifications: Provide manufacturer's affidavit of compliance per AWWA E103.

#### 1.05 PROJECT CONDITIONS

- A. Construction of the well below the curb is as follows:
  1. Top of well curb—USGS elevation.
  2. 20-inch outer casing 0 to 60 feet.
  3. 16-inch casing 0 to 390 feet.
- B. Alignment tests show that a 12-inch-diameter cylinder placed with its center at the centerline of the well can extend to a depth of 380 feet without deflection of that cylinder from a straight line. The pump shall be placed center of the well.
- C. The 48 hour pump test data will be provided once data is obtained.

#### 1.06 WARRANTY

- A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of 1 year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

#### 1.07 MAINTENANCE

- A. Extra Materials:
  1. CONTRACTOR shall furnish a 2-year supply of grease and oils for all items of equipment requiring lubrication.
  2. Lubricants for all items of equipment shall be the same brand when available as recommended by the manufacturer to meet both warm and cold weather requirements.

### PART 2—PRODUCTS

#### 2.01 MANUFACTURERS

- A. Type of pump, efficiency, and head-discharge curve slope required to be similar to Goulds Model 13CMC, or equal. This listed equipment will be considered as establishing the type, function, appearance, and quality required, as defined in the General Conditions.
- B. The Drawings and Specifications were prepared based on Goulds Model 13CMC. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes, including engineering changes, to accommodate the other Base Bid equipment including, but not limited to, structural, mechanical, and electrical work.

## 2.02 EQUIPMENT

### A. Design Requirements:

1. Pump heads as specified herein are field heads external to the pumping unit; they do not include velocity head or internal friction head, and these heads shall not be included in pump test head or pump performance data. Pump discharge head is that shown by a piezometer tap at the pump discharge.
2. To convert pump bowl assembly heads or shop heads and shop test motor loads to field heads and field driver loads, hydraulic and mechanical friction loads as shown in AWWA E103 shall be used.
3. A steep head discharge curve at performance point maintaining high efficiency each side of the performance point is desired, and this characteristic will be considered in awarding the Contract.

### B. Performance Requirements:

1. Pump field head when pumping to the system at 1,000 gpm is calculated as follows:

|                                          |          |
|------------------------------------------|----------|
| Static lift in well                      | 52 feet  |
| Drawdown at specific capacity = 10gpm/ft | 100 feet |
| Well and pump deterioration allowance    | 15 feet  |
| Discharge static head                    | 108 feet |
| System friction loss                     | 8 feet   |
| Total field head at 1,000 gpm            | 283 feet |

2. Under normal operating conditions, the pump shall have a minimum performance point capacity of 1,000 gpm against a total head exterior to the pump of 283 feet while at 1,770 rpm nominal speed.

## 2.03 COMPONENTS

### A. Bowls:

1. The pump bowls shall be cast iron.
2. Replaceable bowl wearing rings shall be provided.
3. The bowls shall be no larger than nominal 12-inch diameter.

### B. Impellers:

1. The impellers shall be bronze or stainless steel.
2. The impellers shall be fully enclosed.
3. Impellers selection shall meet NPSH requirements with pumping level at the top of the bowl assembly.
4. Impellers shall meet NSF 372 requirements.

### C. The impeller shaft shall be Type 416 stainless steel with bronze bearings in each bowl.

### D. Suction and discharge nozzles shall be used below and above the bowl assembly with straightening vanes and long bearings for the pump shaft.

### E. Column:

1. The pump column shall be 10 inches nominal diameter, steel, and threaded and coupled in maximum 10-foot lengths.
2. Column ends shall be finished so that spiders and bearing retainers are tightly and firmly held in place.

3. The pump column will be surface prepared and CONTRACTOR shall furnish and install by welding to the casing any adapter needed to permit proper setting to the pump and miscellaneous tubing.
  4. Column shall be unpainted and completely cleaned of all coatings prior to installation.
  5. The pump shall be set so that the top of the bowls is at 200 feet or as shown on the Drawings.
- F. Line Shaft:
1. The line shaft shall be turned and polished steel ASTM A48, Grade 1045, and shall have stainless steel or Monel sleeves through the shaft bearings with threaded couplings to develop the full strength of the shaft.
  2. The top shaft shall be two-piece.
  3. The shaft shall be at least 1.5-inch diameter.
  4. The line shaft that projects through the stuffing box shall be stainless steel 416.
- G. Line Shaft Bearings:
1. Line shaft bearings shall be rubber, designed for water lubrication, have fluted bearing surface, firmly fixed in the bearing retainer, and shall not rotate in the retainer. Bearings relying only on an adhesive substance to hold the bearings in place will not be accepted. The rubber bearing shall be standard stock size requiring no sleeve, adapter, or modification to fit in the retainer.
  2. Bearing alignment spiders shall be as recommended by the pump manufacturer for the liquid being pumped.
  3. Pump manufacturer shall have bearings as proposed in satisfactory operation on similar pumps for at least 5 years.
- H. Discharge Head:
1. The discharge head shall be cast iron, minimum 150 psi rating. Discharge head shall be capable of withstanding well pump shutoff pressure, plus 100 psi surge allowance.
  2. The outlet of the pump shall be equipped with a flange, faced and drilled to 8-inch diameter, 125-pound standard. The outlet shall be above floor level and shall be smoothly finished to conform in appearance to motor finish.
  3. The base shall have a raised lip to collect gland leakage and shall have a 3/4-inch outlet for connection to drainage piping.
  4. The head shall be built for water lubricated line shaft.
  5. Stuffing Box: A high pressure stuffing box shall be provided. The stuffing box shall be cast iron and shall contain a minimum of five rings of packing. It shall have a pressure relief connection. The packing gland shall be a bronze split type secured in place with noncorrosive studs and nuts. The bearing shall be SAE 660 bronze. A rubber slinger shall be secured to the shaft above the packing gland.
  6. The discharge head shall have a shop prime coat as specified in Division 09 of these specifications.
  7. The discharge head at point of attachment to the motor shall be at least as large in diameter as the motor base so that the motor does not overhang.
- I. Miscellaneous Tubing:
1. All miscellaneous tubing required in or on the pump for bearing cooling, drainage, lubrication, etc., shall be furnished and placed by the pump contractor. Tubing shall be brass or hard copper with sweated fittings. Unions shall be provided for dismantling.
  2. Insofar as practicable, all such piping and tubing shall be installed inside the pump head frame and must be installed in a workmanlike manner.
  3. The base of the discharge head shall have tapped openings and packing arrangement to obtain an air- and watertight seal around two telltale airlines and carrier pipe placed



by this CONTRACTOR; the openings so located that the airlines and future level transducer cable have free and unobstructed passage into the well casing.

J. Subbase:

1. Provide a separate detachable subbase to be permanently grouted into the concrete pump base. The discharge head shall be bolted to the subbase.
2. Anchor bolts shall have 3-inch-square by 3/8-inch plate and nut at lower end.
3. All anchor bolts, sleeves, and adapter (if necessary) for the top of the well casing to permit proper pump and piping installation shall be furnished and placed by CONTRACTOR.

K. Motors:

1. Motors shall conform to all applicable requirements of NEMA, ANSI, IEEE, and NEC standards and shall be UL listed for the service specified.
2. Motors provided for the equipment scheduled below shall meet the following requirements. Motors shall not be loaded beyond nominal rating, not including service factor, at any design condition.
  - a. Physical Construction:
    - (1) Copper leads and windings. Motor leads shall have the same insulation class as the windings.
    - (2) Rotor bars shall be aluminum.
    - (3) Motors shall be equipped with grease fittings and automatic grease reliefs. Bearings shall be prelubricated and field regreasable. Openings for addition of grease shall have grease fittings provided.
    - (4) The motor thrust bearing shall be rated for use with the motor and pump supplied. Minimum rated bearing life shall be 5 years. Nameplate data shall identify the bearing and the type and weight of lubricant required. Bearing shall be proper for use with motor and pump setting as described under line shaft.
  - b. Mounting: Vertical.
  - c. Enclosure: TEFC.
  - d. Efficiency: Premium efficiency as noted in schedule below.
  - e. Service Factor: 1.15 on sine wave power, 1.0 VFD power.
  - f. Power requirements: 60 Hz, three-phase, 460-volt, factory-wired for 460-volt connection,  $\pm 10\%$  voltage variation.
  - g. Load type: Variable torque.
  - h. NEMA Design: B.
  - i. Insulation: Class F and rated for a Class B temperature rise.
  - j. Nominal operating speed: See motor schedule below.
  - k. Nameplate: Stainless steel engraved attached to motor frame or enclosure with stainless steel rivets.
  - l. Conduit/Junction Box: Cast iron, diagonally split, fully rotatable, gasketed between cover and box, and between box and frame. Motor lead opening in the frame shall also be gasketed. A clamp-type terminal shall be provided inside each motor conduit box for grounding.
  - m. Accessories:
    - (1) Nonreverse ratchet.
    - (2) Oversized motor junction box.
    - (3) Lifting eyes.
    - (4) Thermostats applied to motor windings, capable of shutdown and manual reset by external controls (by Division 26).
  - n. VFD requirements: Motor operating on VFDs shall be inverter-duty rated, meet the requirements of NEMA MG1, Part 31, and be capable of a minimum speed turndown

of 10:1. Motor shall also include shaft grounding rings as manufactured by AEGIS, or equal.

3. Motor Schedule: If motor horsepower is increased to meet the requirements of this specification, CONTRACTOR is responsible for increasing all wiring, starters, drives, and other electrical components as required by Code, at no additional cost to OWNER.

| Pump | Horsepower | Nominal Speed | Efficiency | VFD |
|------|------------|---------------|------------|-----|
| P-01 | 125 hp     | 1,770 rpm     | 95.4%      | Yes |

L. Variable Speed Control Coordination:

1. Variable speed drives are specified in Division 26. Care shall be taken in sizing the drive so that adequate starting torque is available for the pump. This information shall include, but not be limited to, motor full load amps and locked rotor amps and shall be provided to the variable speed drive supplier specified in Division 26.
2. Pump controls are specified in Division 26, Section 26 09 00—Controls and Instrumentation of these specifications. Pump manufacturer shall review these controls and coordinate with Division 26.
3. Equipment manufacturer shall, on the job site, perform a vibration analysis and harmonics frequency test of the installed units to determine the actual field-defined range of VFD speeds that should be locked out and also where the VFD should be ramped across (not operate) in this range to limit harmonic frequencies.
4. Equipment manufacturer shall furnish information regarding the minimum motor speed allowed in order to protect the motor and driven equipment to the variable speed drive supplier specified in Division 26. Minimum speed requirements shall be based on actual installed conditions and shall be furnished at or prior to equipment start-up. Calculations showing how minimum speed requirements were determined shall be furnished to ENGINEER for review.

M. Drawdown Measurement:

1. Two air lines shall be furnished and installed.
2. They shall be Dayco Premium neoprene air hose. The hose shall be 1/2-inch i.d. and 250 psi working pressure.
3. Each air line shall be one length with no joints. The lower ends shall be placed at the top of the bowl assembly.
4. The hose shall be fastened to each length of column pipe with 2-inch-wide 3M No. 50 Scotch wrap and shall pass through the base of the discharge head in sanitary stuffing boxes.
5. The upper end of each hose shall be fitted with a brass or copper fitting for connection to 1/4-inch copper airline.
6. Two drawdown gauges calibrated in feet shall be provided.
7. Drawdown gauge shall be direct reading-type.
8. Toro 1/4-inch polyethylene tubing, Model 900-14, with greater than 1,000 psi burst strength may be used for air line in place of the material specified above.
9. One carrier pipe shall be furnished and installed for routing submersible level transducer by others. Carrier pipe shall be 2-inch-diameter PVC pipe.
10. Carrier pipe shall be Schedule 40 PVC and fastened to each length of column pipe using same method as noted above for airline. See Section 40 05 00—Piping and Appurtenances for PVC pipe requirements. Piping shall be connected using push-on fittings without solvent welding for easy removal.

## 2.04 ANCHOR BOLTS

- A. Provide all anchor bolts required for equipment furnished. Anchor bolts shall be 316 stainless steel of ample strength for the intended service. Provide anchor bolts in accordance with Division 05.

## 2.05 WELL CASING

- A. Pipe used to adjust well casings shall be steel. Size, thickness, and grade to match existing or specified well casing pipe. CONTRACTOR shall adjust well casing as necessary.

## 2.06 FINISHES

- A. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished factory shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09. Unless otherwise specified, mechanical equipment and accessories shall be furnished with all surfaces (except galvanized, stainless steel, rubber, copper, PVC) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process to preclude damage to the equipment once assembled. Cleaned surfaces shall then be factory shop-primed. Factory shop-priming shall be with one coat of Tnemec 66HS-1255 Hi-Build Epoxoline primer, or equal, applied to a minimum of 5.0 mils dry thickness. (For equipment surfaces in contact with potable water, primer shall be Tnemec Series 20HS-1255 Beige Pota-Pox Primer and shall be NSF approved.) Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. Motors and speed reducers shall be factory shop-primed and finished-painted using the manufacturer's standard paint system for the specified application.
- B. Pump bowls and column shall be brush-sandblasted prior to installation to remove all coatings.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. CONTRACTOR shall pour the concrete pump base to the elevation required for the pump.
- B. The top of the first pour shall be left rough for proper bonding of the final pour.
- C. The metal pump subbase shall be bolted to the base of the discharge head before placing the assembly on the concrete base. The metal pump subbase shall have a running-thread bolt at each corner which will bear on the top of the rough concrete and carry the load of the pump. The running-thread bolt shall have a locking nut above and below the metal subbase. The metal subbase plate and threaded rods shall be sized to support the entire weight of the installed pump assembly. Provide metal plates on the lower end of the threaded rods as needed to bear the load of the pump on the rough concrete base. The pump base shall be properly adjusted by means of the running thread bolts until the motor shaft is properly centered in the hollow shaft motor.

- D. CONTRACTOR shall then complete the concrete base and grout the entire base assembly in place so that the subbase is a permanent part of the concrete curb.
- E. Both casings shall project 1 inch above the top of the concrete base.
- F. Before installing the pump, CONTRACTOR shall remove any floating material from the well. CONTRACTOR shall also remove any material which falls into the well during installation of the equipment.
- G. As the pump is being installed, it shall be washed inside and out with water containing 200 ppm of available chlorine per AWWA C654. All surfaces shall be wetted with the chlorine solution. CONTRACTOR shall sample for bacteria twice at least 8 hours apart. Results shall be reported to OWNER. If either sample is determined to be unsafe, CONTRACTOR shall rechlorinate per AWWA C654 and resample until two consecutive safe samples are obtained.
- H. CONTRACTOR shall bolt a blind flange on the pump discharge at completion of the installation.

### 3.02 STARTUP AND TESTING

- A. Prior to start up and testing of the well pump, CONTRACTOR shall comply with the requirements for Starting Equipment and Systems as found in Section 01 91 00–Starting of Systems. Startup approval shall be provided in writing. CONTRACTOR shall submit fully executed Certificate of Proper Installation.
- B. CONTRACTOR shall have pump motor installer review pump motor drives and starter settings and motor requirements prior to operating well pump and motor. Starter and drive settings shall be listed in the Certificate of Proper Installation.

### 3.03 FIELD QUALITY CONTROL

- A. Site Tests:
  - 1. OWNER will make field tests to check compliance with these specifications. Site tests may include test of pump operation to confirm operation in accordance to the factory characteristic curve, operation within the specified Acceptance Bands, vibration tolerances, and other tests deemed necessary by OWNER.
  - 2. If the unit, after installation, does not operate smoothly, does not meet the vibration limitations, does not operate in accordance with the factory characteristics curve, or does not operate within the specified Acceptance Bands, or otherwise not meet the requirements of these specifications; OWNER retains the right to reject the equipment and not pay for the equipment. CONTRACTOR may, with OWNER's permission, conduct field tests and make field corrections; and/or remove the equipment, shop test and make shop corrections to meet these requirements. Payment will not be made until these requirements are met.
  - 3. Vibration at any point on the equipment and shafting as operated in the field in excess of limits set forth in the current edition of the Hydraulic Institute Standards shall be the cause for rejection. All surfaces intended for bearing shall be in full contact, and insertion of washers or spacers to minimize vibration will not be permitted.

END OF SECTION

## SECTION 33 52 16

### FUEL GAS DISTRIBUTION UTILITIES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. This section contains specifications for all fuel utility distribution systems for this project.  
Work included:
  - 1. Natural Gas Service.
  - 2. Natural Gas—Aboveground.
  - 3. Buried Natural Gas Piping.
  - 4. Vents and Relief Valves.
  - 5. Unions and Flanges.

##### 1.02 CODES AND STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All material, installation, and workmanship shall comply with the applicable requirements and standards addressed within the following references.
  - 1. Wisconsin Administrative Code SPS 365—Fuel Gas Appliances and applicable standard(s).
  - 2. NFPA 54—National Fuel Gas Code (Current Edition).
  - 3. Polyethylene gas distribution piping shall be installed in accordance with CFR 49, Part 192, Subpart G (mains), Subpart H (service lines), applicable codes and regulations, and ASTM D2774.

##### 1.03 WELDER QUALIFICATIONS

- A. Before any polyethylene fusion welding is performed, Contractor to submit certification that the welders to be used on this project have successfully demonstrated proper welding procedures in accordance with the Code of Federal Regulations, Title 49, Part 192, Section 192.285.
- B. OWNER reserves the right to test the work of any welder employed on the project, at CONTRACTOR's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project.

##### 1.04 NATURAL GAS SERVICE

- A. All charges for the gas service as shown on the Drawings, including the connection from the main in the street or other location to the gas meter, shall be paid by CONTRACTOR, including setting of gas meter(s) and all work performed by the gas company.
- B. The Utility Company is Madison Gas and Electric. The natural gas utility provider contact information obtained during design is Madison Gas and Electric. CONTRACTOR is responsible to verify this information as well as installing and coordinating all aspects of the natural gas service.

- C. The secondary service pressure after the utility provided meter will be 2 psig, 2,415 BTU minimum, for the site, space, generator (standby power) and process heating.
- D. The tertiary service pressure and demand supplied to individual buildings shall be as shown on the Drawings.
- E. An allowance of \$5,000 shall be included by CONTRACTOR in the Lump Sum Bid for the scope of work provided by the Utility. Coordinate the natural gas service with the Utility. This allowance shall be adjusted by change order (up or down), based on the actual cost of the natural gas service from the Utility to CONTRACTOR.

## PART 2-PRODUCTS

### 2.01 NATURAL GAS-ABOVEGROUND

- A. See Section 23 11 23-Facility Fuel Gas Piping for specifications.

### 2.02 VENTS AND RELIEF VALVES

- A. Use pipe and pipe fittings as specified for the system to which the relief valve or vent is connected.

### 2.03 UNIONS AND FLANGES

- A. See Section 23 11 23-Facility Fuel Gas Piping for aboveground system specifications.
- B. Do not use flanges for underground gas or oil systems. Use fittings that are solvent-welded or fusion-bonded joints only.

## PART 3-EXECUTION

### 3.01 INSTALLATION

- A. Gas piping shall be installed in accordance with state, local, and utility codes and the National Fuel Gas Code, NFPA No. 54. All natural gas piping shall be tested in accordance with all state, local, and utility codes pertaining to natural gas service or service requirements. CONTRACTOR shall arrange for natural gas service and shall coordinate service size and location and shall furnish and install all shutoff valves and pressure reduction as required.
- B. CONTRACTOR shall excavate and lay all pipe to the line and grade shown on the Drawings. Grade stakes will be required for all lines.
- C. Where piping is laid in native soil, the width of trench below the top of the pipe shall not exceed the nominal diameter of the pipe plus 2 feet for all pipelines. Where the maximum trench width is exceeded, the pipe shall be placed in a concrete cradle or a stronger pipe used. If the maximum trench width is exceeded for any reason other than as otherwise specified, the concrete cradle or the stronger pipe shall be placed at CONTRACTOR's expense, unless CONTRACTOR can demonstrate that the pipe to be used is compatible with the resulting load applied.

- D. Thermoplastic pressure piping may be bedded in compacted sand. CONTRACTOR shall perform all necessary excavation and shall provide all required materials to provide this bedding. Bedding material shall conform to the requirements of ASTM C33. The material shall be hard, tough, and durable and shall meet the following gradation requirements.

PERCENTAGE BY WEIGHT PASSING

|                 | Bedding Sand |
|-----------------|--------------|
| 1 inch          | ---          |
| 3/4 inch        | ---          |
| 1/2 inch        | ---          |
| 3/8 inch        | 100          |
| No. 4           | 95 to 100    |
| No. 8           | 80 to 100    |
| No. 30          | 25 to 60     |
| No. 100         | 5 to 20      |
| Passing No. 200 | 2 to 10      |

- E. No materials native to the trench shall be used as bedding material unless they meet the above specifications.
- F. When piping is installed during hot weather, it shall be laid in the trench with slack or permitted to cool to ground temperature before it is cut to length for making final connections. PVC expansion joints shall be provided where needed.
- G. Trenches shall be kept water-free and dry during bedding, laying, and jointing. CONTRACTOR shall provide, operate, and maintain all pumps or other equipment necessary to drain and keep all excavation pits and trenches and the entire subgrade area free from water under any and all circumstances that may arise.
- H. Material that is to be placed from the bedding material around and to 1 foot above the top of all pipes shall be termed cover material. Except as otherwise specified, (a) cover material shall consist of durable granular particles ranging in size from fine to coarse in a substantially uniform combination, (b) unwashed bank-run sand and crushed bank-run gravel will be considered generally acceptable for cover material, (c) no stones larger than 3/4 inch in their greatest dimension shall be allowed in the cover material, and (d) native materials may be used if they conform to the above specifications. Cover material for copper piping shall be sand. Cover material for PVC pressure or other thermoplastic piping may be sand.
- I. Cover material shall be deposited in the trench for its full width on each side of the pipe, fittings, and appurtenances simultaneously. Cover material shall be placed over the top of the pipe to the height as shown on Drawing 01-975-43A for Class "B" (minimum 12 inches) or Class "C" (minimum 6 inches) Bedding. This backfill shall be placed by hand in 6-inch layers and shall be compacted using hand tamping bars and/or mechanical tampers. If bedding material conforming to any of the above three crushed stone or crushed gravel gradations is used as cover material, it need not be tamped. The remaining 6 inches to make up the required 1 foot of select cover material for Class "C" Bedding shall be granular material specified previously with no stones larger than 3/4 inch.

- J. All cover material shall be placed in maximum 6-inch layers and compacted by hand tamping. Compaction shall be equivalent to that described under "Compacted Fill and Backfill" as specified in Section 31 23 00–Excavation, Fill, Backfill, and Grading.
- K. Except as otherwise specified, all backfill above 1 foot above the pipe shall be "Compacted Fill and Backfill" as specified in Section 31 23 00–Excavation, Fill, Backfill, and Grading.
- L. Install an electrically conductive 10 gauge copper wire with yellow insulation with buried natural gas piping. The tracer wire shall be installed at a distance of 4 inches to 6 inches adjacent to the pipe. The wire and all of its connections shall be insulated to prevent corrosion.
- M. Do not install natural gas piping in same trench with other utilities. Minimum horizontal clearance between gas pipe and parallel utility pipe shall be 2 feet. Natural gas pipe shall not be installed through catch basins, vaults, manholes or similar underground structures.
- N. Natural gas entrances into buildings shall be above grade.
- O. Protection Against Shear and Bending Loads: In accordance with ASTM D2774, natural gas connections shall be protected where an underground polyethylene branch or service pipe is joined to a branch fitting such as a service saddle, branch saddle, or tapping tee on a main pipe, and where pipes enter or exit casings or walls. The area surrounding the connection shall be embedded in properly placed, compacted backfill, preferably in combination with a protective sleeve or other mechanical structural support to protect the polyethylene pipe against shear and bending loads.
- P. Butt, socket, and saddle fusion joints in polyethylene natural gas piping shall be made using procedures that have been qualified and approved by the Operator in accordance with Title 49, CFR, and Part 192.283.
- Q. In accordance with CFR. 49, part 192, Section 192.285, the Operator shall review that all persons making heat fusion joints have been qualified to make joints in accordance with the Operator's Approved Qualified Fusion Procedures. The Operator shall maintain records of qualified personnel, and shall certify that qualification training was received not more than 12 months before commencing construction. CONTRACTOR shall review that all persons making heat fusion joints are qualified in accordance with this section.
- R. Butt fusion of unlike wall thickness: Butt fusion shall be performed between pipe ends, or pipe ends and fitting outlets that have the same outside diameter and are not different in wall thickness by more than one Standard DR. Transitions between unlike wall thickness greater than one SDR shall be made with a transition nipple or by mechanical means or electrofusion.
- S. Polyethylene natural gas pipe and fittings may be joined together or to other materials by transition fittings, fully restrained mechanical couplings, or electrofusion. These devices shall be designed for joining polyethylene to another material and shall be approved by ENGINEER for use in natural gas distribution system.
- T. When mechanical OD compression couplings are used, polyethylene natural gas pipe shall be reinforced with a stiffener in the pipe bore. Stiffeners shall be properly sized for the diameter and wall thickness of polyethylene pipe being joined. For service pipe connections, the stiffener length shall match the pipe end penetration depth into the coupling.



U. General Excavation:

1. CONTRACTOR shall do all excavation, undercutting, dewatering, and backfilling necessary for work under this contract unless otherwise noted. All trees, shrubs, and improved areas outside the excavation shall be protected from damage.
2. Work shall conform to other sections of Division 31, except where modified by this section.
3. Pipe shall be placed only on dry foundations. No extra payment will be made to CONTRACTOR for dewatering.
4. Excavation shall include all necessary clearing of excavated areas, tree removal, all grubbing, all wet, dry, fill, and rock excavation, the removal of pavement, filling, and all incidental work such as tunneling, sheet piling, shoring, underpinning, pumping, bailing, transportation, and all fill and backfilling. All above work shall be included in the Lump Sum Bid.
5. CONTRACTOR shall excavate whatever materials are encountered as required to place at the elevations shown, all pipe, manholes, and other work as required to complete the project as shown. The bottom of the excavation shall be leveled off, all loose and disturbed soil shall be removed, and it shall be hand-tamped prior to pipe, manhole, etc., installation. Where requested by ENGINEER, original material below the excavation necessary for construction according to grades shown or specified shall be removed and replaced in accordance with Section 31 23 00–Excavation, Fill, Backfill, and Grading. Payment will also be in accordance with Section 31 23 00–Excavation, Fill, Backfill, and Grading.
6. The excavation at the crossing of all underground utility services in place shall be as narrow as practicable. All underground services shall be protected from damage and maintained in service at their original location and grade during the process of the work. Any damage to underground services shall be replaced or repaired at no cost to OWNER or to the owner of the service. The present underground services shown on the Drawings are located in accordance with available data. Encountering these services at a different location or encountering services not shown shall not release CONTRACTOR from the above-stated conditions.
7. Excavated native material that is unsuitable or not required for filling shall be removed from the site. Materials to be used for fill and suitable for this purpose shall be deposited where required except that no fill shall be placed where trenches for sewers, water lines, or other services will be located until after the trench work is completed.
8. CONTRACTOR shall provide adequate shoring, sheet piling, and bracing to prevent earth from caving or washing into the excavation and shall do all shoring and underpinning necessary to properly support adjacent or adjoining structures. All shoring, sheet piling, and underpinning must be maintained until permanent support is provided.
9. Any water, drainage, gas, sewer, or electric lines encountered in the excavation that are not to be disturbed shall be properly underpinned and supported. Any service connections encountered that are to be removed shall be cut off at limits of the excavation and capped in accordance with the requirements of or permits governing such removals. Any permits required for this work will be obtained by OWNER upon request of CONTRACTOR.

V. Gas lines shall not be installed under buildings, structures, or in crawl spaces.

W. A Schedule 40 steel sleeve shall be installed on all natural gas risers passing through asphalt or concrete slabs. Allow at least 1 inch of radial clearance between sleeve and riser. Void shall be filled with pea gravel.

X. Natural gas piping shall be buried a minimum depth of 36 inches, unless noted otherwise.

- Y. Do not route piping through sub-grade utility vaults.
- Z. Install all valves, and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.
- AA. Pitch horizontal piping down 1-inch in 60 feet in the direction of flow to dirt leg that is to be located in building for accessibility. When installing mains and branches, cap gas-tight each tee or pipe end which will not be immediately extended. All branch connections to the main shall be from the top or side of the main.
- BB. Do not install gas pipe below a building or its foundation or in a ventilation air plenum.
- CC. If an above ground vent terminates in an area subject to snow accumulation, terminate the line at least 5 feet above grade.
- DD. All joints in underground polyethylene gas pipe must be made by qualified personnel proficient in the joining methods of ASTM D2513 thermoplastic gas pressure pipe and polyethylene fittings. Do not install polyethylene gas pipe inside buildings.
- EE. Install shut off valves as shown on Drawings. Provide valve box and valve operator per NFPA and AGA standards.
- FF. Blow compressed air into gas piping system as a part of commissioning system, before placing into service, to clean piping until target cloth is clean and free of debris.
- GG. Use for all underground metallic piping or underground metallic gas conduit.
- HH. Remove all dirt and other foreign material from exterior of pipe. Apply primer as recommended by the manufacturer. Use a spiral wrap process for applying tape to the pipe. Repair any breaks in the tape coating caused by the installation process.
- II. Concealed or underground unions or flanges are not acceptable.

### 3.02 FIELD QUALITY CONTROL

- A. If required for the additional pressure load under test, provide temporary restraints at expansion joints or isolate them during the test. Verify that hangers can withstand any additional weight load that may be imposed by the test.
- B. Provide all piping, fittings, blind flanges, and equipment to perform the testing.
- C. Conduct pressure test with test medium of air unless specifically indicated. Minimum test time is indicated in the table below; additional time may be necessary to conduct an examination for leakage. Each test must be witnessed by the Division's representative. If leaks are found, repair the area with new materials and repeat the test; caulking will not be acceptable.
- D. Do not backfill pipe until it has been successfully tested.

- E. For air tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. The piping system exclusive of possible localized instances at pump or valve packing shall show no evidence of leaking. After testing is complete, slowly release the pressure in a safe manner.
- F. Measure natural gas system test pressure with a water manometer or an equivalent device calibrated in increments not greater than 0.1 inch water column. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.

| System      | Pressure | Medium | Duration |
|-------------|----------|--------|----------|
| Natural gas | 100 psig | Air    | 24 hr    |

- G. On piping that cannot be tested because of connection to an active line, provide temporary blind flanges and hydrostatically test new section of piping. After completion of test, remove temporary flanges and make final connections to piping. Die penetrate test pass weld or x-ray the piping that was not hydrostatically tested up to the active system.

END OF SECTION

## SECTION 40 05 00

### PIPING AND APPURTENANCES

#### PART 1—GENERAL

##### 1.01 SUMMARY

- A. Work Included:
  - 1. All piping, valves, and appurtenances of every description except for pipe as specified in Divisions 22, 33, and 46, natural gas piping and appurtenances as specified in Section 23 11 23—Facility Fuel Gas Piping, and hot water heating system.
  - 2. Concrete foundations and anchor bolts for all equipment furnished under this section.
  - 3. Piping connections to all equipment, whether furnished under this section or not.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 SUBMITTALS

- A. Applicable provisions of Section 01 33 00—Submittals cover requirements for shop drawings and Operation and Maintenance Manuals.
- B. General arrangement drawings, including support system of 3 inches or larger interior and 3 inches or larger exterior (aboveground) ductile iron, PVC, piping shall be submitted to ENGINEER for approval. Shop drawings for all interior and aboveground exterior piping shall be two-line drawings drawn to scale. Drawings shall include proposed materials, length, location, and elevation of pipe, fittings, supports, and valves and appurtenances. Plug valve orientation, including operator and plug orientation, shall be shown on Drawings.
- C. Refer to Division 22 for DWV and potable water piping and valves.

#### PART 2—PRODUCTS

##### 2.01 MATERIALS OF CONSTRUCTION

- A. Materials of Construction: All materials used in the manufacture, assembly, and painting of piping and valves in contact with water shall be compatible with potable water supplies and in contact with chemical feed systems shall be compatible with the chemicals being used. All glues, solvents, solders, etc., shall likewise be compatible. For instance, no lead-base solders shall be used. Products used in potable water systems shall be UL classified in accordance with ANSI/NSF-61 for potable water service and shall meet the low-lead requirements of NSF-372.
- B. Size and Type:
  - 1. All materials shall conform to the size and type shown on the Drawings or called for in the specifications.
  - 2. In joining two dissimilar types of pipe, standard fittings shall be used when available. In the event standard fittings are not available, the method of joining shall be selected by CONTRACTOR and submitted for review by ENGINEER.

- C. Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be subject to approval of ENGINEER. All grooved joint couplings and fittings shall be of the same manufacturer.

## 2.02 PIPE AND PIPE FITTINGS

### A. Ductile Iron Piping and Fittings:

1. Unless otherwise shown or specified, all interior piping 4 inches in diameter or larger shall be ductile iron conforming to AWWA C115.
2. Interior piping shall be minimum Special Class 53 with a minimum rated working pressure of 250 psi.
3. Except where shown, interior pipe joints shall be flanged. Flanged joints shall conform to applicable flanged joint sections of AWWA C110, C111, and C115 and shall be compatible with ANSI B16.1 Class 125. Flanges shall be ductile iron. Manufacturers of flanged pipe and fittings shall be certified to NSF 61 by an ANSI-accredited third-party certification organization.
4. Gaps between flanges and all locations where a gap exists at flange hub/pipe intersection shall be caulked prior to finish painting with Masterseal NP1 by Master Builders Solutions, Sikaflex-1A by Sika Corporation, or equal. CONTRACTOR shall verify compatibility of caulk with finish painting system specified in Division 09.
5. Flanged gaskets shall be minimum 1/8-inch-thick, styrene butadiene rubber (SBR), full-face, Toruseal, Flange-Tyte, Maloney, or equal, gaskets. Thicker gaskets shall be provided as recommended by the manufacturer to meet joint tolerance.
6. Flanged fittings shall be of ductile iron with ductile iron flanges. Flanged fittings shall conform to AWWA C110 and ANSI B16.1, as applicable, with a minimum rated working pressure of 150 psi.
7. All ductile iron fittings shall be American Ductile Iron Pipe, Tyler Union, U.S. Pipe, or equal.
8. All flanged sections of pipe shall be made up in accordance with AWWA C115 specifications. No field makeup flanges will be allowed unless they are approved in advance by ENGINEER and strictly conform to AWWA C115, with facing done after turning pipe through flange.
9. Unless otherwise specified, all ductile iron piping and fittings shall be cement mortar lined and asphaltic-coated inside. Cement mortar lining shall be in accordance with AWWA C104. Asphaltic coating shall conform to applicable standards herein for the pipe and fittings. Exterior exposed, submerged, and interior piping shall be furnished with outside surfaces prepared by abrasive blasting in accordance with NAPF 500C-03. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. It is the intent of this specification that all piping, supports, and appurtenances shall be furnished shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.

### B. Copper Piping:

1. Copper piping shall conform to the requirements of ASTM B88.
2. All interior or aboveground non-potable water supply piping smaller than 3 inches shall be Type K hard copper. Fittings shall conform to ANSI B16.22 wrought copper and be

soldered or sweated on. No lead-based solder may be used. Piping shall run exposed in buildings, except in finished areas.

3. Shutoff valves shall be placed on each branch for all underground, aboveground, or interior piping.
4. Pump vent and drain lines, seal water supply and other small-diameter interior piping from the PW or NPW source, and manometer lines shall be rigid, Type K hard copper. An ample number of unions shall be provided for disassembling. Pump vents shall be valved.
5. Provide a 1-inch solenoid valve as specified herein in the well pump copper prelube line. Provide 3/4-inch bypass around solenoid with manual shutoff valves.

C. PVC Piping—Chemical Feed Piping:

1. Except as otherwise specified, all chemical feed piping and chemical solution shall be constructed of PVC.
2. PVC material shall conform to ASTM D1784, Class 12454-B. PVC piping and fittings shall be PVC 1120, Schedule 80, high impact pipe conforming to ASTM D1785 with bells conforming to ASTM D2672. Solvent weld fittings shall conform to ASTM D2467, and for threaded, ASTM D2464.
3. All piping shall be approved for use by the National Sanitation Foundation. All pipe delivered to the job site shall be properly marked for type, grade, and design stress rating. Expansion joints shall be provided where needed. In general, all joints shall be solvent weld, except where flanges are required or as shown on the Drawings or where transition to another pipe material is required. Underground gravity pipe shall be installed in compliance with ASTM D2321 except as otherwise specified herein. Underground pressure piping shall be installed in compliance with ASTM D2774.
4. All exterior exposed or PVC piping in open tanks shall be formulated with sufficient ultraviolet light screeners to provide for long-term outdoor exposure with no deleterious effects.
5. Solvents shall be compatible with chemicals carried in piping. Submit solvent information with shop drawings.

- D. Polyethylene Tubing: Chemical tubing shall be polyethylene tubing, unless otherwise shown or specified. All tubing bends, tees, adapters, and unions shall be clear polypropylene compatible with the tubing and solution, or equal. Tubing inserts shall be used at all fittings. Tubing and fittings shall be rated for operating pressures of 120 psi, minimum. Tubing runs in excess of 10 feet shall be run in adequately supported minimum 2-inch ID Schedule 40 PVC conduits. Conduit runs shall be broken at all fittings and bends to allow easy access to interior tubing. Conduit shall be supported as specified for PVC piping.

## 2.03 VALVES

A. Gate Valves:

1. Shutoff valves in potable and non-potable water lines 4-inch diameter and larger shall be AWWA C509, cast iron, resilient seat, nonrising stem, 150 psi working pressure with O-ring packing box, Kennedy, American, American AVK, or equal.
2. Shutoff valves in non-potable water lines, grit flush water lines, pump vent and drain lines 1-inch 2 1/2-inch diameter through 3-inch diameter shall be gate valves, Class 150, bronze or iron body bronze-mounted, solid wedge disc, threaded, rising stem, Nibco T-131, Milwaukee Valve 1150, or equal. Provide unions for ease of valve removal.
3. Underground valves shall have extended stem, cast iron telescopic valve box, and key. Exposed valves not in reach of the floor (7 feet to centerline, or greater) shall have chain

wheel operator. All other valves shall have handwheels. Right angle operators shall be provided, if required, because of valve position.

4. Asphaltic varnish and coal tar coating are not allowed on interior valves. Exterior buried valves shall be fusion-bonded epoxy-coated or epoxy-coated (prime and finish coats) as specified in Division 09. Interior and exterior exposed valves shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the valve once assembled. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. A fusion-bonded epoxy system is an acceptable alternative to the specified primer. It is the intent of this specification that all valves, supports, and appurtenances shall be furnished shop primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.

B. Check Valves:

1. Except where noted, check valves in ductile iron lines carrying liquid shall be GA Industries 250-D, Apco Model 250 by DeZURIK, or equal, air cushion check valves. The swing check valves shall be constructed with a heavy cast iron or ductile iron body, a bronze or stainless steel seat ring, an extra heavy noncorrosive shaft for attachment of lever and necessary weights to close valve, and a complete noncorrosive air cushion chamber. The valve shall be tight-seating and shockless in operation. The seal ring shall be renewable and shall be securely held in place by a threaded joint. The air cushion chamber shall be attached to the side of the valve body externally and so constructed with a piston operating in a chamber that will effectively permit the valve to be operated without any slamming action. Shock absorption shall be by air, and the chamber shall be so arranged that the closing speed can be adjusted to meet the service requirements. The valve disc shall be of cast iron or ductile iron and shall be suspended from a noncorrosive shaft that shall pass through a stuffing box to be connected to the chamber on the outside of the valve.
2. Miscellaneous:
  - a. Check valves in other than ductile iron, cast iron, PVC, polyethylene, or compressed air lines shall be Class 150, Milwaukee Valve 510, Nibco T-433, or equal, screwed end, bronze, bronze disc, swing check for water and air.
  - b. Check valves in PVC lines shall be ball check type of PVC construction.
  - c. Check valves in polyethylene lines shall be of polypropylene construction.
  - d. Check valves in compressed air lines 3 inches or smaller shall be horizontal lift check valves, Class 150, Crane No. 27TF, or equal. Valves shall have threaded ends, PTFE disc, union cap, and bronze body and cap.
3. Asphaltic varnish and coal tar coating are not allowed on check valves. Exterior of cast iron or steel valve body shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation shall be done at such time during the assembly process as to preclude damage to the valve once assembled. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. Primer used shall be compatible with proposed finish coats;

CONTRACTOR shall verify. A fusion-bonded epoxy system is an acceptable alternative to the specified primer. It is the intent of this specification that all valves, supports, and appurtenances shall be furnished shop-primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.

C. Butterfly Valves:

1. General:

- a. Except as otherwise specified or shown on the Drawings, shutoff valves in lines 4 inches in diameter or larger shall be butterfly valves.
- b. Butterfly valves shall be AWWA C504, short body, Class 150B. Provide certified drawings by manufacturer and Affidavit of Compliance.
- c. Valve bodies shall be cast iron (ASTM A126, Class B), or ductile iron ASTM A536. Valves shall be flanged interior exposed and mechanical joint underground and conform to ANSI B16.1, Class 125.
- d. Valve shaft shall be stainless steel.
- e. Valve disc shall be cast iron.
- f. Valve seat shall be constructed of synthetic rubber compound and shall be recess-mounted and bonded in the valve body or attached to the disc. Seat shall be mechanically attached to the valve body or seat with screws, bolts, clamping-rings, or similar devices.
- g. Valve shaft bearing shall be self-lubricating Teflon, nylon, or bronze.
- h. Shaft seals shall have split V-type packings that are replaceable without removing the valve from the line.

2. Standard Operators:

- a. Except as noted below, butterfly valves shall be equipped with top-mounted handwheel operators with totally enclosed, sealed and lubricated gear boxes.
- b. The rated torque capability of each operator shall be sufficient to seat, unseat, and hold any valve disc position with the maximum pressure differential across the valve without creep or fluttering.
- c. Exposed valves shall be equipped with handwheels and valve disc position indicators, and shall be equipped with field-adjustable mechanical stop limiting devices. Handwheels shall be ductile iron or gray iron.

D. Solenoid Valves: Except where otherwise shown or specified, solenoid valves for water services shall be normally closed, 2-way pilot-operated, slow closing solenoid valves, ASCO Red Hat II 8221 Series, or equal. Valves on seal water systems shall fail open. Valve shall be brass body with Buna-N disc. Enclosure shall be rated for NEMA 4X. Valve shall be operated on 120 VAC, 60 Hz power supply. Valve shall be rated for a maximum operating pressure differential of 150 psi. Unit shall be CSA certified and UL listed.

E. Miscellaneous Valves, Strainers, Hose Bibs, and Valve Boxes:

1. Shutoff valves in PVC piping shall be hand-operated 150 psi union-type PVC ball valves, Chemtrol TU Series Tru-bloc, Walworth Series 8927, or equal. Valves and all components including O-rings shall be compatible with chemicals in piping. PVC valves and union shall not be painted. Valves in sodium hypochlorite and sodium bisulfite piping shall be fitted with a relief hole from center port to high pressure side of valve.
2. Y-strainers in chemical lines shall be transparent PVC, Asahi, or equal, True Union strainer. Provide 20 mesh PVC mesh screens. Strainers used for hypochlorite service shall have Teflon O-rings.
3. All valves for use on chemical waste lines shall be chemically compatible with the liquid to be carried. Valves in polyethylene piping shall be 1/2-inch polypropylene ball valves



- suitable for 100 psi operating pressure. Valves in PVDF piping shall be PVDF valves suitable for 200 psi operating pressure.
4. Water Air Release Vacuum Relief Valve:
    - a. The combination air and vacuum release valve shall be 2-inch as manufactured by APCO, Val-Matic, or equal.
    - b. The valve assembly shall include a discharge throttling valve, water diffuser, and 2-inch gate valve on the valve inlet.
    - c. CONTRACTOR shall run 2-inch pipe from the top of the valve as shown. SS No. 24 mesh screen end of pipe.
  5. Hose Bibs:
    - a. Hose bibs providing non-potable water shall be provided with a removable key handle.
    - b. Exterior hose valves shall be Woodford Model 65, Watts, or equal, freezeless wall hydrants with integral ASSE 1019 backflow preventer outlet, permanent valve seat, and brushed chrome exterior face with 3/4-inch outlet garden hose threads and 3/4-inch inlet. Provide loose key operator with each exterior hose bib. Provide round or square box recessed enclosure with locking door for the hose bib. CONTRACTOR shall coordinate wall thickness with recessed enclosure depth.
    - c. Interior hose valves shall be Woodford Model 24, Watts, or equal. Provide 3/4-inch garden hose thread, 3/4-inch inlet, and ASSE 1011 approved backflow preventer outlet. Interior hose valves shall be equipped with approved vacuum breaker, Watts 8A, Nidel Model 34H, or equal. Provide metal handle and chrome plate finish. Provide loose key with each faucet.
  6. Valve Boxes:
    - a. Valve boxes shall be provided for all buried valves.
    - b. Valve boxes shall be made of cast iron conforming to ASTM A48, Class 20. Valve boxes shall consist of a base section, tubular mid and top sections, both with cast threads by which one can be telescoped on the other, extension sections if required, and a circular drop cover. The castings shall be free from blowholes, porosity, hard spots, shrinkage defects or cracks, or other injurious defects and shall have a normal smooth casting finish. The castings shall be thoroughly coated with a 1 mil minimum thickness bituminous coating. Valve boxes shall be 5 1/4 inches in diameter. Valve boxes shall have a maximum length of 7 feet when extended without extension sections. Extensions shall be provided for deeper mains.
    - c. The valve box shall be centered and plumb over the wrench nut of the valve with the box cover flush with the finished ground elevation. Solid 4-inch concrete blocks shall be placed under the base of valve boxes so that the bottom of the base is about 2 inches away from contact with the valve bonnet. The valve box shall not transmit shock or stress to the valve.
    - d. Valve box alignment devices: All valves shall be supplied with a gate valve adaptor as manufactured by Adaptor, Inc., or equal. All adaptors shall have a metal frame and be supplied with a 3/4-inch rubber gasket. All adaptors shall be sized to fit the brand of valve being supplied.
  7. For pressures <80 psi, provide 1/2-inch, chrome-plated, smooth-end sampling cock, Zurn Z-80401, or equal. For pressures >80 psi, provide 1/2-inch satin brass smooth-end sample cock, Apollo 26-314, or equal.

## 2.04 PIPING APPURTENANCES AND MISCELLANEOUS MATERIALS

- A. General: Piping appurtenances shall be made of the materials specified. All appurtenances not designated as to type shall be subject to approval of ENGINEER.

- B. Pipe Coupling: Pipe couplings identified on the Drawings shall be Dresser Type 38, Smith Blair 411, or equal, coupling. CONTRACTOR shall provide tie ears and tension ties where necessary to restrain pipe.
- C. Tension Ties: All tension ties and rod ties shall be provided to resist a minimum 150 psi pressure in the pipe line. CONTRACTOR shall provide tie ears to secure tension rods to flanges where necessary. Rods shall be provided with nuts and washers on both sides of tie ears. All nuts, washers, and rods shall be Type 304 stainless steel. Rods shall be Type 304 stainless steel at a minimum. Tie rods shall be equally spaced around pipe. The following table lists the minimum number and diameter in inches for the tie rods for various sizes of pipe.

| Pipe Size<br>(inches) | 150 psi Pressure  |                             | 250 psi Pressure  |                             |
|-----------------------|-------------------|-----------------------------|-------------------|-----------------------------|
|                       | Minimum<br>Number | Minimum<br>Size<br>(inches) | Minimum<br>Number | Minimum<br>Size<br>(inches) |
| 4-10                  | 4                 | 5/8                         | 4                 | 5/8                         |

- D. Equipment–Pressure Gauges:
- Gauges are to be aluminum 6-inch ANSI B40.1, Grade 2A bourdon gauges and be equipped with properly-sized Ray pressure snubbers and brass shutoff valves.
  - Gauges shall be accurate to  $\pm 1/2\%$  of scale range.
  - Gauges shall be Trerice No. 500-X Series, Ashcroft Duragauge, or equal.
  - Gauges shall be as follows: Well discharge gauge graduated in psi, range 0 to 100 psi.

### PART 3–EXECUTION

#### 3.01 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, start-up, and operator training.

#### 3.02 INSTALLATION

- A. Interior or Exposed Piping:
- Provide pipe supports for all piping. Pipe support spacing and type shall, at a minimum, conform to manufacturer's recommendations unless more restrictive requirements are specified or shown on the Drawings. All interior or exposed pipelines shall be securely supported by adjustable saddles, brackets, or adjustable hangers supported directly by concrete, masonry work, or tile. Strap hangers, tin clips, or U-hooks will not be acceptable. Piping shall be supported, even though not shown on the Drawings, using base fittings and concrete pads to 6 inches above the floor, Anvil 264, B-line, or equal, adjustable pipe saddle stand with floor flange to 6 feet above the floor, and supporting clamps or inserts more than 6 feet above the floor. In general, the maximum spacing of supports shall not exceed 10 feet on center. Except as specified for plumbing system, all PVC piping shall be supported using galvanized supports for flexible piping except as indicated. Piping in chemical feed rooms shall be supported with a plastic support system, Aickinstrut, or equal. Insulation saddles shall be used at supports of insulated piping. CONTRACTOR shall furnish and place hangers, supports, wall pipes, and sleeves in the forms before concrete is poured where needed or shown on the Drawings.

2. All piping shall be adequately supported and braced to resist thrust at bends, expansion joints, and joints. Use base elbows, poured concrete, or rod ties. The weight of the piping shall be supported independently of connected equipment.
3. All supports and parts shall conform to the latest requirements of ASME B31 and shall have a structural safety factor of 5. Accurate weight balance calculation shall be made by CONTRACTOR to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection. CONTRACTOR shall be responsible for the installation of the supports. Pipe hangers shall be capable of supporting the pipe weight load in all conditions of operation. The hangers shall allow free expansion and contraction of the piping to prevent excessive stress in the piping. Where vertical movement up to 1/8 inch is anticipated, a precompressed variable spring support shall be used. Rigid hangers shall be provided with a means of vertical adjustment after erection. Where horizontal piping movements are greater than 1/2 inch, or where the hanger rod angularity from vertical is greater than 4 degrees from hot to cold position of the pipe, the hanger pipe and structural attachments shall be offset in a manner that the rod is vertical in the hot position. Hangers and supports shall be spaced in accordance with ASME B31 and as indicated in this specification. Pipe supports shall be placed before and after a valve, expansion joint, or equipment so stress will not be transferred to them.
4. CONTRACTOR shall provide calculations of pipe supports if requested by ENGINEER.
5. All carbon steel parts shall be furnished with all surfaces (except galvanized or stainless steel) prepared in accordance with near white grade SSPC Specification No. 10 removing all dirt, rust scale, and foreign materials. Surface preparation of all carbon steel parts shall be performed at such time during the assembly process as to preclude damage to the equipment once installed and assembled. Cleaned surfaces shall then be shop-primed. Factory shop prime with one coat of Tnemec N69 or N140 or Sherwin Williams Duraplate 235 or Macropoxy 646PW, or equal, applied at a minimum 5.0 mils dry film thickness. Primer color shall be beige. Primer used shall be compatible with proposed finish coats; CONTRACTOR shall verify. It is the intent of this specification that all equipment, supports, and appurtenances shall be furnished shop primed, clean, and ready to accept finish painting by CONTRACTOR with a minimal amount of surface preparation. Preparation and painting shall conform to all requirements and provisions specified in Division 09.
6. The following maximum spacings shall be provided for supports:

#### MAXIMUM HORIZONTAL PIPE HANGER AND SUPPORT SPACING

| Nominal Pipe<br>or<br>Tube Size | Copper Tubing          |                               | Ductile Iron<br>(See Note 1)<br>ft | PVC/CPVC<br>Pipe<br>(See Note 2)<br>ft |
|---------------------------------|------------------------|-------------------------------|------------------------------------|----------------------------------------|
|                                 | Water<br>Service<br>ft | Vapor or<br>Air Service<br>ft |                                    |                                        |
| 1/4                             | 5                      | 5                             |                                    |                                        |
| 3/8                             | 5                      | 6                             |                                    | Continuous                             |
| 1/2                             | 5                      | 6                             |                                    | Continuous                             |
| 3/4                             | 5                      | 7                             |                                    | Continuous                             |
| 1                               | 6                      | 8                             |                                    | 4                                      |
| 1 1/4                           | 7                      | 9                             |                                    | 4                                      |
| 1 1/2                           | 8                      | 10                            |                                    | 4                                      |
| 2                               | 8                      | 10                            |                                    | 4                                      |
| 2 1/2                           | 9                      | 10                            |                                    | 4                                      |
| 3                               | 10                     | 10                            |                                    | 4                                      |
| 4                               | 10                     | 10                            | 10                                 | 4                                      |

| Nominal Pipe<br>or<br>Tube Size | Copper Tubing          |                               | Ductile Iron<br>(See Note 1)<br>ft | PVC/CPVC<br>Pipe<br>(See Note 2)<br>ft |
|---------------------------------|------------------------|-------------------------------|------------------------------------|----------------------------------------|
|                                 | Water<br>Service<br>ft | Vapor or<br>Air Service<br>ft |                                    |                                        |
| 5                               | 10                     | 10                            | 10                                 | 4                                      |
| 6                               | 10                     | 10                            | 10                                 | 9                                      |
| 8                               | 10                     | 10                            | 10                                 | 9                                      |
| 10                              | 10                     | 10                            | 10                                 | 10                                     |
| 12                              | 10                     | 10                            | 10                                 | 10                                     |
| 14                              |                        |                               | 10                                 | 10                                     |
| 16                              |                        |                               | 10                                 | 10                                     |
| 18                              |                        |                               | 10                                 | 10                                     |
| 20                              |                        |                               | 10                                 |                                        |
| 24                              |                        |                               | 10                                 |                                        |
| 30                              |                        |                               | 10                                 |                                        |
| 36                              |                        |                               | 10                                 |                                        |
| 42                              |                        |                               | 10                                 |                                        |

Note 1: Provide at least one hanger per pipe length located as close to the flange or joint on barrel as possible.

Note 2: Spacing is based on Schedule 80 at 100°F. For Schedule 40 or higher temperatures, provide shorter span. Consult local plumbing code and manufacturer's recommendations as required. Minimum spacing requirements shall govern.

7. The length of hanger span and support spacing in the above table refers to straight lengths of pipe. When there are changes of direction in pipe, two supports shall be placed less than three-fourths the full span in the table. When practical, a hanger shall be located immediately adjacent to a change in direction of piping. Where there are concentrated loads between supports such as valves, spacing shall be based on load calculations rather than this table.
8. Exposed piping shall run straight, in neat parallel lines, and shall be located far enough from walls, ceilings, and floors to permit access for covering of pipe and painting work. Care shall be taken in laying out piping so that there is no interference with the proper location of piping for other purposes or other equipment and shall be run with regard to the requirements of each service.
9. Piping shall not interfere with headroom or clear floor space. Unless otherwise shown, piping shall run exposed in buildings, except in finished areas. Unless otherwise shown, small water piping in finished areas shall be concealed in interior walls, above suspended ceilings, or under floors where possible. Water piping shall not be installed in exterior walls, unless otherwise shown or noted on the Drawings. Joints shall not be used under floor slabs. Unless otherwise shown, piping under floor slabs shall clear floor slabs or footings by a minimum of 6 inches. Pipes under floors shall have a minimum of 6 inches of sand cover. Plates shall be provided on all uncovered pipes passing through floors, walls, and ceilings constructed of materials other than poured concrete. Plates shall be on exposed sides and shall be chrome-plated, spring and snap type.
10. Except for flanged piping, an ample number of standard weight ground joint unions and a shutoff valve shall be provided in all pipelines and at all equipment. CONTRACTOR shall provide 3/8-inch tapped and plugged connections in suction and discharge of all pumps for testing.

11. Valves shall be located on all branches of water supply lines where shown on the Drawings. Position valves to facilitate access and operation.
12. The locations and elevations of existing piping are approximate. Any changes in the pipe location or elevation shall be reviewed by ENGINEER.
13. CONTRACTOR shall submit shop drawings showing new pipe routing and existing pipe removal. CONTRACTOR shall be responsible for final pipe routing and shall route new piping as required to minimize conflicts. Piping shown on the Drawings is approximate only. Not all existing piping, conduit, equipment, etc., are shown on the Drawings. CONTRACTOR shall field-verify locations. CONTRACTOR shall reroute existing piping, conduit, etc., as indicated or as required to install new piping or equipment. CONTRACTOR shall remove and relocate existing pipe supports as required to install new piping. CONTRACTOR shall provide all piping, fittings, flange fillers, and other appurtenances as required to provide functional system at no additional cost to OWNER.
14. Caulking Ductile Iron Piping: Caulk to seal all gaps between flanges and all locations where a gap exists at flange hub/pipe intersection on ductile iron piping following installation and testing and prior to field finish painting. Trim back excess edge of rubber gasket between flanges as necessary to achieve a uniform and flush caulk joint, but no more than 1/8 inch from the outside edge of the flange. Caulking of joints shall be done in a workmanlike manner and in accordance with the applicable specifications of Division 07. There shall be no excess caulk outside of the gaps or joints to be filled, and adjacent surfaces to be painted shall be clean and free of excess caulk. Caulking shall be done and fully cured as required prior to painting of piping. Coordinate work with Division 09.

B. Wall and Other Pipe Penetrations:

1. CONTRACTOR shall furnish and place hangers, supports, wall pipes, sleeves, and floor boxes in the forms before concrete is poured wherever needed or shown on the Drawings.
2. Where pipes pass through concrete members without wall fittings shown, CONTRACTOR shall provide sleeves in the forms for the piping, unless otherwise shown on the Drawings. The sleeve diameter shall not exceed the pipe o.d. plus 2 inches (or the pipe flange o.d. plus 1 inch, as applicable), unless otherwise shown on Drawings. If the concrete members are to be watertight, the annular space around the pipe shall be sealed with a mechanical seal. Sleeves shall be steel unless noted otherwise and shall include minimum 1-inch waterstop. Steel sleeves shall be prepared, primed, and painted in accordance with Division 09 prior to placement in between concrete forms. Steel sleeves shall receive touch-up paint prior to placing forms. For copper pipe, provide an elastomeric sleeve on pipe where it passes through walls or slabs.
3. Where plain end wall pipes are shown or indicated on the Drawings, CONTRACTOR may substitute a flanged end wall pipe, if desired, for the purposes of pressure testing specified herein.
4. Where pipe passes through nonwatertight walls, the annular space shall be grouted full. Where pipes pass through nonwatertight floors, the sleeve shall extend 1 inch above the finished floor elevation. The annular space shall remain open, except the annular space between a rated space (example—Class I, Division 1, Group D hazardous location) and a nonrated space shall be sealed with a mechanical seal.
5. Where pipes pass through a roof, they shall be run through an approved roof penetration with flashing and counter flashing.
6. Where new pipes go through existing watertight concrete members, CONTRACTOR shall core a hole through the member, unless otherwise shown on the Drawings. The

annular space between the concrete and pipe shall be sealed with a mechanical seal. Where new pipes go through existing nonwatertight concrete or masonry members, holes shall be cored and annular space between the concrete and the pipe shall be grouted full (walls or floors at rated spaces) or remain open (floors at nonrated spaces). Prior to any coring, CONTRACTOR shall locate reinforcing steel in the member and shall consult with ENGINEER to determine optimal location for the core. Plug abandoned pipes and wall pipes, after pipe and fittings removal flush to the concrete surface, with nonshrink grout, to achieve a watertight seal.

7. Where pipes pass through fire-rated walls, floors, ceilings, or other assemblies, the required firestopping materials shall be provided. Refer to Section 07 84 00—Firestopping for requirements.
  8. Nonshrink grout shall be as specified in Division 03.
  9. No chases or recesses shall be made in poured concrete for pipe installation, and no pipe shall run in poured concrete unless called for in the Drawings or specifications or permitted by ENGINEER. The cutting or core drilling of concrete for pipe shall be avoided wherever possible, and in no case where such cutting or core drilling is necessary shall reinforcing rods be cut or disturbed without notifying ENGINEER. All openings for pipe work shall be neatly patched in a workmanlike manner.
- C. Cleaning and Disinfection: All equipment and materials shall be clean before installation. CONTRACTOR shall disinfect and flush the potable water system before it is put online. Water main shall be disinfected according to AWWA C651.

### 3.03 FIELD QUALITY CONTROL

- A. CONTRACTOR shall include the cost of all testing, cleaning, and disinfection in the price Bid.
- B. Work shall be tested as specified in this section. Unless indicated by ENGINEER in writing before testing begins, tests shall be witnessed by ENGINEER and others as necessary. Test results shall be recorded, and reports or appropriate certificates shall be submitted to ENGINEER in triplicate.
- C. New piping shall be tested. Piping, interior or exposed, shall be subject to test before being covered with insulation or paint or before caulking of any gaps at flanges of ductile iron piping. Piping and appurtenances shall be watertight or airtight and free from visible leaks.
- D. Piping shall be flushed or blown out after installation and prior to testing. CONTRACTOR shall provide all necessary piping connections, water, air, test pumping equipment, water meter, bulkheads, valves, pressure gauge and other equipment, materials, and facilities necessary to complete the specified tests. CONTRACTOR shall provide all temporary sectionalizing devices and vents for testing.
- E. Gauges used for testing shall have increments as follows:
  1. Tests requiring a pressure of 10 psi or less shall use a testing gauge having increments of 0.10 psi or less.
  2. Tests requiring a pressure of greater than 10 psi but less than or equal to 100 psi shall use a testing gauge having increments of 1 psi or less.
  3. Tests requiring a pressure of greater than 100 psi shall use a testing gauge having increments of 2 psi or less.

- F. Pressure Tests: The test pressure in all lines shall be held for one hour during which time the leakage allowance shall not exceed that specified. In case repairs are required, the pressure test shall be repeated until the pipeline installation conforms to the specified requirements. Pumps, air compressors, instrumentation, and similar equipment shall not be subjected to the pressure tests. All piping conveying a combination of fluids shall be tested at the higher test pressure.

| Fluid<br>Abbreviation<br>or Name                       | Minimum Test<br>Pressure<br>in psi | Test<br>Medium | Leakage<br>Allowance<br>Designation |
|--------------------------------------------------------|------------------------------------|----------------|-------------------------------------|
| Chlorine Solution, Fluoride Solution,<br>Potable Water | 150                                | Water          | "A" <sup>(1)</sup>                  |

<sup>(1)</sup> Leakage allowance Designation "A" shall mean zero leakage.

- G. See Section 22 13 16—Sanitary Waste and Vent Piping for testing of building drainage systems.
- H. Prior to making final connection between new and existing piping, new piping shall be tested as specified above.

#### 3.04 DISINFECTION

- A. CONTRACTOR shall disinfect and flush the system before it is put on line.
- B. CONTRACTOR shall obtain water samples and arrange for analysis of water in potable systems for bacteria as part of the Lump Sum Bid. Copies of test results shall be submitted to OWNER and ENGINEER.

#### 3.05 CLEANING

- A. All equipment and materials shall be clean before installation.
- B. Broken concrete, rubble fill, and other excess material shall be removed from the site and wasted.
- C. All surplus material, tools, and equipment shall be removed, and the premises shall be left free of everything of the kind.

END OF SECTION

## SECTION 46 33 10

### FLUORIDATION EQUIPMENT

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation one complete fluoridation system. The equipment and appurtenances shall be furnished by the same supplier.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. NEMA–National Electrical Manufacturers Association Standard.

##### 1.03 WARRANTY

- A. Standard 1-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of 1 year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

#### PART 2–PRODUCTS

##### 2.01 MANUFACTURERS

- A. Feed pump shall be Stenner Pumps Model S3001AA101N, or equal.

##### 2.02 EQUIPMENT

- A. Peristaltic Fluoride Metering Pump:
  - 1. Provide one S Series, Model S3001AA101N, chemical feed pump manufactured by Stenner Pumps, or equal. Pump shall be capable of producing 0.002 gph to 0.21 gph at 100 psi.
  - 2. Pumps shall consist of an enclosed housing with bolted clear cover and roller compressor mechanism designed for operation with a hose. Hose shall be rigidly mounted to the pump body with NPT connections. Provide 20 feet of PE piping to connect to the two NPT connections before hard piping begins for easy removal of hose.
  - 3. Housing: Polycarbonate tube housing and tube housing cover. The tube housing cover shall have an integral, oil impregnated bronze bushing for shaft support. The tube housing cover shall be secured to the tube housing via polypropylene latches that do not require a tool to fasten or unfasten.
  - 4. Shafts: The main shaft shall be splined for ease of maintenance.
  - 5. Rollers: Three polyethylene rollers located 120 degrees apart for compression of the hose against the housing. One roller shall at all times be fully engaged with tubing



- providing complete compression to prevent backflow or siphoning. Roller bushings shall be oil impregnated bronze to aid in roller movement.
6. Cover: A single signal cover with eight screws, O-ring seal, and two liquid tight cord grips for signal cables. Pumps shall have clear cover on the control panel with tamper resistant screw.
  7. Connections: Pump tube connecting nuts shall be constructed in PVC or polypropylene.
  8. Motor: Motor shall be 44 rpm maximum, 100:1 turn down ratio, and 120V 50-60 Hz power provided with cord and plug.
  9. Drives and Controls:
    - a. Drive shall be rated for 24-hour operation. Drive enclosure shall be NEMA 4X.
    - b. Local controls on keypad shall include: Up arrow, Prime, On/Off, Back, Enter, and Down arrow.
    - c. Provide the following hardwired signal interfaces with the plant SCADA System:
      - (1) Dry-Contact Inputs: Start/Stop.
      - (2) Dry Contract Outputs:
        - (a) Running.
        - (b) Drive Fault.
        - (c) Tube Leak Detected.
      - (3) Analog Inputs (4-20mA): Pump Speed Command.
      - (4) Analog Output (4-20mA): Pump Speed Feedback.
  10. Provide a pressure relief valve with pump.
  11. Performance: Pumps shall be capable of self-priming when completely dry with a suction lift capability of 25 feet. Pump shall be capable of running dry without damaging effects to the pump or tube.
  12. Spare Parts: Provide replacement hose and two additional latches.
  13. Wall Stand: Provide one latching mounting bracket suitable for vertical or horizontal mounting.

## 2.03 ACCESSORIES

- A. Provide one 70-gallon straight-sided HDPE or XLPE plastic solution tank with plastic cover, floating intakes, and marked scale or float device to accurately measure dilution water and consumption of diluted acid. Tank and all wetted parts shall be chemically compatible with fluoride solution.
- B. Provide necessary tubing, hose pipe, couplings, fittings, and valves for complete installation.
- C. Provide with the fluoride system the following items: rubber gloves, dust mask, acid-resistant apron, and protective goggles.
- D. Supply leak-proof cover to eliminate etching of glass and vent pipe to carry fumes to outside of building. Installation should be essentially fume-tight.
- E. Include 3/4-inch corporation cock with NPT thread, ball valve, check valve, and solution tube for point of application.
- F. Provide latching mounting bracket suitable for vertical or horizontal mounting.
- G. Provide injection nozzle equal to LMI Model 49287. Include 3/4-inch NPT injection check valve with corporation stop and nozzle assembly.

- H. Provide one 2-inch PVC exhaust ventilation piping to provide negative pressure on chemical tank. Provide screened-end or shield on end of piping to meet code.
- I. Provide 2-inch fitting for drum to attach 2 feet of hard rubber vent tubing. Provide fittings, as necessary, to transition hose to 2-inch PVC vent piping.
- J. Provide one peristaltic pump spare parts kit.

#### 2.04 FINISHES

- A. Factory-fabricated items shall have a factory-applied finished paint system.
- B. Other items shall be painted per Division 09.
- C. Plastic solution tank shall not be painted.

### PART 3—EXECUTION

#### 3.01 INSTALLATION

- A. Provide all necessary tubing, hose, pipe, couplings, fittings, and valves for a complete installation. Point of application for fluoride shall be as shown on the Drawings.
- B. Fluoride feed pump shall be mounted on a plastic stand adjacent to solution tank.
- C. Install 2-inch-diameter PVC vent piping and install shield and screened-end on exterior of building.

#### 3.02 TESTING AND START-UP

- A. Provide manufacturer's services for start-up and field testing of all equipment.

END OF SECTION

## SECTION 46 33 20

### LIQUID CHLORINATION EQUIPMENT

#### PART 1–GENERAL

##### 1.01 SUMMARY

- A. Work Included: This section includes furnishing, installing, and placing into successful operation one chlorination system. The equipment and appurtenances shall be furnished by the same supplier.
- B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

##### 1.02 REFERENCES

- A. NEMA–National Electrical Manufacturers Association Standard.

##### 1.03 SUBMITTALS

- A. Shop drawings showing system installation shall be submitted.
- B. Schematic diagram for installation must be reviewed by ENGINEER before approval of equipment will be made.

##### 1.04 WARRANTY

- A. Standard 1-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of 1 year from the earlier of either the date established for partial utilization in accordance with GC15.03 and 15.04, as modified in the Supplementary Conditions, or Substantial Completion of the project.

#### PART 2–PRODUCTS

##### 2.01 MANUFACTURERS

- A. Feed pump shall be Stenner Pumps Model S3007AA101N, or equal.

##### 2.02 EQUIPMENT

- A. Peristaltic Chlorine Metering Pump:
  - 1. Provide one S Series, Model S3007AA101N, chemical feed pump manufactured by Stenner Pumps, or equal. Pump shall be capable of producing 0.017 gph to 1.67 gph at 100 psi.
  - 2. Pumps shall consist of an enclosed housing with bolted clear cover and roller compressor mechanism designed for operation with a hose. Hose shall be rigidly mounted to the pump body with NPT connections. Provide 20 feet of PE piping to connect to the two NPT connections before hard piping begins for easy removal of hose.

3. Housing: Polycarbonate tube housing and tube housing cover. The tube housing cover shall have an integral, oil impregnated bronze bushing for shaft support. The tube housing cover shall be secured to the tube housing via polypropylene latches that do not require a tool to fasten or unfasten.
4. Shafts: The main shaft shall be splined for ease of maintenance.
5. Rollers: Three polyethylene rollers located 120 degrees apart for compression of the hose against the housing. One roller shall at all times be fully engaged with tubing providing complete compression to prevent backflow or siphoning. Roller bushings shall be oil impregnated bronze to aid in roller movement.
6. Cover: A single signal cover with eight screws, O-ring seal, and two liquid tight cord grips for signal cables. Pumps shall have clear cover on the control panel with tamper resistant screw.
7. Connections: Pump tube connecting nuts shall be constructed in PVC or polypropylene.
8. Motor: Motor shall be 44 rpm maximum, 100:1 turn down ratio, and 120V 50-60 Hz power provided with cord and plug.
9. Drives and Controls:
  - a. Drive shall be rated for 24-hour operation. Drive enclosure shall be NEMA 4X.
  - b. Local controls on keypad shall include: Up arrow, Prime, On/Off, Back, Enter, and Down arrow.
  - c. Provide the following hardwired signal interfaces with the plant SCADA System:
    - (1) Dry-Contact Inputs: Start/Stop.
    - (2) Dry Contract Outputs:
      - (a) Running.
      - (b) Drive Fault.
      - (c) Tube Leak Detected.
    - (3) Analog Inputs (4-20mA): Pump Speed Command.
    - (4) Analog Output (4-20mA): Pump Speed Feedback.
10. Provide a pressure relief valve with pump.
11. Performance: Pumps shall be capable of self-priming when completely dry with a suction lift capability of 25 feet. Pump shall be capable of running dry without damaging effects to the pump or tube.
12. Spare Parts: Provide replacement hose and two additional latches.
13. Wall Stand: Provide one latching mounting bracket suitable for vertical or horizontal mounting.

## 2.03 ACCESSORIES

- A. Provide one 80-gallon polyethylene feed tank with graduations on the side. Tank material and all wetted parts shall be chemically compatible.
- B. Provide necessary tubing, hose pipe, couplings, fittings, and valves for complete installation.
- C. Include a 3/4-inch corporation cock with NPT threads, check valve, and solution tube for point of application.
- D. Provide injection nozzle equal to LMI Model 49287. Include 3/4-inch NPT injection check valve with corporation stop and nozzle assembly.
- E. Provide necessary fittings and adapters and 2-inch PVC exhaust ventilation piping from tank to building exterior. Provide screened-end to meet code.

## 2.04 FINISHES

- A. Provide factory-applied paint finish to all fabricated items; color to be selected by ENGINEER.
- B. Piping, insulation, valves, fittings, and other items which are not provided with a factory finish shall be coated per Division 09.

## PART 3—EXECUTION

### 3.01 INSTALLATION

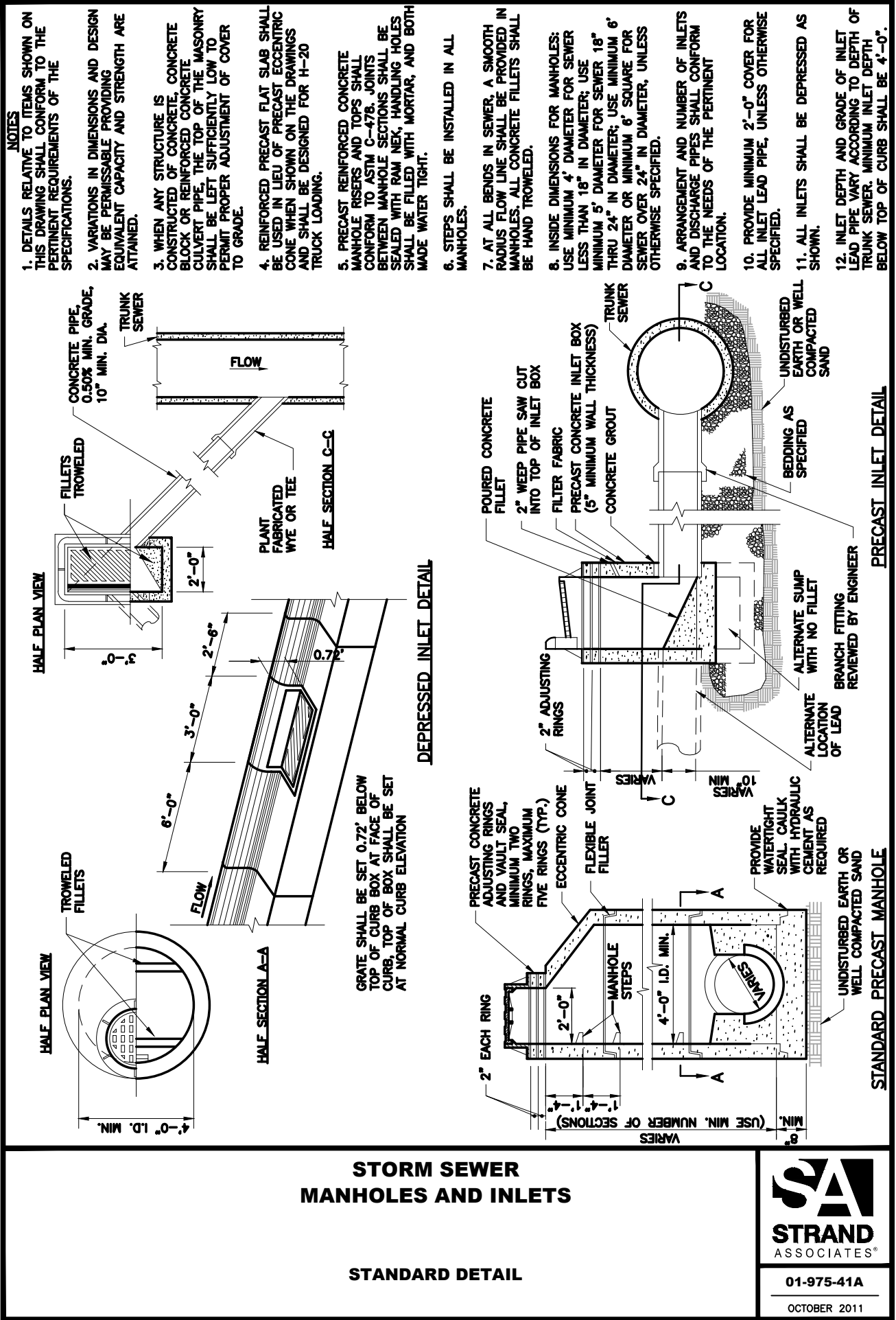
- A. Provide all necessary tubing, hose, couplings, fittings, and valves for a complete installation. Point of application for chemical shall be as shown on the Drawings.

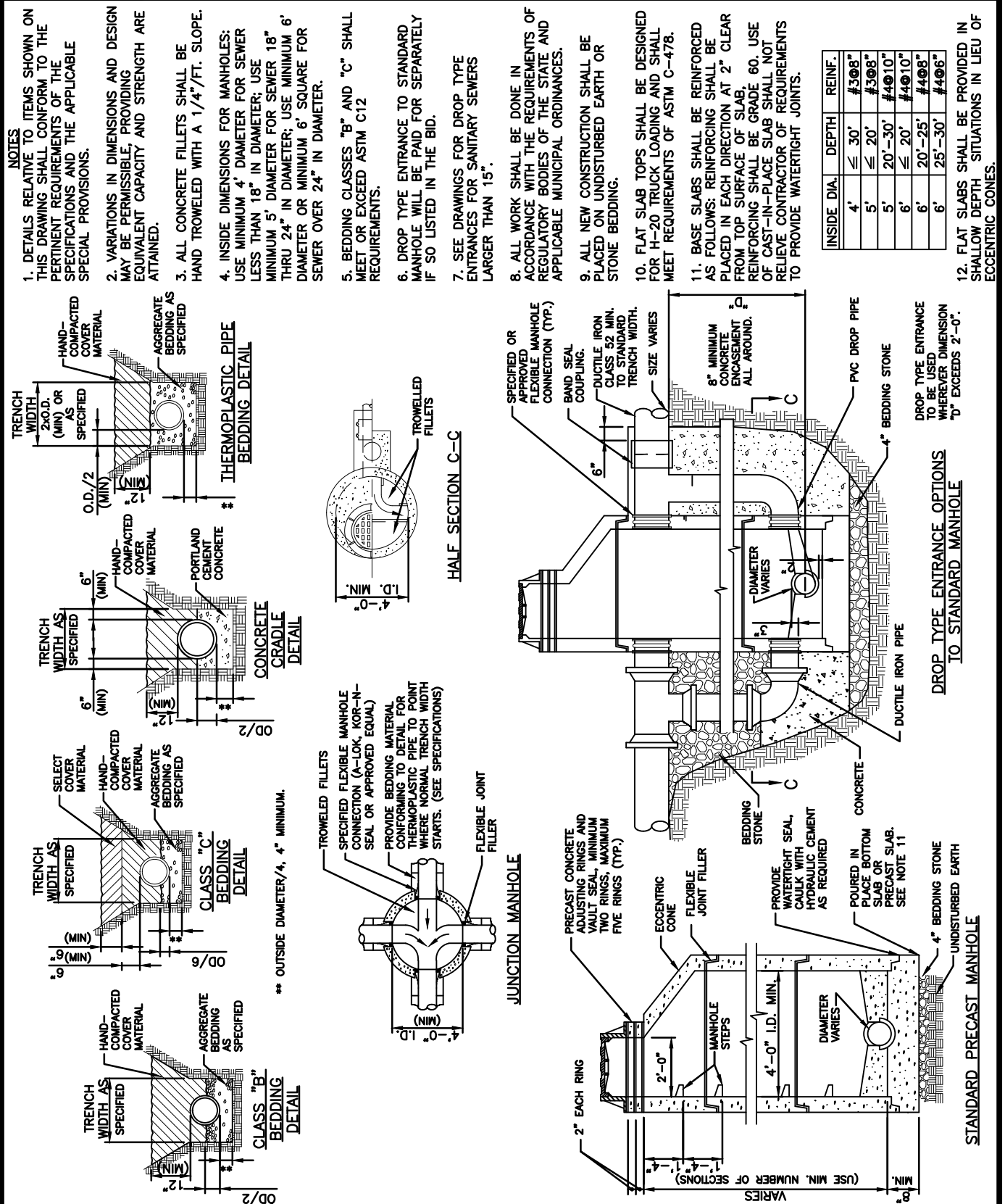
### 3.02 TESTING AND START-UP

- A. Provide manufacturer's services for the following:
  - 1. Start-up for each item of equipment.
  - 2. Field testing for each item of equipment.

END OF SECTION

## **DRAWINGS**





# **SANITARY SEWER APPURTENANCES**

**STANDARD DETAIL**

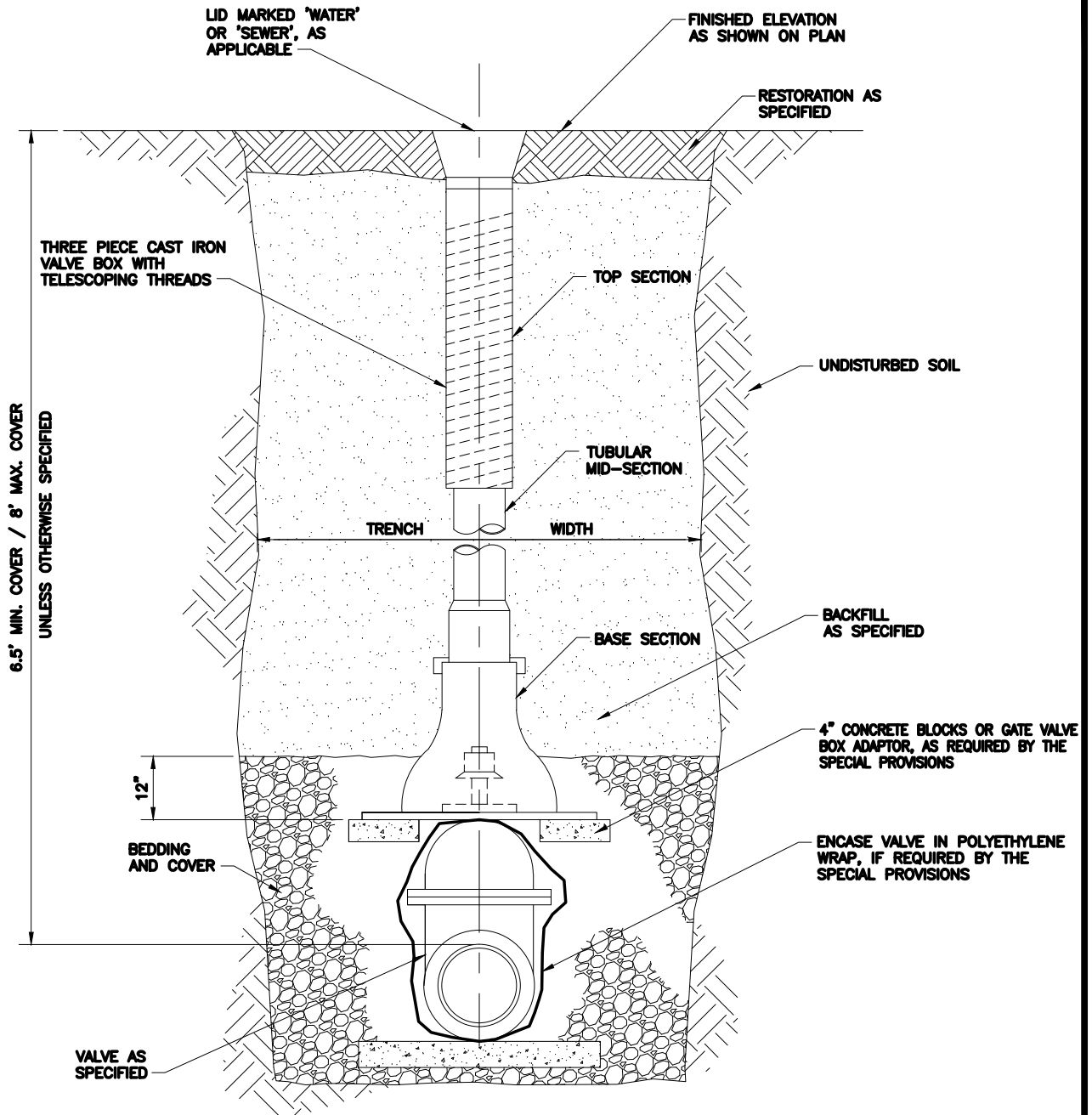


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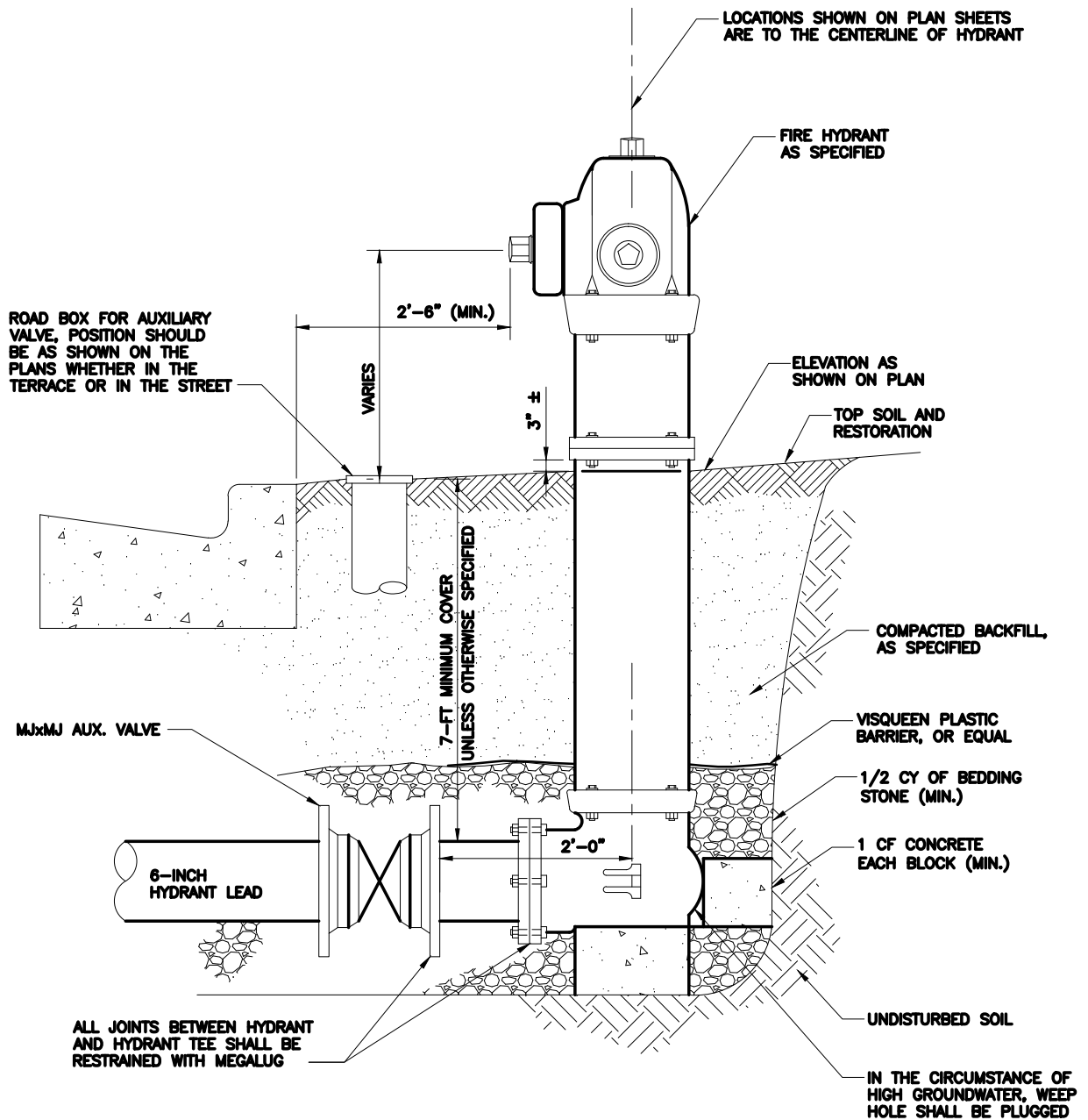
STANDARD DETAIL



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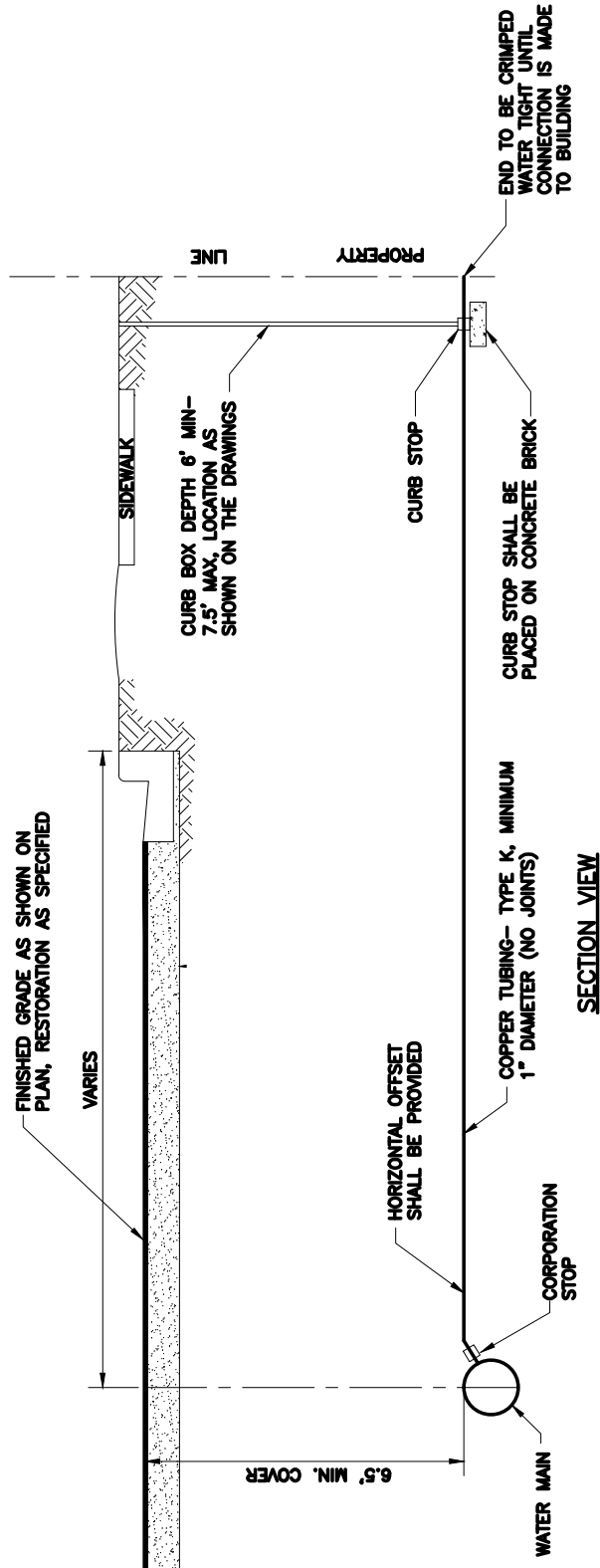
## HYDRANT INSTALLATION

### STANDARD DETAIL

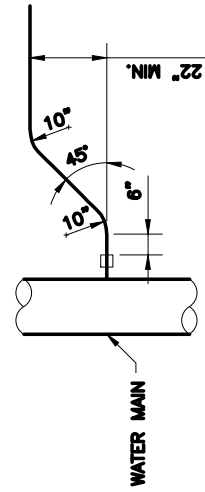


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**SECTION VIEW**



**HORIZONTAL OFFSET  
PLAN VIEW**

- NOTES**
1. ALL FITTINGS SHALL BE FLARED OR COMPRESSION JOINT TYPE, AND CONFORM TO AWWA REQUIREMENTS
  2. CORPORATION STOP TO BE TAPPED INTO DUCTILE IRON WATER MAIN, UNLESS OTHERWISE SPECIFIED, AND ATTACHED TO PVC WATER MAIN WITH A SADDLE
  3. ALL TAPS TO BE MADE UNDER PRESSURE WHEN APPLICABLE.
  4. NO TAPS TO BE CLOSER THAN 18" APART ALONG MAIN
  5. ALL COPPER TUBE BENDS TO BE SMOOTH RADIUS, 10" MIN
  6. WATER SERVICE LATERAL TO BE TESTED ALONG WITH WATER MAIN, UNLESS IT IS AN EXISTING SERVICE BEING RECONNECTED

## RESIDENTIAL WATER SERVICE LATERAL

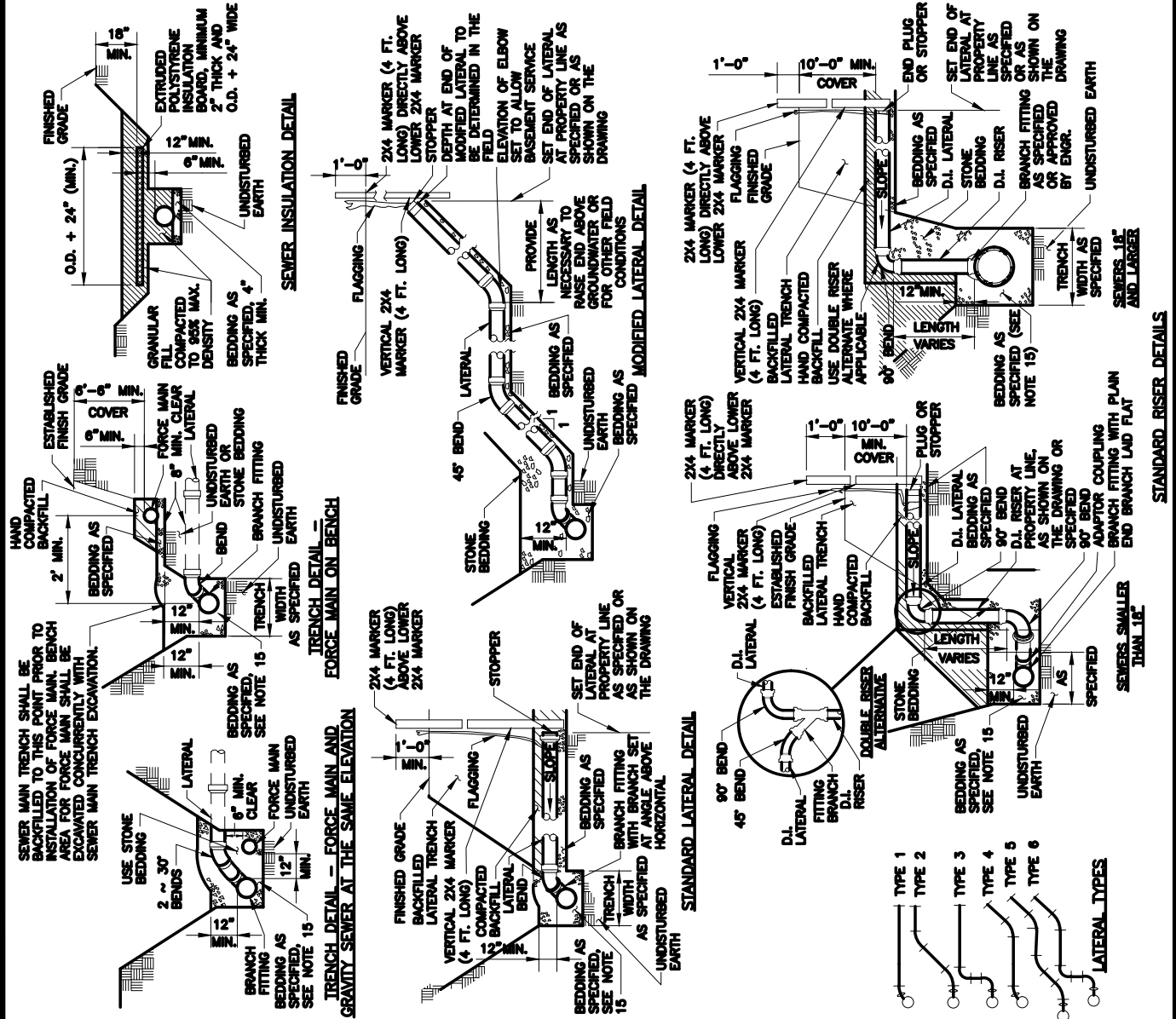
### STANDARD DETAIL



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OCTOBER 2011

1. ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE REQUIREMENTS OF REGULATORY BODIES OF THE STATE AND APPLICABLE MUNICIPAL ORDINANCES.
2. DETAILS RELATIVE TO ITEMS SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE SPECIFICATIONS AND THE APPLICABLE SPECIAL PROVISIONS.
3. VARIATIONS IN DIMENSIONS AND DESIGN MAY BE PERMISSIBLE, PROVIDING EQUIVALENT CAPACITY AND STRENGTH ARE ATTAINED.
4. ALL NEW CONSTRUCTION SHALL BE PLACED ON UNDISTURBED EARTH OR STONE BEDDING.
5. BEDDING CLASSES "B" AND "C" SHALL MEET OR EXCEED ASTM C12 REQUIREMENTS.
6. ALL LATERALS SHALL BE LAID AT A STANDARD SLOPE OF 1/4-INCH PER FOOT UNLESS OTHERWISE NOTED ON THE DRAWINGS, OR SPECIFIED. IN NO CASE SHALL LATERAL SLOPE BE LESS THAN 1/8-INCH PER FOOT. MAXIMUM LATERAL SLOPE SHALL BE 1 TO 1.
7. END PLUGS OR STOPPERS FOR THE ENDS OF LATERALS AND BRANCH FITTINGS SHALL BE PROVIDED.
8. 2x4'S SHALL BE PLACED AT ALL LATERALS ENDS SO THAT ONE PROTRUDES 12 INCHES ABOVE FINISHED GRADE AND ONE IS LOCATED IN THE GROUND AT THE END OF THE LATERAL. 2x4'S SHALL BE PAINTED FLOURESCENT ORANGE. 2x4'S SHALL EACH BE AT LEAST 4 FT. LONG.
9. BAR STEEL REINFORCEMENT SHALL BE IMBEDDED 1 1/2-INCH CLEAR MINIMUM.
10. THE TOP OF ANY MANHOLE STRUCTURE SHALL BE LEFT SUFFICIENTLY LOW TO PERMIT PROPER ADJUSTMENT OF COVER TO GRADE.
11. INSTALL DOUBLE RISERS WHERE SHOWN ON THE DRAWINGS OR SPECIFIED.
12. STANDARD LATERALS AND MODIFIED LATERALS SHALL BE CONSTRUCTED OF MATERIAL AS SPECIFIED.
13. RISERS AND LATERALS FROM RISERS SHALL BE CONSTRUCTED OF DUCTILE IRON. FITTINGS FOR RISERS AND LATERALS FROM RISERS SHALL BE GRAY IRON OR DUCTILE IRON.
14. FLAGGING SHALL BE 4-INCH WIDE STANDARD ORANGE VINYL TAPE. THE FLAGGING AROUND END OF ALL LATERALS AND EXTEND UNBROKEN TO FINISHED GRADE DIRECTLY ABOVE ENDS OF LATERALS.
15. STONE BEDDING SHALL BE USED AROUND AND TO ONE FT. ABOVE TOP OF ALL SEWER MAINS AT LATERAL CONNECTIONS. PROVIDE BEDDING AS SPECIFIED ELSEWHERE.



## SANITARY SEWER LATERALS

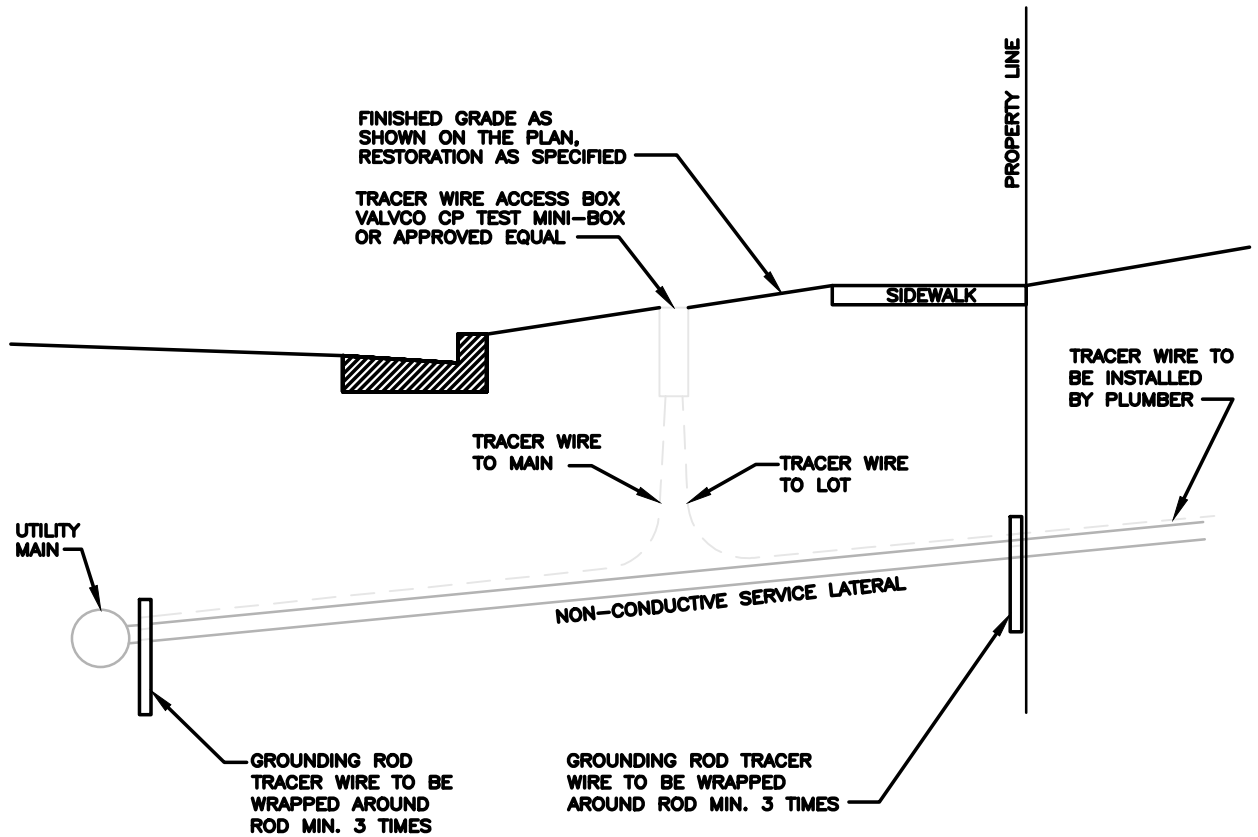
## STANDARD DETAIL



**01-975-75A**

OCTOBER 2011

File: T:\MAD\APPS\ACAD\ALL-STRAND\STD-DWG\Madison Files\Std-076A.dwg Time: Oct 18, 2011 - 10:30am



**NOTES:**

1. TRACER WIRE ACCESS BOX TO INSTALLED IN THE TERRACE.  
EXACT LOCTATION TO BE DETERMINED IN THE FIELD BY OWNER.
2. TRACER WIRE ACCESS BOX COVER TO BE PERMANENTLY  
ENGRAVED WITH "SEWER" BY THE MANUFACTURER.
3. MINIMUM 18-IN OF WIRE TO BE COILED WITHIN THE ACCESS  
BOX.
4. GROUNDING ROD TO BE A 2-FT LONG, 5/8-IN DIAMETER  
STEEL GROUNDING ROD.
5. TRACER WIRE TO BE 10 GAUGE SOLID WIRE

**TRACER WIRE INSTALLATION  
FOR NON-CONDUCTIVE SERVICE LATERALS**

**STANDARD DETAIL**



**01-975-76A**

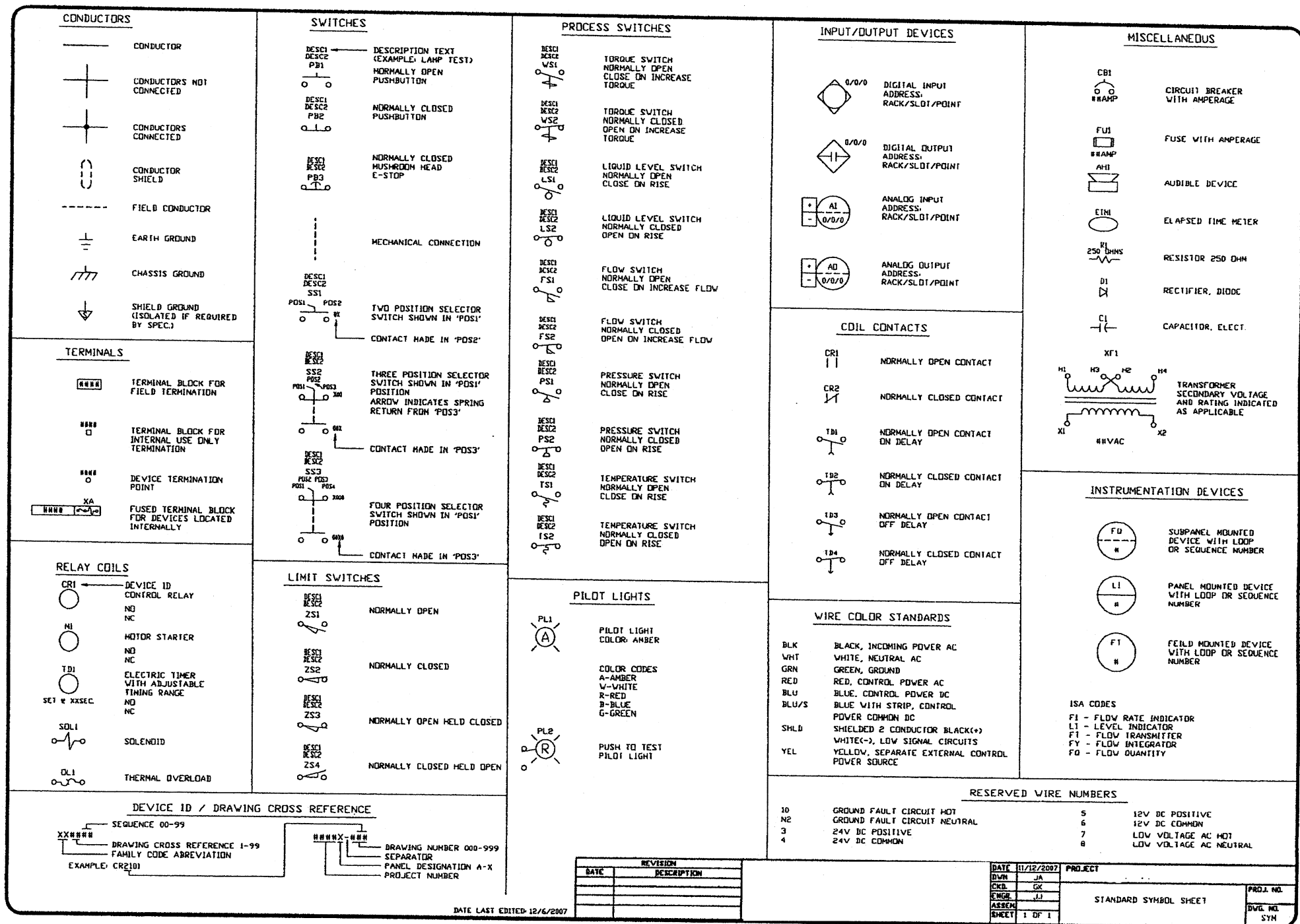
OCTOBER 2011

**9. ALTERNATES A AND B ARE EQUAL AND EITHER MAY BE USED.**



## OCTOBER 2011

## **SAMPLE DRAWINGS**



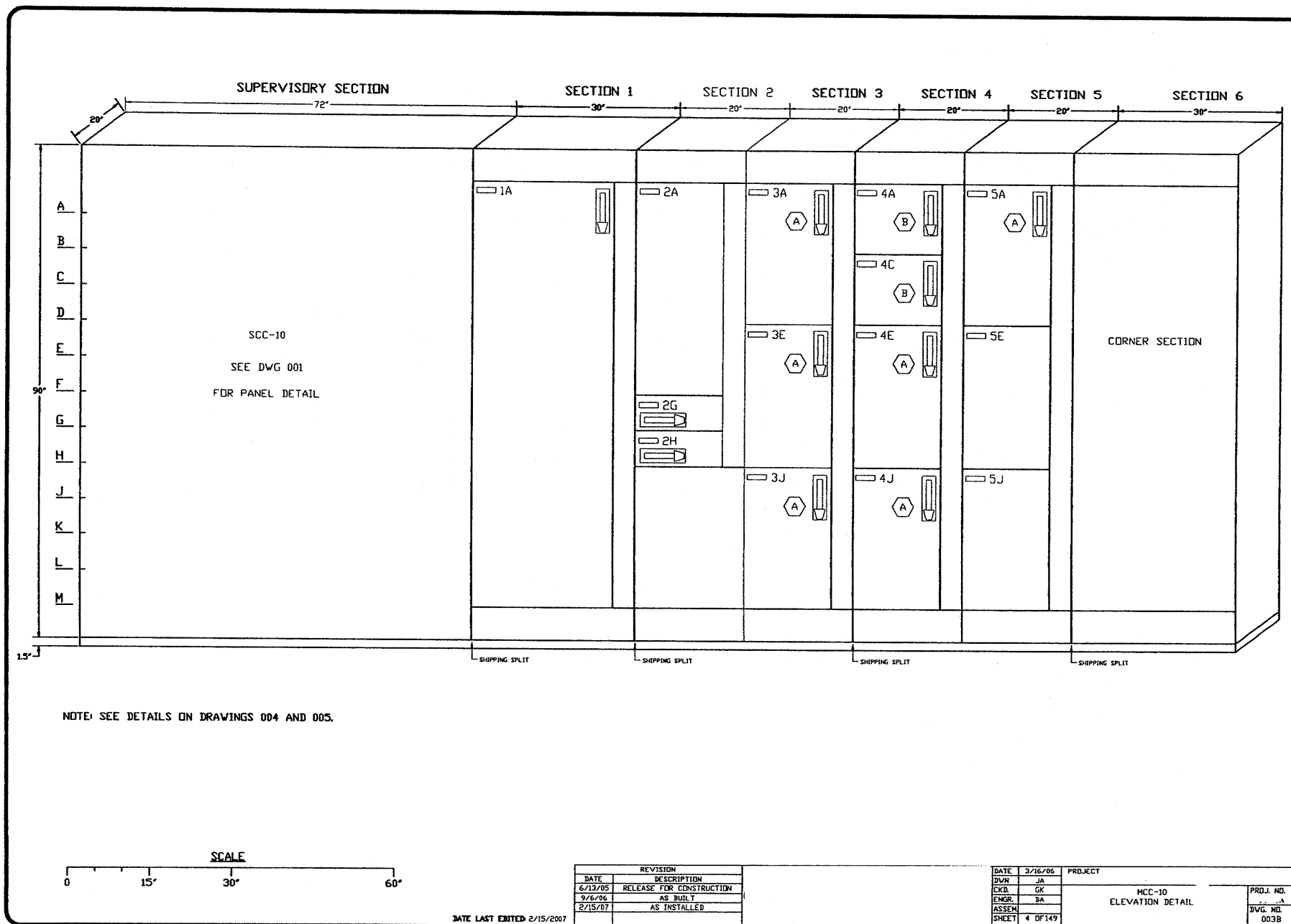
Sample Symbol sheet



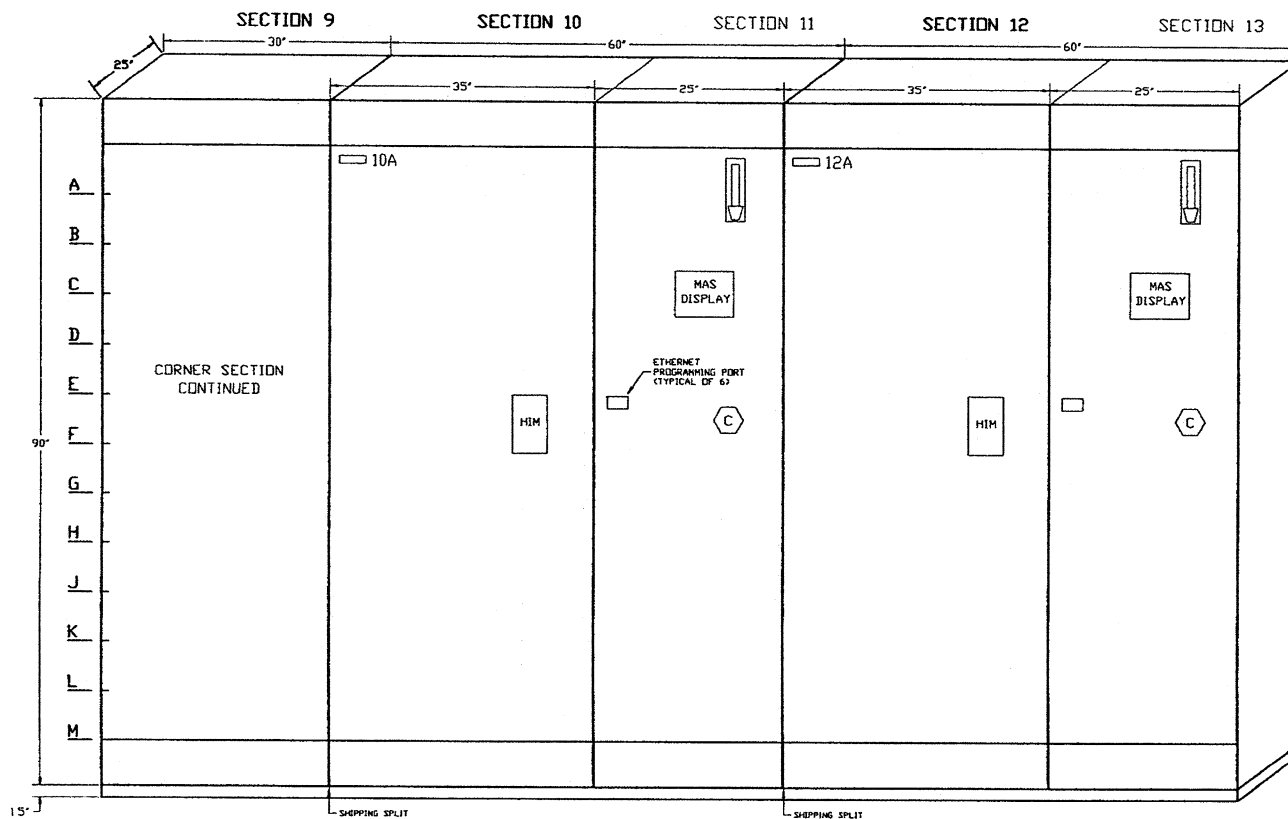
## Standard Abbreviations

| <u>Abbreviation</u> | <u>Description</u>          | <u>Abbreviation</u> | <u>Description</u>            |
|---------------------|-----------------------------|---------------------|-------------------------------|
| A                   | Air Compressed              | OV                  | Overvoltage                   |
| AC                  | Air Condition               | PB                  | Pushbutton                    |
| AD                  | Auto Dialer                 | PC                  | Pull Cord                     |
| AH                  | Alarm Horn                  | PC                  | Personal Computer             |
| AL                  | Alarm Light                 | PFC                 | Power Factor Capacitor        |
| AM                  | Amp Meter/Ammeter           | PL                  | Pilot Light                   |
| ANN                 | Annunciator                 | PLC                 | Programmable Logic Controller |
| AR                  | Alternating Relay           | PM                  | Power or Phase Monitor        |
| AWG                 | American Wire Gauge         | PN                  | Pneumatic                     |
| BA                  | Battery                     | PR                  | Pressure Regulator            |
| BLU                 | Blue                        | PS                  | Pressure Switch               |
| BRN                 | Brown                       | PS                  | Power Supply                  |
| CA                  | Cable                       | PSH                 | Pressure Switch High          |
| CB                  | Circuit Breaker             | PSL                 | Pressure Switch Low           |
| CR                  | Control Relay               | REC                 | Receptacle                    |
| CT                  | Current Transformer         | SP                  | Surge Protector               |
| DB                  | Distribution Block          | SS                  | Selector Switch               |
| DI                  | Diode                       | STP                 | Shielded Twisted Pair         |
| DS                  | Disconnect Switch           | SV                  | Solenoid Valve                |
| EC                  | Electronic Control Device   | TD                  | Time Delay Relay              |
| ETM                 | Elapsed Time Meter          | TG                  | Toggle Switch                 |
| EN                  | Enclosure                   | TS                  | Temperature Switch            |
| FO                  | Fiber Optic                 | TSP                 | Twisted Shielded Pair         |
| FS                  | Flow Switch                 | TT                  | Temperature Transmitter       |
| FU                  | Fuse                        | UPS                 | Uninterruptible Power Supply  |
| GFI                 | Ground Fault Interrupter    | UTP                 | Unshielded Twisted Pair       |
| GND                 | Ground                      | VA                  | Voltampere                    |
| GRN                 | Green                       | VFD                 | Variable                      |
| HTR                 | Heater                      | VM                  | Voltmeter                     |
| LA                  | Lightning Arrestor          | WHT                 | White                         |
| LP                  | Lighting Panel              | WS                  | Weight Switch                 |
| LR                  | Latching Relay              | WT                  | Weight Transmitter            |
| LS                  | Level Switch                | XFMR                | Transformer                   |
| MS                  | Motor Starter Contactor     | SI                  | Signal Isolator               |
| M                   | Motor                       | SS                  | Speed Switch                  |
| NP                  | Nameplate                   | ZS                  | Position Switch               |
| OIT                 | Operator Interface Terminal |                     |                               |
| OL or O/L           | Overload                    |                     |                               |
| ORG                 | Orange                      |                     |                               |

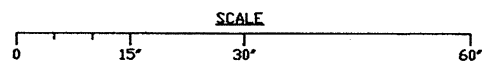
Sample List of  
Abbreviations



Sample Exterior  
Layout Drawing



NOTE: SEE DETAILS ON DRAWINGS 004 AND 005.  
SECTIONS 10 THROUGH 13 ARE MOUNTED BACK-TO-BACK  
WITH SECTIONS 14 THROUGH 17.



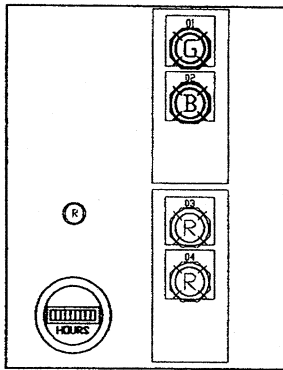
DATE LAST EDITED 2/15/2007

| REVISION |                          |
|----------|--------------------------|
| DATE     | DESCRIPTION              |
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| 9/6/06   | AS BUILT                 |
| 2/15/07  | AS INSTALLED             |

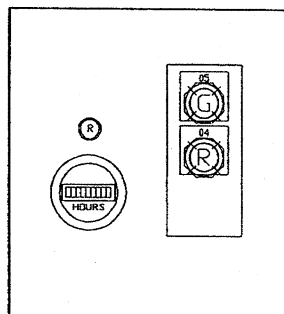
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|-------|----------|------------------|-----------|
| DATE  | 3/16/06  | PROJECT          |           |
| DWN   | JA       |                  |           |
| CKD   | GK       | MCC-10           | PROJ. NO. |
| ENGR  | BA       | ELEVATION DETAIL |           |
| ASSEN |          |                  | DWG. NO.  |
| SHEET | 6 OF 149 |                  | 003D      |

Sample Exterior  
Layout Drawing

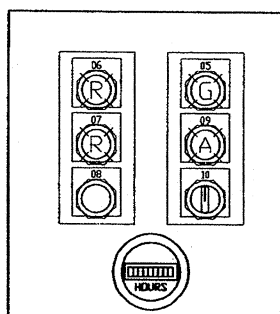
A DETAIL



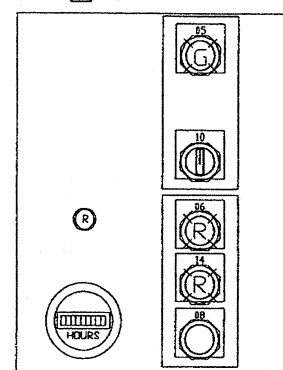
B DETAIL



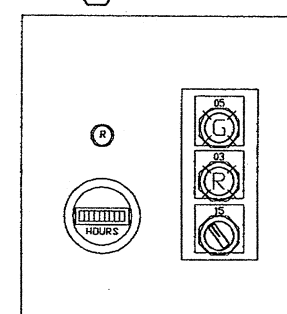
C DETAIL



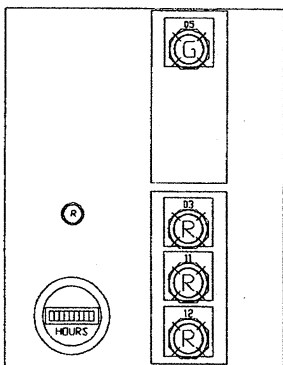
G DETAIL



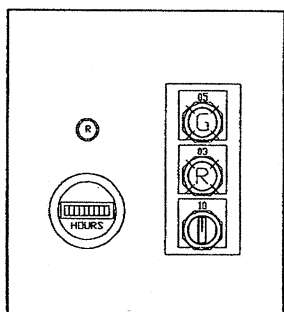
H DETAIL



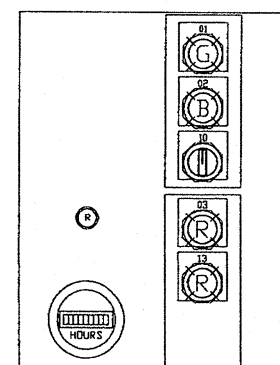
D DETAIL



E DETAIL

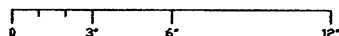


F DETAIL



| LEGEND PLATE SCHEDULE |               |           |       |             |         |
|-----------------------|---------------|-----------|-------|-------------|---------|
| TAG                   | DESC1         | DESC2     | DESC3 | SIZE        | REMARKS |
| 01                    | FORWARD       |           |       | 1-13/16" SQ |         |
| 02                    | REVERSE       |           |       | 1-13/16" SQ |         |
| 03                    | OVERLOAD      |           |       | 1-13/16" SQ |         |
| 04                    | OVERCURRENT   |           |       | 1-13/16" SQ |         |
| 05                    | RUN           |           |       | 1-13/16" SQ |         |
| 06                    | VFD FAULT     |           |       | 1-13/16" SQ |         |
| 07                    | MOTOR/BEARING | HIGH TEMP |       | 1-13/16" SQ |         |
| 08                    | RESET         |           |       | 1-13/16" SQ |         |
| 09                    | JIB/CR/MOTOR  | MOISTURE  |       | 1-13/16" SQ |         |
| 10                    | HAND          | AUTO      | OFF   | 1-13/16" SQ |         |
| 11                    | ZERO SPEED    | ALARM     |       | 1-13/16" SQ |         |
| 12                    | ESTOP         | ACTIVATED |       | 1-13/16" SQ |         |
| 13                    | INSPECTION    | DOOR OPEN |       | 1-13/16" SQ |         |
| 14                    | MOTOR         | DIVERTEMP |       | 1-13/16" SQ |         |
| 15                    | OFF           | ON        |       | 1-13/16" SQ |         |

SCALE



DATE LAST EDITED: 2/15/2007

| REVISION |                          |
|----------|--------------------------|
| DATE     | DESCRIPTION              |
| 6/13/05  | RELEASE FOR CONSTRUCTION |
| 9/6/06   | AS BUILT                 |
| 2/15/07  | AS INSTALLED             |

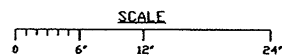
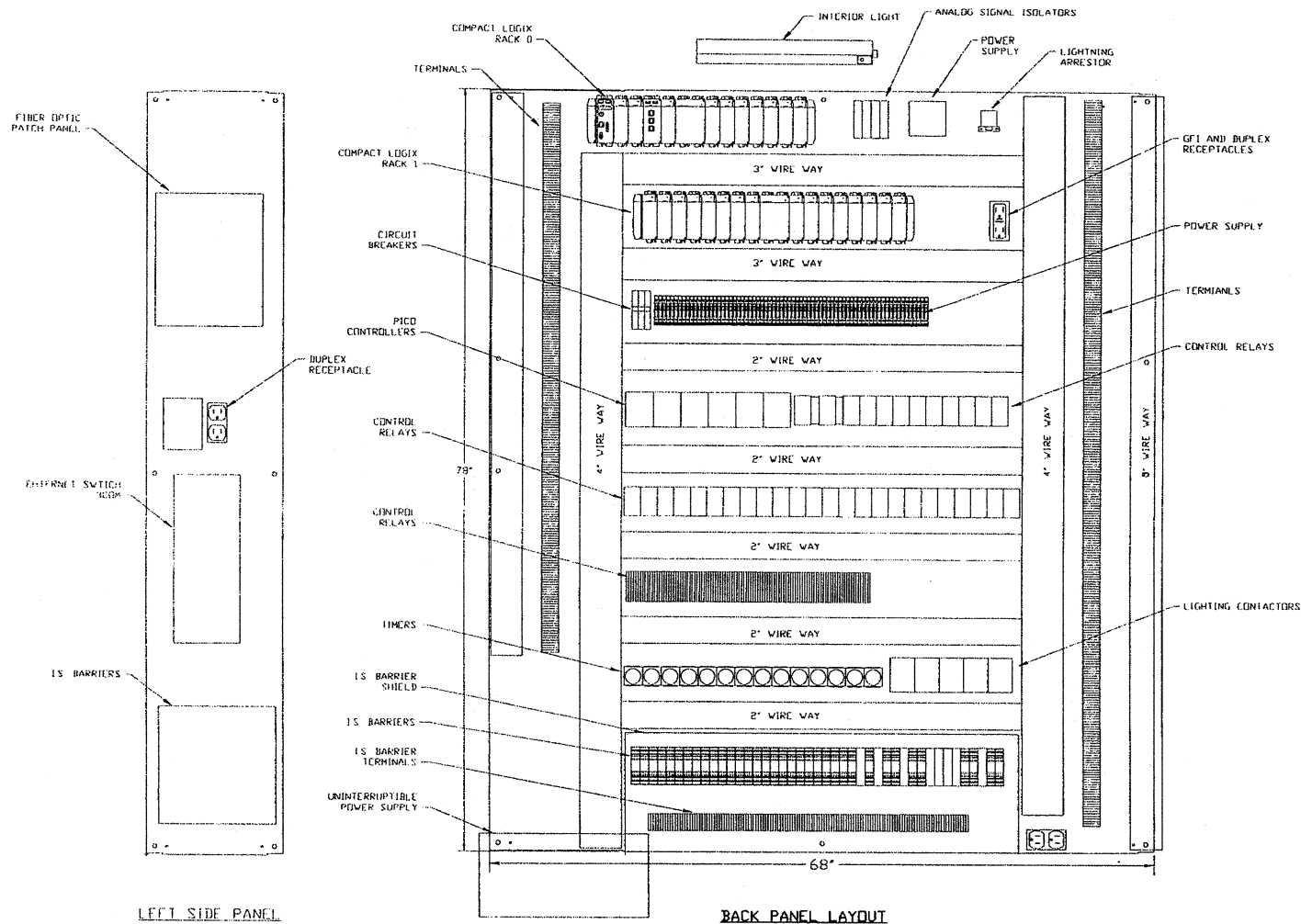
| DATE  | 3/16/06   | PROJECT |  |
|-------|-----------|---------|--|
| DWN   | JA        |         |  |
| CKD   | CK        |         |  |
| ENGR  | BA        |         |  |
| ASSEM |           |         |  |
| SHEET | 11 OF 149 |         |  |

MCC-10  
BUCKET DETAILS

PROJ. NO.  
DWG. NO.  
004

Sample Exterior  
Layout Drawing



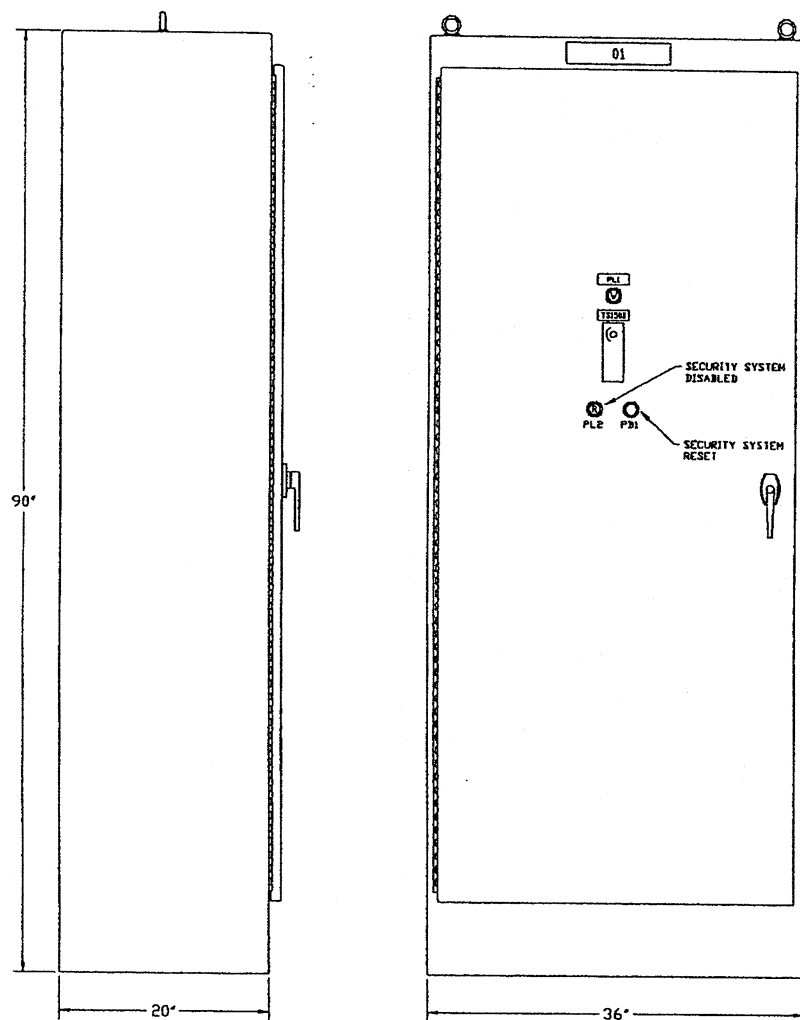


DATE LAST EDITED 2/15/2007

| REVISION |                          |
|----------|--------------------------|
| DATE     | DESCRIPTION              |
| 6/13/85  | RELEASE FOR CONSTRUCTION |
| 7/6/86   | AS BUILT                 |
| 2/15/87  | AS INSTALLED             |

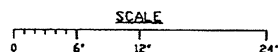
| DATE     | 3/16/86  | PROJECT                     |
|----------|----------|-----------------------------|
| DWN      | JA       | SCC-10<br>BACK PANEL LAYOUT |
| CKD      | GK       |                             |
| ENGR     | BA       |                             |
| ASSEM    |          |                             |
| SHEET    | 2 OF 149 |                             |
| PRJ. NO. |          |                             |
| DWG. NO. |          | 002                         |

Sample Interior Layout Drawing



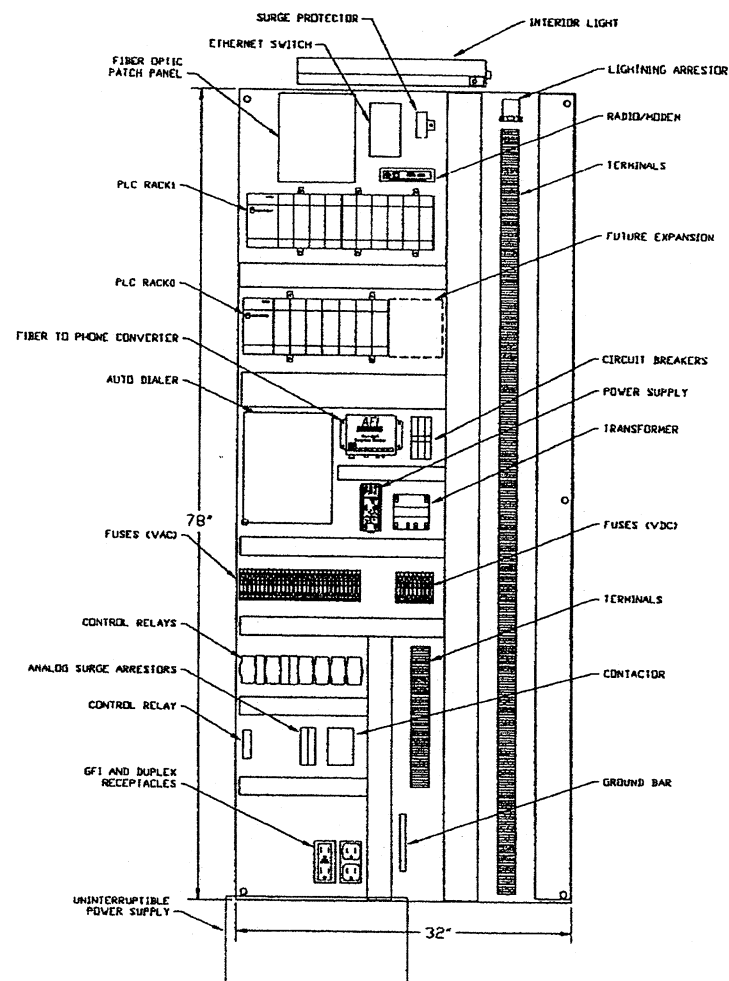
# NOTES:

- ENCLOSURE IS A NEMA TYPE 12 FREESTANDING HOFFMAN A903620FS, WITH INNER PANEL HOFFMAN A90P36FL.
- FINISH IS ANSI 61 GRAY.
- UL 508A



SUBMITTAL USE ONLY  
NOT FOR  
CONSTRUCTION  
DATE LAST EDITED: 12/6/2007

| REVISION |             |
|----------|-------------|
| DATE     | DESCRIPTION |
|          |             |
|          |             |
|          |             |



PANEL LAYOUT

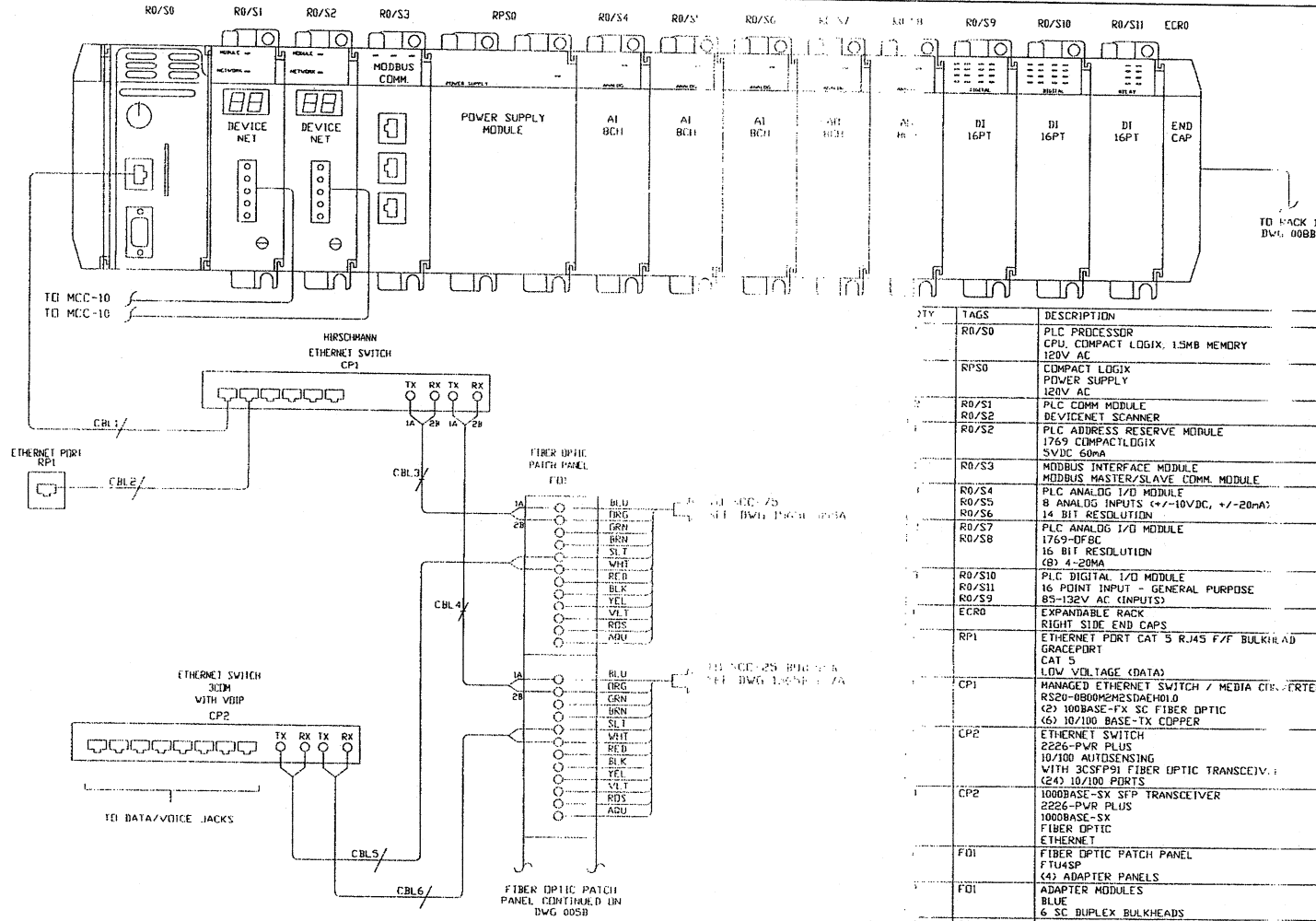
| NAMEPLATE SCHEDULE |                          |        |        |      |         |
|--------------------|--------------------------|--------|--------|------|---------|
| TAG                | LINE 1                   | LINE 2 | LINE 3 | SIZE | REMARKS |
| 01                 | SCC-MAIN                 |        |        | 2x10 |         |
| PL1                | POWER ON UPS             |        |        | 1x3  |         |
| TS1580             | LOW BUILDING TEMPERATURE |        |        | 1x3  |         |

NAMEPLATES ARE BLACK WITH WHITE LETTERS

| DATE       |         | PROJECT          |          |
|------------|---------|------------------|----------|
| 11/12/2007 | JA      | SCC-MAIN         | PRJ. NO. |
| DWN        | GK      | ENCLOSURE DETAIL | DWG. NO. |
| ENGR       | JJ      |                  | 001      |
| ASSEM      |         |                  |          |
| SHEET      | 1 OF 34 |                  |          |

Sample Exterior and Interior Layout  
Drawing

# COMPACT LOGIX I/O SCHEDULE



| QTY | TAGS   | DESCRIPTION                                                                                                                     | MFG                | CATALOG     |
|-----|--------|---------------------------------------------------------------------------------------------------------------------------------|--------------------|-------------|
| 1   | R0/S0  | PLC PROCESSOR<br>CPU, COMPACT LOGIX, 15MB MEMORY<br>120V AC                                                                     | ALLEN BRADLEY      | 1769-L3SE   |
| 1   | RPS0   | COMPACT LOGIX<br>POWER SUPPLY<br>120V AC                                                                                        | ALLEN BRADLEY      | 1769-PA4    |
| 1   | R0/S1  | PLC COMM MODULE<br>DEVICENET SCANNER                                                                                            | ALLEN BRADLEY      | 1769-SDN    |
| 1   | R0/S2  | PLC ADDRESS RESERVE MODULE<br>1769 COMPACTLOGIX<br>5VDC 60MA                                                                    | ALLEN BRADLEY      | 1769-ARM    |
| 1   | R0/S3  | MODBUS INTERFACE MODULE<br>MODBUS MASTER/SLAVE COMM. MODULE                                                                     | PROSOFT            | MV169-MCM   |
| 1   | R0/S4  | PLC ANALOG I/O MODULE<br>8 ANALOG INPUTS (+/-10VDC, +/-20mA)                                                                    | ALLEN BRADLEY      | 1769-IFB    |
| 1   | R0/S5  | PLC ANALOG I/O MODULE<br>1769-OFBC<br>16 BIT RESOLUTION<br>0.4-20MA                                                             | ALLEN BRADLEY      | 1769-OFBC   |
| 1   | R0/S6  | PLC ANALOG I/O MODULE<br>16 POINT INPUT - GENERAL PURPOSE<br>0.5-120V AC (INPUTS)                                               | ALLEN BRADLEY      | 1769-IA16   |
| 1   | R0/S7  | EXPANDABLE RACK<br>RIGHT SIDE END CAPS                                                                                          | ALLEN BRADLEY      | 1769-CRRI   |
| 1   | R0/S8  | ETHERNET PORT CAT 5 RJ45 F/F BULKHEAD<br>GRACEPORT<br>CAT 5<br>120V VOLTAGE (DATA)                                              | GRACE ENG PRODUCTS | P-R2-B3     |
| 1   | R0/S9  | MANAGED ETHERNET SWITCH / MEDIA CONVERTER<br>RS20-0800M2MSDAEH010<br>(2) 100BASE-TX SC FIBER OPTIC<br>(6) 10/100 BASE-TX COPPER | HIRSCHMANN         | 943 434-003 |
| 1   | R0/S10 | ETHERNET SWITCH<br>2226-PWR PLUS<br>10/100 AUTOSENSING<br>WITH 3CSFP91 FIBER OPTIC TRANSCEIVER<br>(24) 10/100 PORTS             | 3COM               | 3C16490-US  |
| 1   | R0/S11 | 1000BASE-SX SFP TRANSCEIVER<br>2226-PWR PLUS<br>1000BASE-SX<br>FIBER OPTIC<br>ETHERNET                                          | 3COM               | 3CSFP91     |
| 1   | ECR0   | FIBER OPTIC PATCH PANEL<br>FTU4SP<br>(4) ADAPTER PANELS                                                                         | HUBBELL            | FTU4SP      |
| 1   | FO1    | ADAPTER MODULES<br>BLUE<br>6 SC DUPLEX BULKHEADS                                                                                | HUBBELL            | FSPSCN6     |
| 1   | CBL1   | UTP PATCH CABLE<br>PCXSEB03<br>CAT 5E<br>RJ45                                                                                   | HUBBELL            | PCXSEB03    |
| 1   | CBL2   | FIBER OPTIC PATCH CABLE<br>1 METER (1 PAIR) (2) FIBERS<br>SC MM 62.5                                                            | HUBBELL            | DFPCSCSC1MM |
| 1   | CBL3   | FIBER OPTIC PATCH CABLE<br>2 METER (1 PAIR) (2) FIBERS<br>SC-LC MM 62.5                                                         | HUBBELL            | DFPCLCSC2MM |

| DATE       | REVISION                 |
|------------|--------------------------|
| 11/16/2007 | RELEASE FOR DISTRIBUTION |
| 11/16/2007 | AS BUILT                 |
| 11/16/2007 | AS BUILT                 |

DATE LAST EDITED 11/16/2007

| DATE  | 3/7/2006  | PROJECT          |
|-------|-----------|------------------|
| DWN   | 3/7/2006  | SCC-10           |
| CKD   | 3/7/2006  | PLC I/O SCHEDULE |
| ENGR  | 3/7/2006  | PRJ NO.          |
| ASSEM | 3/7/2006  | DWG NO.          |
| SHEET | 17 OF 149 | 008A             |

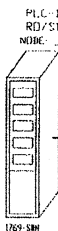
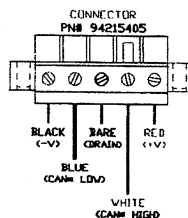
Sample Interconnection  
Diagram



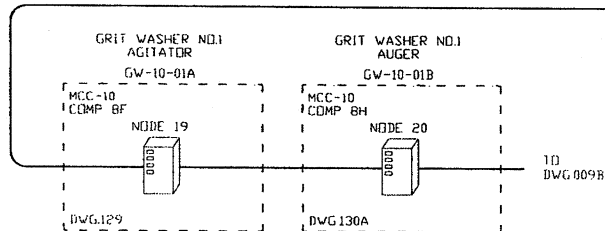
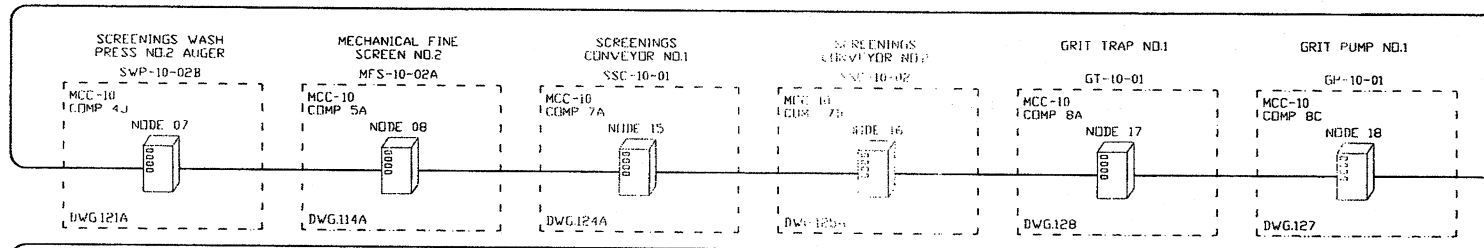
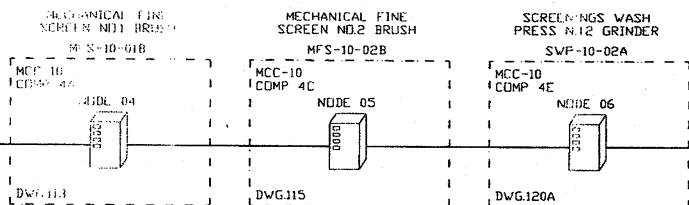
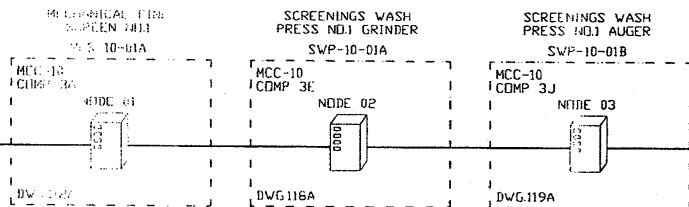
# DEVICENET CONNECTOR DETAIL

## NOTES:

1. CAN+ = CONTROLLER AREA NETWORK



SEE DEVICENET  
CONNECTION DETAIL



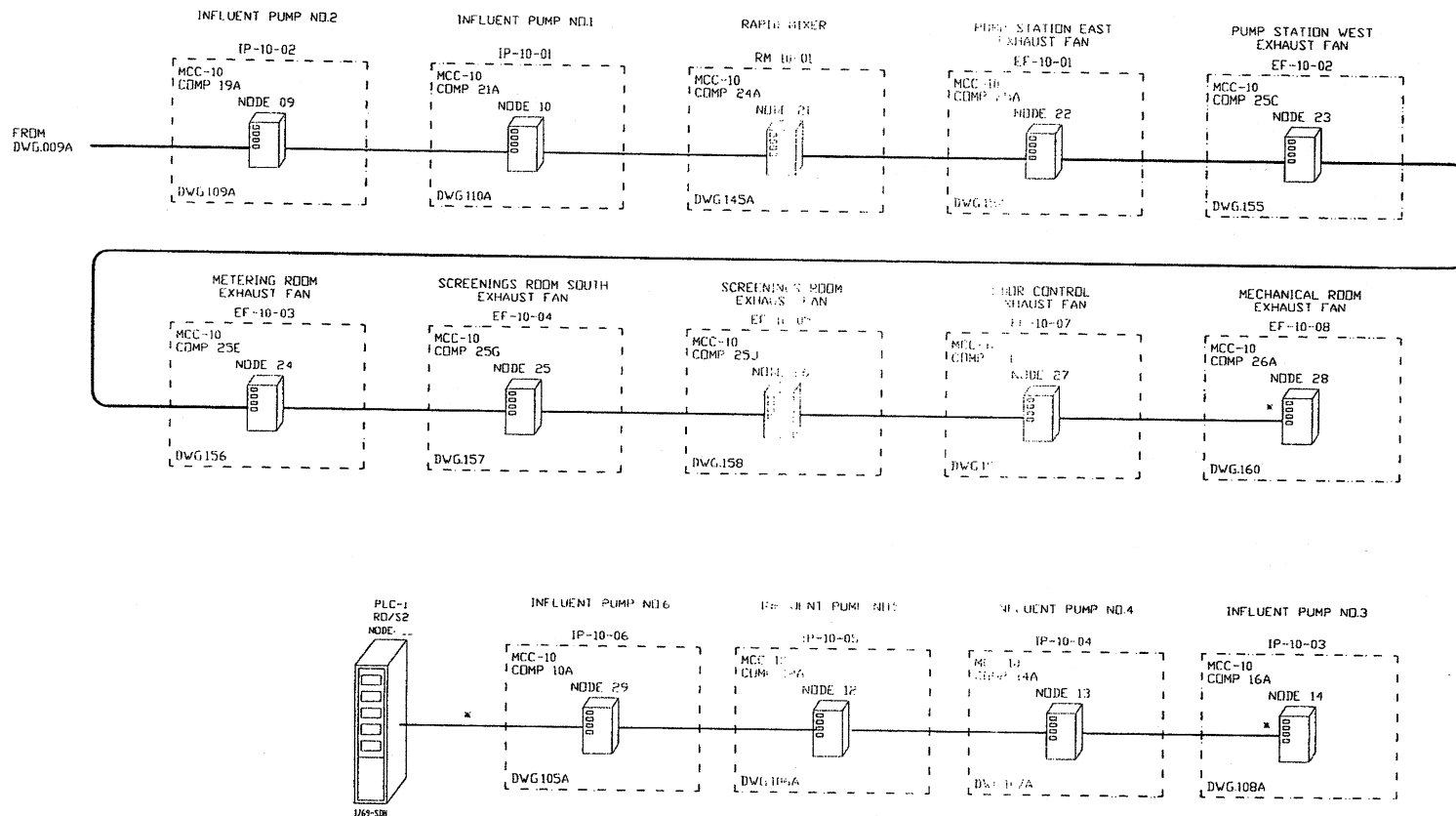
\* 120 OHM TERMINATING  
RESISTOR REQUIRED

DATE LAST EDITED 7/16/2008

| REVISION |                          |
|----------|--------------------------|
| DATE     | DESCRIPTION              |
| 7/17/08  | RELEASE FOR CONSTRUCTION |
| 7/22/08  | AS BUILT                 |
| 8/15/07  | AS INSTALLED             |

| DATE      | 3/16/06   | PROJECT                                |
|-----------|-----------|----------------------------------------|
| DWN       | JA        | MCC-10<br>DEVICENET<br>NODE ADDRESSING |
| CKD       | OK        |                                        |
| ENGR      | BA        |                                        |
| ASSEM     |           |                                        |
| SHEET     | 19 OF 149 |                                        |
| PRD.J NO. |           | DWG. NO.<br>009A                       |

Sample Network Diagram



■ 120 OHM TERMINATING RESISTOR REQUIRED

DATE LAST EDITED 7/16/2008

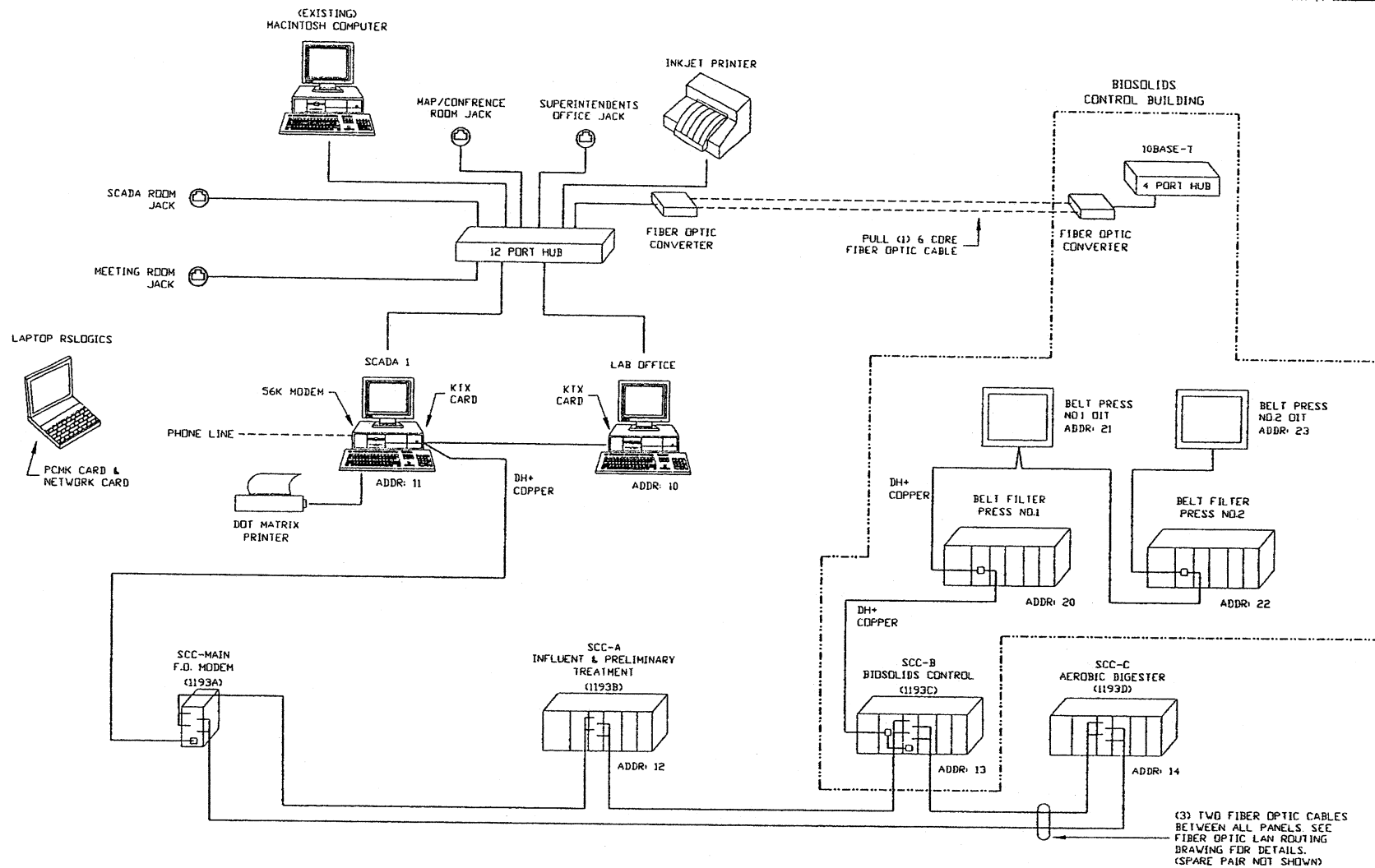
| REVISION |                          |
|----------|--------------------------|
| DATE     | DESCRIPTION              |
| 02/28/03 | RELEASE FOR CONSTRUCTION |
| 03/10/03 | AS NOTED                 |
| 07/17/07 | AS INSTALLED             |

| DATE  | 3/16/06   | PROJECT |
|-------|-----------|---------|
| DWN   | JA        |         |
| CKD   | JK        |         |
| ENGR  | JA        |         |
| ASSEN |           |         |
| SHEET | 20 OF 149 |         |

MCC-10  
DEVICENET  
NODE ADDRESSING

PROJ. NO.  
DWG. NO.  
009B

Sample Network Diagram



DATE LAST EDITED 02/09/01

| REVISION |             |
|----------|-------------|
| DATE     | DESCRIPTION |
|          |             |
|          |             |
|          |             |

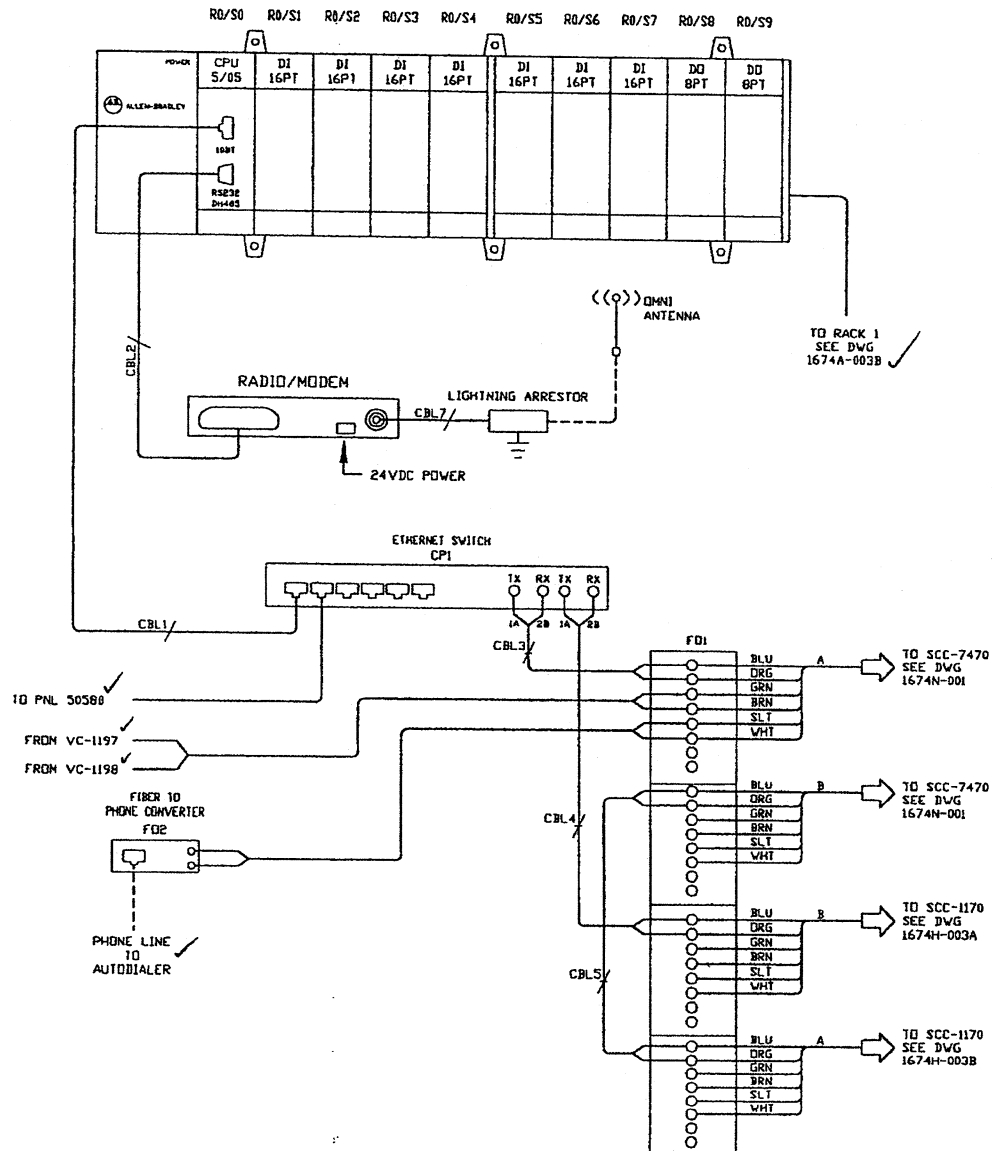
| DATE  | 3/12/01 | PROJECT |
|-------|---------|---------|
| BY    | JA      |         |
| CHKD  | GR      |         |
| ENGR  | PS      |         |
| ASSEM |         |         |
| SHEET | OF      |         |

SCADA SYSTEM LAYOUT

PROJ. NO.  
   
DWG. NO.  
001

Sample Network Diagram

# SLC500 I/O SCHEDULE



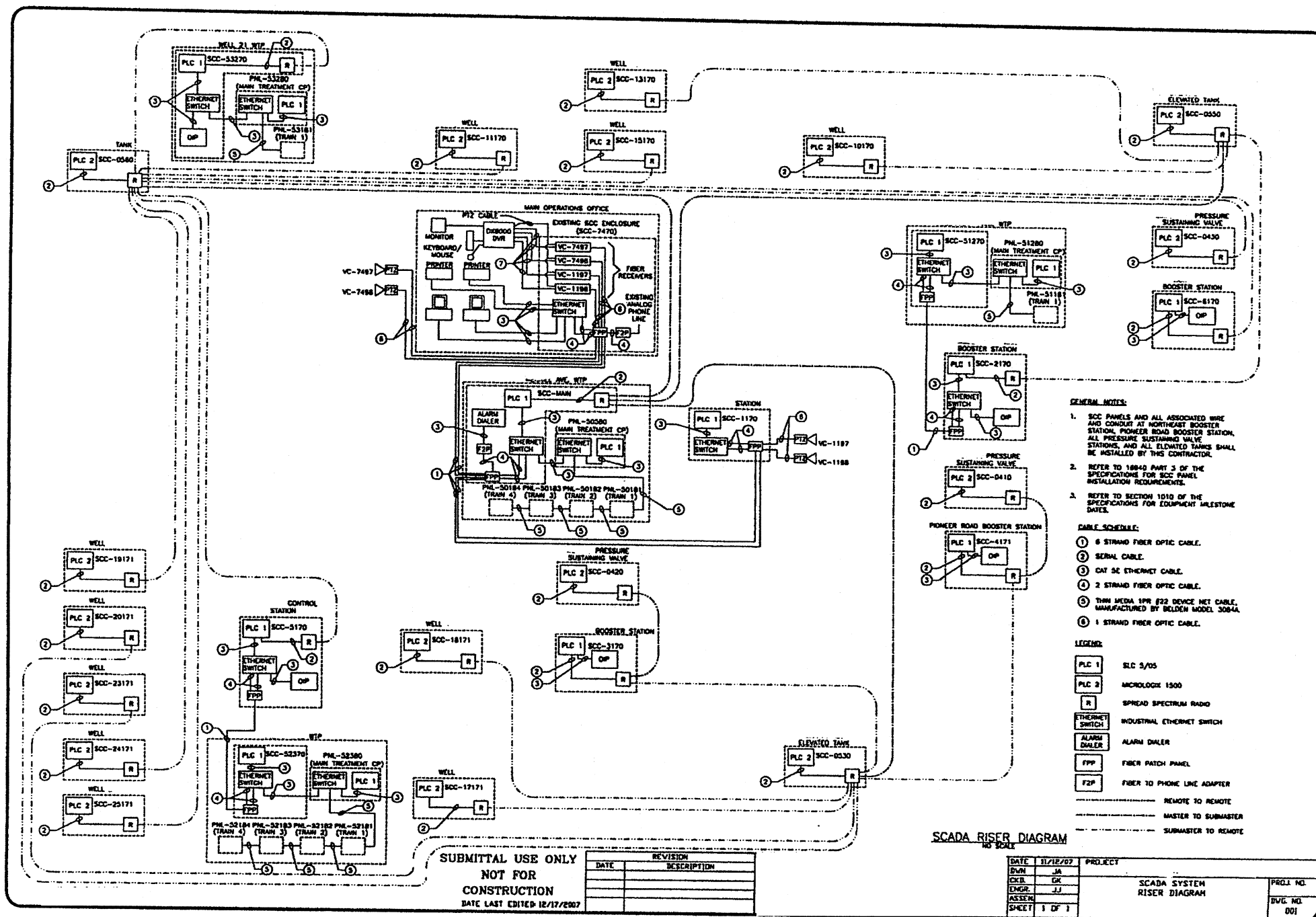
| QTY | TAGS                                                        | DESCRIPTION                                                                                                              | MFG               | CATALOG      |
|-----|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-------------------|--------------|
| 1   | R0                                                          | PLC RACK<br>10 SLOT BASE RACK                                                                                            | ALLEN BRADLEY     | 1746-A10     |
| 1   | RPS0                                                        | PLC POWER SUPPLY<br>RACK POWER SUPPLY (5A @ 5VDC)<br>120/240V AC                                                         | ALLEN BRADLEY     | 1746-P2      |
| 1   | R0/S0                                                       | PLC CPU WITH ETHERNET<br>CPU 5/05 WITH 32K MEMORY                                                                        | ALLEN BRADLEY     | 1747-L552    |
| 7   | R0/S1<br>R0/S2<br>R0/S3<br>R0/S4<br>R0/S5<br>R0/S6<br>R0/S7 | PLC DIGITAL I/O MODULE<br>16 POINT INPUT - GENERAL PURPOSE<br>85-132V AC                                                 | ALLEN BRADLEY     | 1746-IA16    |
| 2   | R0/S8<br>R0/S9                                              | PLC DIGITAL I/O MODULE<br>8 POINT RELAY CONTACT OUTPUT (ISOLATED)<br>3A @ 120V AC                                        | ALLEN BRADLEY     | 1746-DX8     |
| 1   | CP1                                                         | 8 PORT ETHERNET HUB<br>RS20-0800M2M2DAEH01.0<br>10/100 MBIT/S AUTOSENSING<br>(2) SC DUPLEX FIBER OPTIC<br>(6) RJ45 PORTS | HIRSCHMANN        | 943 434-021  |
| 1   | FD1                                                         | FIBER OPTIC PATCH PANEL, BLACK<br>SVIC3-M                                                                                | SIEMON COMPANY    | SVIC3-M-01   |
| 4   | FO1                                                         | ST BULKHEAD CONNECTOR MODULE<br>RIC-F-SCB-01                                                                             | SIEMON COMPANY    | RIC-F-SCB-01 |
| 1   | FD2                                                         | TELEPHONE LINE EXTENDER<br>B6 SERIES<br>12VAC 500mA<br>N/A                                                               | AMERICAN FIBERTEK | MT-86CC      |
| 1   | CBL1                                                        | UTP PATCH CABLE<br>PCXSE<br>CAT 5E<br>RJ45                                                                               | HUBBELL           | PCX5CB03     |
| 1   | CBL2                                                        | SERIAL COMMUNICATIONS CABLE<br>1001<br>3 FEET<br>DB9F/DB9M STRAIGHT THROUGH                                              | CABLE WHOLESALE   | 1001-03200   |
| 3   | CBL3<br>CBL4<br>CBL5                                        | FIBER OPTIC PATCH CABLE<br>1 METER (1 PAIR) (2) FIBERS<br>SC MH 62.5<br>SC MH 62.5                                       | HUBBELL           | DFPCSCSCC1MM |
| 1   | CBL7                                                        | ANTENNA CABLE RG142B/U<br>RG142 - 3FT LENGTH<br>NMALE - TNC                                                              | TESSCO            | 448350       |

SUBMITTAL USE ONLY  
NOT FOR  
CONSTRUCTION  
DATE LAST EDITED 12/6/2007

| DATE | REVISION    |
|------|-------------|
|      | DESCRIPTION |
|      |             |
|      |             |
|      |             |

| DATE  | 12/12/2007 | PROJECT | 1 |
|-------|------------|---------|---|
| DWN   | JA         |         |   |
| CHK   | JK         |         |   |
| ENGR  | JJ         |         |   |
| ASST  |            |         |   |
| SHEET | 3 OF 34    |         |   |

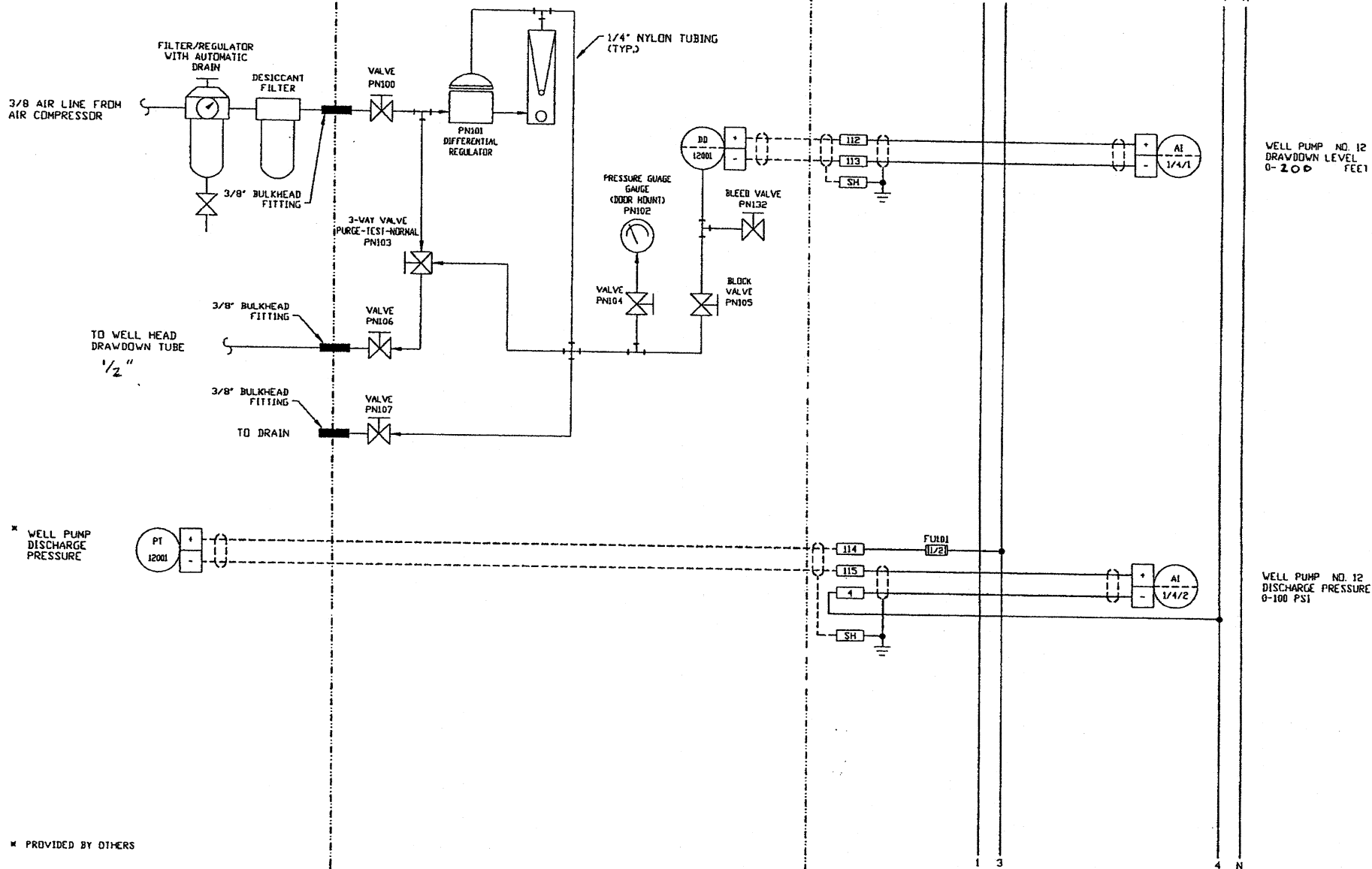
Sample Interconnection Diagram



FIELD OR AS NOTED

DRAWDOWN TRANSDUCER PANEL (1674A1-002)

SCC-MAIN



\* WELL PUMP DISCHARGE PRESSURE

\* PROVIDED BY OTHERS

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DATE LAST EDITED: 12/10/2007

| REVISION |             |
|----------|-------------|
| DATE     | DESCRIPTION |
|          |             |
|          |             |
|          |             |

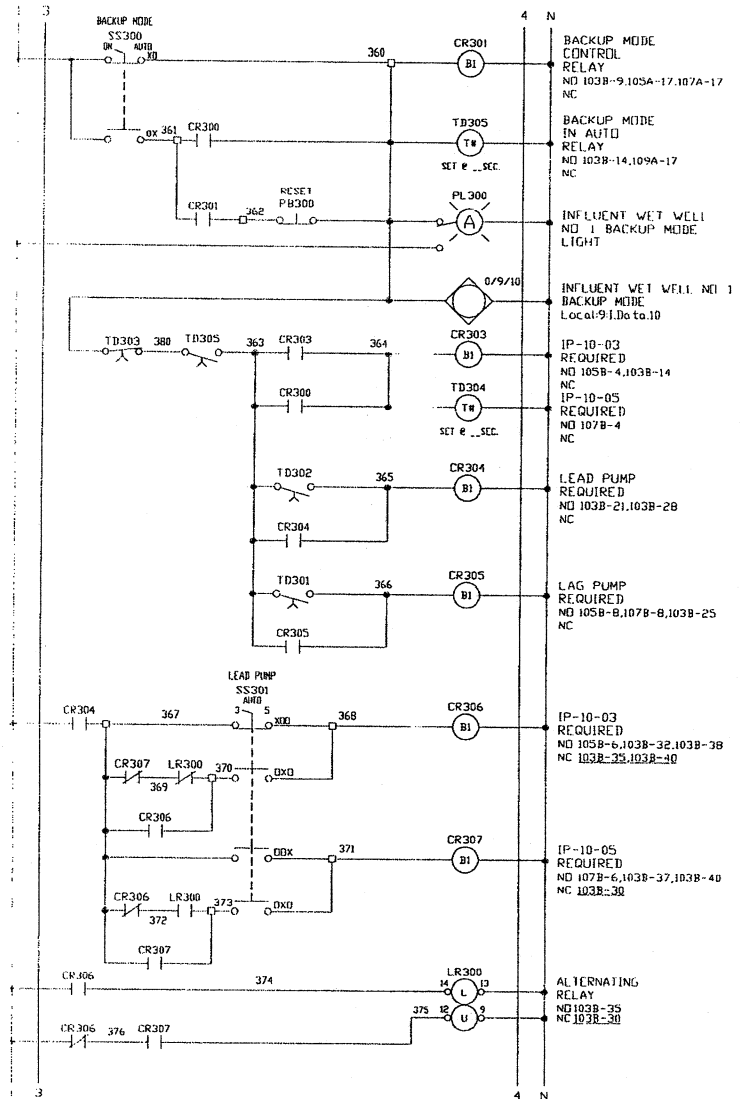
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|-------|------------|-------------------------------|
| DWN   | JA         | SCC-MAIN<br>WELL PUMP NO. 12  |
| CKR   | GR         |                               |
| ENGR  | JJ         |                               |
| ASST  |            |                               |
| SHEET | 9 OF 24    | PROJ. NO.<br>DWG. NO.<br>101B |

Sample Elementary schematic



FIELD OR AS NOTED

SCC-10



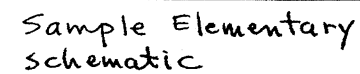
| REVISION |                          |
|----------|--------------------------|
| DATE     | DESCRIPTION              |
| 7/13/05  | RELEASE FOR CONSTRUCTION |
| 7/6/06   | AS BUILT                 |
| 7/1/07   | AS INSTALLED             |

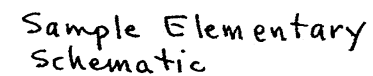
DATE LAST EDITED 2/15/2007

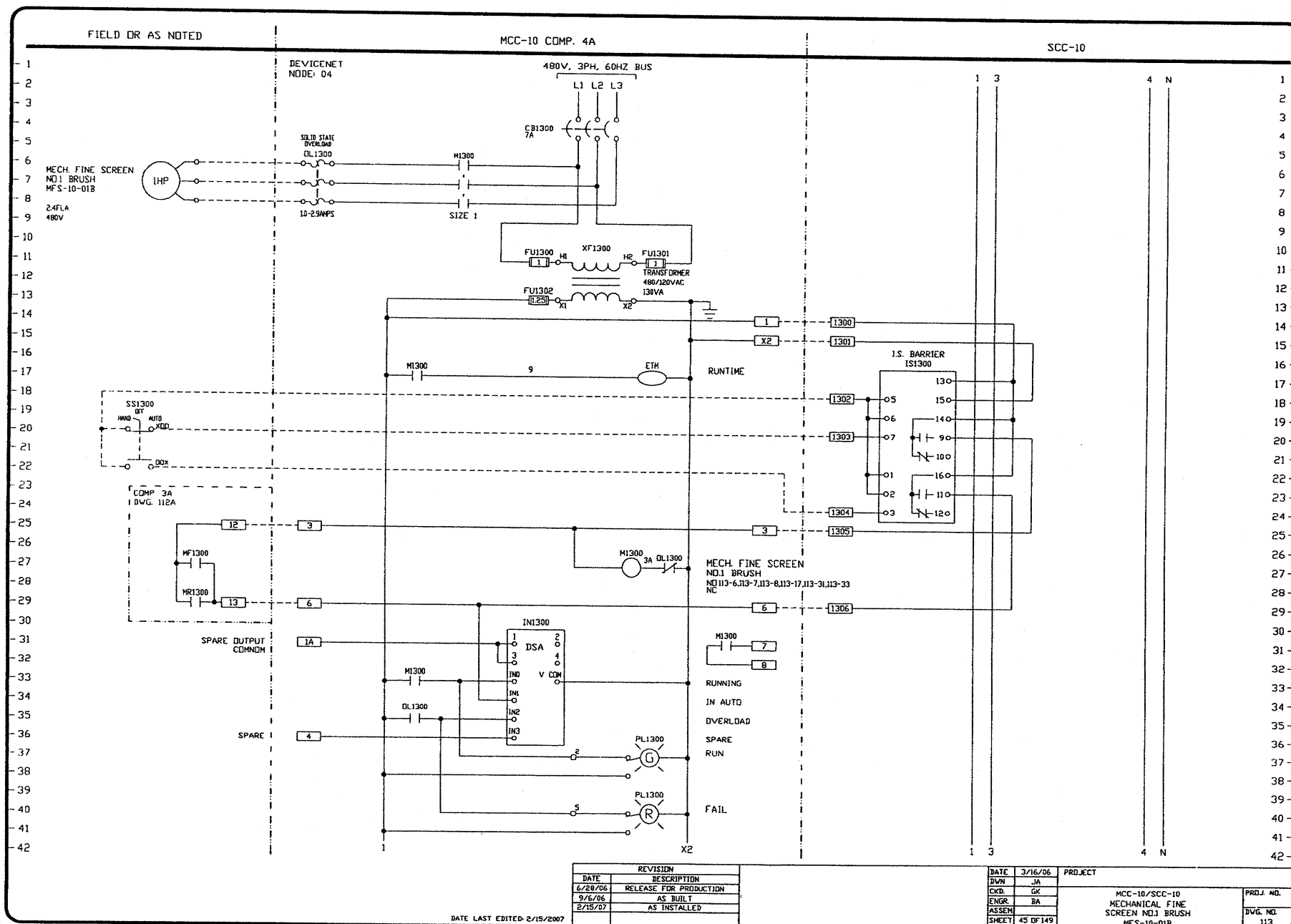
| DATE  | 3/16/06 | PROJECT                | PROJ. NO. |
|-------|---------|------------------------|-----------|
| DWN   | JA      | SCC-10                 |           |
| ENGR. | JK      | INFLUENT WET WELL NO 1 | DWG. NO.  |
| ASST. |         |                        | 103B      |
| SHEET | 7-9     |                        |           |

Sample Elementary  
Schematic









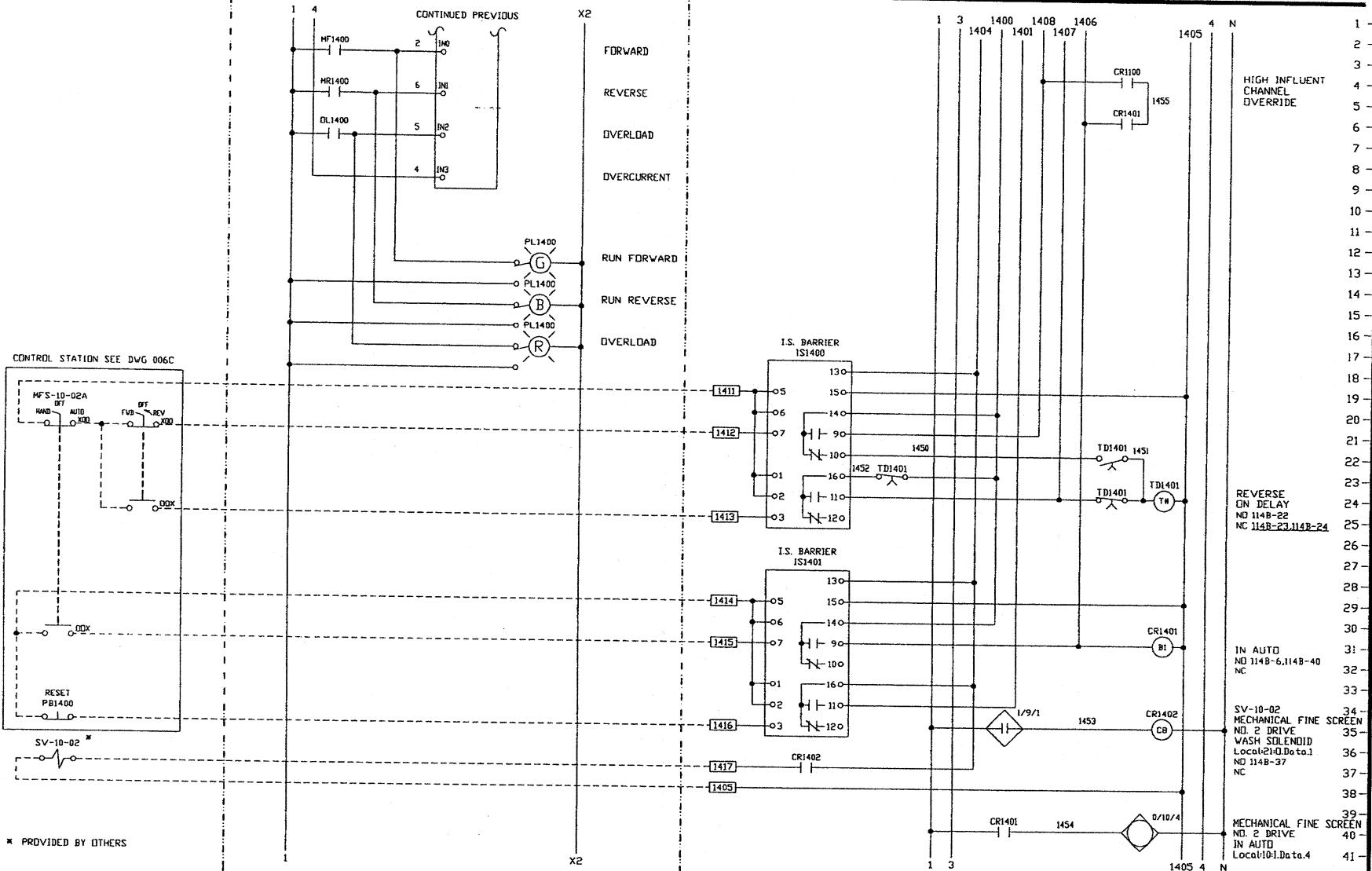
Sample Elementary  
Schematic



FIELD OR AS NOTED

MCC-10 COMP. 5A

SCC-10



| REVISION |                        |
|----------|------------------------|
| DATE     | DESCRIPTION            |
| 6/28/06  | RELEASE FOR PRODUCTION |
| 9/6/06   | AS BUILT               |
| 2/15/07  | AS INSTALLED           |

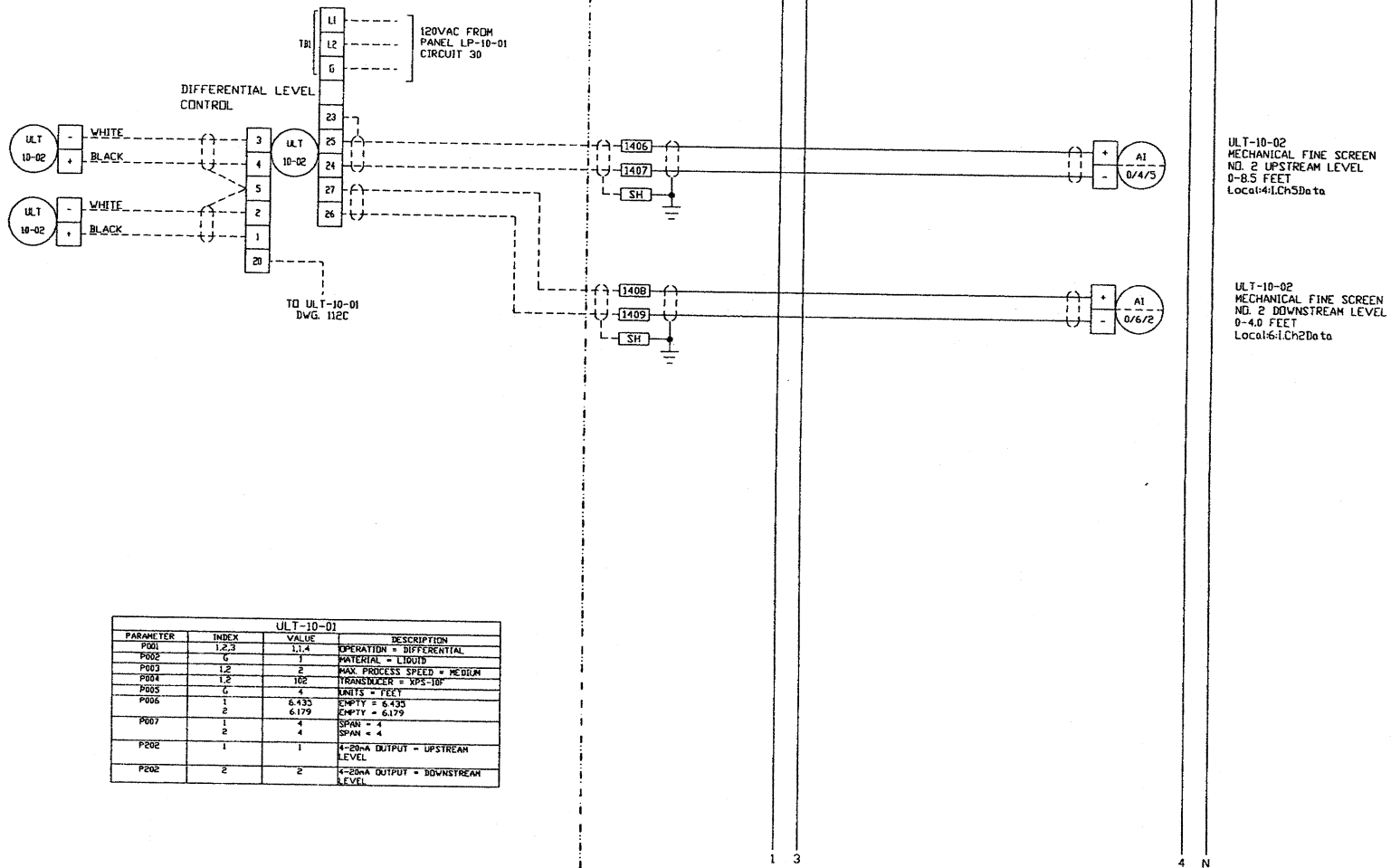
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| DATE  | 3/16/06   | PROJECT |
|-------|-----------|---------|
| DVN   | JA        |         |
| CHK   | GR        |         |
| ENGR  | BA        |         |
| ASSEM |           |         |
| SHEET | 47 OF 149 |         |

MCC-10/SCC-10  
MECHANICAL FINE SCREEN NO.2  
HFS-10-02APPOJ. NO.  
DVS. NO.  
114BSample Elementary  
Schematic

FIELD OR AS NOTED

SCC-10

UPSTREAM  
LEVEL TRANSDUCERDOWNSTREAM  
LEVEL TRANSDUCER

| ULT-10-01 |       |       |                                  |
|-----------|-------|-------|----------------------------------|
| PARAMETER | INDEX | VALUE | DESCRIPTION                      |
| P001      | 1,2,3 | 1,1,4 | OPERATION = DIFFERENTIAL         |
| P002      | 6     | 1     | MATERIAL = LIQUID                |
| P003      | 1,2   | 2     | MAX PROCESS SPEED = MEDIUM       |
| P004      | 1,2   | 102   | TRANSDUCER = XPS-10"             |
| P005      | 6     | 4     | UNITS = FEET                     |
| P006      | 1     | 6.435 | EMPTY = 6.435                    |
|           | 2     | 6.179 | EMPTY = 6.179                    |
| P007      | 1     | 4     | SPAN = 4                         |
|           | 2     | 4     | SPAN = 4                         |
| P202      | 1     | 1     | 4-20mA OUTPUT = UPSTREAM LEVEL   |
| P202      | 2     | 2     | 4-20mA OUTPUT = DOWNSTREAM LEVEL |

DATE LAST EDITED: 7/16/2008

| REVISION |                        |
|----------|------------------------|
| DATE     | DESCRIPTION            |
| 6/28/06  | RELEASE FOR PRODUCTION |
| 9/6/06   | AS BUILT               |
| 2/15/07  | AS INSTALLED           |

| DATE  | 3/16/06   | PROJECT |
|-------|-----------|---------|
| DWN   | JA        |         |
| ENGR  | BA        |         |
| ASSEM |           |         |
| SHEET | 48 OF 149 |         |

SCC-10  
MECHANICAL FINE SCREEN NO.2  
MFS-10-02A

PROJ NO.  
DVL NO.  
114C

Sample Elementary  
Schematic

## **GEOTECHNICAL EXPLORATION REPORT**



Construction • Geotechnical  
Consulting Engineering/Testing

November 8, 2024  
C24503

Tim Herlitzka  
Waunakee Utilities  
322 Moravian Valley Road  
Waunakee, WI 53597

Re: Geotechnical Exploration Report  
Proposed Well No. 6 and Elevated Tank  
Kilkenny Farms West Development  
Village of Waunakee, Wisconsin

Dear Mr. Herlitzka:

Construction • Geotechnical Consultants, Inc. (CGC) has completed the subsurface exploration program for the above-referenced project. The purpose of this program was to evaluate the subsurface conditions within the project area and to provide geotechnical recommendations regarding site preparation, foundation, utility and pavement design/construction. A determination of the site class for seismic design is also included. We are sending you an electronic copy of this report, and we can provide a paper copy upon request. Electronic copies are also being sent to the project team at Strand Associates.

### **PROJECT AND SITE DESCRIPTION**

We understand a new well facility and elevated water storage tank are planned within a new residential development located west of CTH Q and south of Woodland Drive in the Village of Waunakee, Wisconsin. More specifically, the structures are proposed within the northern approximately half of Outlot 15, which is bounded to the west by Rex's Way and south by Winn Drive, in the Kilkenny Farms West development. The well facility building, to be located in the southern part of the site, will consist of an approximately 42 ft by 36 ft, single-story, slab-on-grade masonry structure. The 500,000 gallon elevated storage tank will be located just north of the well facility. The spheroid, single pedestal-type tank will be approximately 120 ft tall. An asphalt paved driveway will be constructed to provide access to the well facility and elevated tank from Rex's Way, west of the site.

The development area was formerly a farm field with rolling topography, but mass earthwork operations were on-going at the time of this report to establish street and lot grades, as well as to facilitate underground utility installation that is part of the new residential development surrounding the outlot. More specifically, based on discussion with on-site Moll Construction personnel (the developer's earthwork contractor), site grades within Outlot 15 had been established to within about 0.5 ft below future finished grades (e.g., no topsoil spread). Therefore, based on proposed finished topographic contour lines shown on a site plan provided by Strand, current site grades slope down slightly from south to north and range between about EL 954 and 950 ft. Existing topographic contour





Geotechnical Exploration Report  
Proposed Kilkenny Farms Well and Water Storage  
CGC Project No. C24503  
November 8, 2024  
Page 2

lines on the same site plan indicate that former site grades in the vicinity of the well facility and elevated storage tank sloped down from southeast to northwest, between about 962 ft to 958 ft.

## **SUBSURFACE CONDITIONS**

Subsurface conditions for this study were explored by drilling seven (7) Standard Penetration Test (SPT) soil borings to depths of 10 to 70 ft below current site grades at general locations selected by Strand and field-staked by CCG based on plan-dimensions referenced to site boundaries provided by Strand. Borings 1 to 4 were planned to depths of 70 ft at the elevated tank foundation. However, following encountering very dense conditions at Boring 1 at the center of the foundation, Borings 2 through 4 were shortened to 35 ft. Borings 5 and 6 were completed to the planned depth of 25 ft at the well facility and Boring 7 to a depth of 10 ft within the planned drive area. Surface elevations at the boring locations were estimated by CGC based on contour lines included on the site grading plan and discussion with Moll Construction personnel. The borings were conducted by America's Drilling Company (ADC; under subcontract to CGC) between October 10 and 14, 2024 using a truck-mounted rotary drill rig equipped with hollow stem augers and an automatic SPT hammer. The specific procedures used for drilling and sampling are described in Appendix A.

The subsurface profiles at the boring locations were consistent and included predominantly dense to very dense (with isolated medium dense zones near the top) **sand** deposits, generally containing significant amounts of silt and gravel, as well as scattered cobbles/boulders, to the maximum depths explored. Layers/seams of sand with minor silt and gravel contents were also present in varying positions in the profile at each boring.

Groundwater was encountered at depths of 38.5 and 33.5 ft during drilling at Borings 1 and 3, respectively. At Boring 1, water levels were measured at 38.5 ft below grade about 24 hrs after completion of drilling. At Boring 3, the borehole was caved at a depth of 20 ft following removal of the augers, with no signs of groundwater above cave depths. Groundwater levels are expected to fluctuate with seasonal variations in precipitation, infiltration, evapotranspiration, the level in nearby waterbodies and other factors.

A more detailed description of the site's subsurface conditions is presented on the individual soil boring logs attached in Appendix B.

## **DISCUSSION AND RECOMMENDATIONS**

Subject to the limitations discussed below and based on the subsurface exploration, it is our opinion that the site is generally suitable for the proposed construction and that the planned well facility building and water tower can be supported on a conventional shallow foundation system bearing within the medium dense to very dense granular soils encountered on the site. Our geotechnical recommendations for site preparation, foundation, utility and pavement design/construction, along with our assessment of the site class for seismic design, are presented in the following subsections.

Additional information regarding the conclusions and recommendations presented in this report is discussed in Appendix C.

## 1. **Site Preparation**

As stated, we understand that the site had been rough graded to approximately 0.5 ft below proposed finished grades at the time of exploration. In areas remaining at-grade or requiring fill to establish site and structure grades, we recommend that the siltier granular soils be thoroughly recompacted with a vibratory smooth-drum roller and subsequently proof-rolled with a piece of heavy rubber-tire construction equipment, such as a loaded tri-axle dump truck, to check for soft/yielding areas. Where soft/yielding areas are observed, these soils should be undercut and replaced with granular backfill compacted to at least 95% compaction based on modified Proctor methods (ASTM D1557) in accordance with our Recommended Compacted Fill Specifications presented in Appendix D. Alternatively, 3-in. dense graded base (DGB) that is placed in loose 10-in. lifts and compacted until deflection ceases can also be used to restore grades in undercut areas. *Due to the presence of sands with significant fines-content across the surface of the site near finished site and building grades, which are considered moisture-sensitive and susceptible to disturbance from repetitive construction traffic when wet, we recommend that the project budget include a contingency for subgrade improvement in planned pavement and slab areas, and to create a stable base for the placement of structural fill, where necessary.*

Although minor additional filling is expected to be required, following the development of a firm and stable subgrade, fill placement to establish site and pavement grades can proceed, where required. To the extent possible, we recommend using granular soils (i.e., sands/gravels, including native granular soils if selectively excavated and stockpiled) as structural fill within the upper 2± ft in pavement areas because these soils are relatively easy to place and compact in most weather conditions compared to clay/silt soils. We recommend that structural fill be compacted to at least 95% compaction based on modified Proctor methods (ASTM D1557) following Appendix D guidelines. Periodic field density tests should be taken by CGC staff within the fill to document the adequacy of the compaction efforts.

## 2. **Foundation Design**

### ***A. Elevated Water Storage Tank***

Based on the proposed grading plan, it appears that finished site grades surrounding the water tower are expected to be established between about EL 951 and 952 ft, and *we recommend that the water tower foundation extend a minimum of 4 ft below finished site grades for frost protection.* It is our opinion that a circular/bell-shaped foundation bearing on native sands will be appropriate for the encountered soil condition. Assuming the minimum recommended embedment of 4 ft for frost protection, the sand soils at the foundation subgrade are generally expected to be dense to very dense. However, although not encountered in the borings, isolated loose zones may also be encountered, which should be undercut and re-placed in well-compacted lifts if they cannot be recompacted satisfactorily in-place. Foundations bearing entirely on native, undisturbed dense to very dense sands

(encountered immediately below the surface at Borings 1 through 4), or if loose or disturbed soils which cannot be adequately recompacted in-place are undercut below the tank foundation to expose the dense to very dense soils, followed by subgrade recompaction and restoring foundation subgrade with 3-in. DGB or “lean mix” concrete, an allowable bearing pressure of 8,000 psf and a subgrade modulus of 200 pci can be utilized for foundation design.

We recommend the following additional parameters be used for the design of the elevated water tank foundation:

- Nominal lateral earth pressure<sup>1</sup> coefficients and friction<sup>2</sup> factor:
  - Active earth pressure coefficient,  $K_a$ : 0.31
  - Passive earth pressure coefficient,  $K_p$ : 3.25
  - At-rest earth pressure coefficient,  $K_0$ : 0.47
  - Friction factor: 0.50

As subsurface conditions may vary across the footprint of the tank foundation, subgrades should be checked by a CGC field representative to document that the subgrade soils are suitable for footing support or otherwise advise on corrective measures, such as undercutting. This includes evaluation using dynamic cone penetrometer (DCP) testing to a depth of at least 2 ft below the planned foundation bottom. We recommend using a smooth-edged backhoe bucket for footing excavations. *If necessary, the base of undercut excavations should be widened beyond the footing edges at least 0.5 ft in each direction for each foot of undercut depth for stress distribution purposes.* Granular soils exposed at footing grade or at the bottom of undercut excavations should be thoroughly recompacted with a large vibratory plate compactor or an excavator-mounted hoe-pack prior to backfilling or formwork/concrete placement to densify soils loosened during the excavation process. OSHA slope guidelines should be followed if workers need to enter the excavations.

Although not observed within the pertinent borings, any clay, fill, disturbed, or loose to medium dense sand soils identified by DCP testing should be undercut and replaced below the tank foundation. Following removal of unsuitable soils, if any, the undercut base should be thoroughly recompacted, with foundation grade restored with 3-in. DGB that is placed in loose 10-in. lifts and compacted until deflection ceases. Alternatively, “lean mix” concrete may be used to restore foundation grades for an allowable bearing pressure of 8,000 psf. The lean mix concrete should be capable of developing a minimum 28-day design strength of 1,000 psi.

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<sup>1</sup> *Unfactored values – appropriate factors of safety need to be applied; assuming granular foundation backfill with less than 20% by weight passing the No. 200 U.S. standard sieve (including some of the native sands), compacted to a minimum 95% compaction based on modified Proctor methods (ASTM D1557). Unit weight of 120 pcf can be assumed for adequately compacted granular backfill.*

<sup>2</sup> *Unfactored values – appropriate factor of safety needs to be applied; for mass concrete on native sand soils or granular/DGB backfill.*

Provided the foundation design/construction recommendations discussed above are followed, we estimate that total and differential settlements should be on the order of 1.0 and 0.5 in., respectively.

### ***B. Well Facility Building***

Finished floor grade of the well house is expected to be near EL 953 ft, which is near proposed finished site grades surrounding the building. Conventional frost-depth perimeter footings are anticipated to extend on the order of 4 ft below this elevation (or exterior site grades, if lower) for frost protection, with interior footings potentially bearing slightly shallower. Accordingly, we expect footing subgrades to largely consist of dense to very dense granular soils as encountered in Borings 5 and 6. Isolated, shallow undercutting may potentially be required if loosened soils cannot be adequately recompacted in-place.

Provided that the recommendations outlined above and in further detail below are followed, we recommend the following parameters be used for foundation design:

- Maximum net allowable bearing pressure: 5,000 psf
- Minimum foundation widths:
  - Continuous wall footings: 18 in.
  - Column pad footings: 30 in.
- Minimum footing depths below finish site grades:
  - Exterior/perimeter footings: 4 ft
  - Interior footings: no minimum requirement

Note that although an allowable bearing pressure higher than 5,000 psf could be utilized for foundation design, due to the anticipated demands of the lightly-loaded structure, the use of such is not anticipated to be economically advantageous. Foundation subgrades should be checked by a CGC field representative to document that the subgrade soils are suitable for footing support or otherwise advise on corrective measures, such as undercutting. We recommend using a smooth-edged backhoe bucket for footing and undercut excavations. Granular soils which remain loose following recompaction will require undercutting and replacement. Soils potentially susceptible to disturbance from vibratory compaction (e.g., cohesive/fine-grained soils or sands with elevated moisture contents) should be hand-trimmed. OSHA slope guidelines should be followed if workers need to enter the excavations.

Undercutting below footing grades will be required if loose native sands which cannot be adequately recompacted, unsuitable existing fill or clay soils are encountered at or slightly below foundation grades. *The base of undercut excavations should be widened beyond the footing edges at least 0.5 ft in each direction for each foot of undercut depth for stress distribution purposes.* Where undercutting is required, foundation elevations should be restored with granular (sand) soils compacted to at least 95% compaction based on modified Proctor methods (ASTM D1557), in accordance with the Recommended

Compacted Fill Specifications presented in Appendix D. Alternatively, 3-in. DGB that is placed in loose 10-in. lifts and compacted until deflection ceases can also be used to restore foundation grades.

Provided the foundation design/construction recommendations discussed above are followed, we estimate that total and differential settlements should be on the order of 1.0 and 0.5 in., respectively.

### **3. Seismic Site Class**

In our opinion, the average soil properties in the upper 100 ft of the site (based on N-values projected to be greater than 50 blows/ft, on average, in the granular soils underlying the site) may be characterized as a very dense soil profile. This characterization would place the site in Site Class C for seismic design according to the International Building Code and ASCE 7.

### **4. Floor Slab**

The building floor slab is generally expected to be supported on native dense to very dense granular soils, or on a thin layer of newly placed structural fill above these soils where filling is required to establish building grades. Prior to slab construction, granular subgrade soils should be thoroughly recompacted with a vibratory smooth-drum roller to densify soils that may become disturbed or loosened during construction activities. Fine-grained subgrades, if any, should be statically recompacted and subsequently proof-rolled to check for soft/yielding areas. Areas of disturbed soil or where soils remain loose after recompaction should be undercut and replaced with compacted 3-in. DGB or granular fill. Due to the silty nature of the on-site granular soils at/below anticipated slab subgrade elevations, *some undercutting/replacement or stabilization may be required to create firm and stable floor slab subgrades, and we recommend that the project budget include a contingency for such operations.*

To act as a capillary break below the slab, we recommend including a minimum 6-in. thick layer of well-graded sand/gravel with less than 5% by weight passing the No. 200 U.S. standard sieve. Note, however, that some structural engineers require a layer of dense graded base, such as 1¼-in. DGB, rather than sand/gravel below floor slabs to increase the subgrade modulus immediately below the slab. To further reduce the potential for moisture migration through the slab, a vapor barrier can also be utilized. Fill and base layer material below the floor slab should be placed as described in the Site Preparation section of this report. Slabs constructed on a minimum 6-in. thick dense graded base layer may be designed utilizing a subgrade modulus of 150 pci, and a subgrade modulus of 100 pci should be used for the design of slabs that are constructed on a sand/gravel layer. The design subgrade moduli are based on a firm or adequately stabilized, recompacted subgrade such that non-yielding conditions are developed. The slab should be structurally separated from the footings with a compressible filler and have construction joints and reinforcement for crack control.

## 5. Utility Construction

Based on the available soil and groundwater information, it appears that utility construction can proceed using traditional open-cut methods. It is expected that excavation sidewalls will be sloped back for relatively shallow installations (i.e., less than 4 ft in depth) and that a trench shield and/or internal bracing will be used for deeper excavations. The following are our recommendations regarding trench excavation, dewatering and backfilling:

- Excavation: Open cuts should be sloped and/or braced in accordance with OSHA guidelines. Sand soils with low “fines” content (denoted as SP on the boring logs) are generally classified as OSHA “Type C” soils, and slopes of 1.5H:1V or flatter are expected to be at least temporarily stable. The prevalent sand soils with higher amounts of fines (SM) are generally classified as OSHA “Type B” soils where slopes of 1H:1V are expected to be temporarily stable. Note that flatter side slopes may also be required where perched or seeping water is present that destabilizes the side slopes. *The appropriate utility trench excavation side slopes should be determined by a competent person completing the earthwork in accordance with OSHA slope guidelines.*
- Dewatering: Groundwater was encountered well below existing grade and anticipated utility inverts in Borings 1 and 3 during and upon completion of drilling. We therefore generally do not anticipate the need for dewatering during utility installation. However, water accumulating at the bottom of the excavation as a result of precipitation or seepage from perched water layers should be quickly removed, with dewatering means and methods being the responsibility of the utility contractor.
- Rock Removal: Bedrock was not encountered in the soil borings to the maximum depths explored. As such, bedrock excavation techniques are generally not expected for utility installation. Note, however, that larger cobbles or boulders encountered in narrow utility trenches may also hinder and slow excavation.
- Backfilling: Excavation backfilling may proceed using the following guidelines:
  - To the extent possible, we recommend that granular soils be used as backfill below paved areas because sand/gravel soils are relatively easy to place and compact in most weather conditions compared to cohesive and fine-grained soils. The on-site granular soils are considered suitable for re-used as utility trench backfill. However, cobbles and boulders should not be used in direct contact with utility lines.
  - Backfill material should be placed in accordance with Appendix D guidelines or applicable municipal requirements.

- Compaction recommendations:
  - o Within 10 ft of the water tower foundation: 95% modified Proctor (ASTM D1557);
  - o Depths greater than 3 ft below grade in pavement areas: 90% modified Proctor;
  - o Final 3 ft in pavement areas: 95% modified Proctor; and
  - o Landscape areas: 85% modified Proctor.

## 5. **Pavement Design**

We anticipate that pavement design will be controlled by the silty sand soils that were encountered at shallow depths across the site, and subgrades should be prepared as described in the Site Preparation section of this report, with recompaction/proof-rolling completed prior to base course placement. *We recommend that the project budget include a contingency for pavement subgrade undercutting/stabilization, as the sands with significant fines content are generally considered moisture-sensitive and susceptible to disturbance from precipitation and construction traffic. Subgrade improvement in pavement areas may involve about 12 in. of additional coarse aggregate (e.g., 3-in. DGB), potentially over biaxial geogrid (e.g., Tensar BX Type 1 or equivalent).* The areas requiring undercutting/stabilization and the depth of undercutting should be determined in the field by proof-rolling prior to installing the base course layer, and the need for undercutting/stabilization will likely depend on the weather conditions during construction.

We anticipate that asphalt pavement on this site will primarily be exposed to light to medium-duty maintenance vehicle traffic with up to five 18-kip equivalent single axle load (ESAL) per day. In view of this, we have assumed Traffic Class II following Wisconsin Asphalt Pavement Association (WAPA) recommendations. The pavement section summarized in Table 1 below were selected assuming a Soil Support Value “SSV” of about 4.0 for a firm or adequately stabilized silty sand subgrade and a design life of 20 years.



**TABLE 1 – Recommended Pavement Section**

| <b>Material</b>                           | <b>Thickness (in.)</b> | <b>WDOT Specification <sup>(1)</sup></b> |
|-------------------------------------------|------------------------|------------------------------------------|
| Bituminous Upper Layer <sup>(2,3)</sup>   | 1.75                   | Section 460, Table 460-1                 |
| Bituminous Lower Layer <sup>(2,3)</sup>   | 2.25                   | Section 460, Table 460-1                 |
| Dense Graded Base Course <sup>(2,4)</sup> | 10.0                   | Sections 301 and 305                     |
| <b>Total Thickness</b>                    | <b>14.0</b>            |                                          |

Notes:

- 1) Wisconsin DOT *Standard Specifications for Highway and Structure Construction*, latest edition, including supplemental specifications, and *Wisconsin Asphalt Pavement Association 2021 Asphalt Pavement Design Guide*.
- 2) Compaction requirements:
  - Bituminous concrete: Refer to Section 460-3.
  - Base course: Refer to Section 301.3.4.2, Standard Compaction
- 3) Mixture Type LT (or E-0.3) bituminous; refer to Section 460, Table 460-2 of the *Standard Specifications*.
- 4) The upper 4 in. should consist of 1¼-in. DGB; the bottom part of the layer can consist of 3-in. DGB.

The recommended pavement section assumes regular maintenance (crack sealing, etc.) will occur, as needed. Note that if traffic volumes are greater than those assumed, CGC should be allowed to review the recommended pavement section and adjust it accordingly. Alternative pavement designs may prove acceptable and should be reviewed by CGC. If there is a delay between subgrade preparation and placing the base course, the subgrade should be recompacted.

Where concrete pavement may be used, such as in pavement areas subjected to concentrated wheel loads (e.g., dumpster pads, etc.), we recommend that the concrete be at least 6 in. thick and contain adequate reinforcement for crack control. Concrete slabs underlain by a minimum 6-in. thick dense graded base layer over a firm or stabilized subgrade can be designed utilizing a subgrade modulus of 150 pci.



## **CONSTRUCTION CONSIDERATIONS**

Due to variations in weather, construction methods and other factors, specific construction problems are difficult to predict. Soil-related difficulties which could be encountered on the site are discussed below:

- Due to the potentially sensitive nature of some of the on-site soils, we recommend that final site grading activities be completed during dry weather, if possible. Construction traffic should be avoided on prepared subgrades to minimize potential disturbance.
- Contingencies in the project budget for subgrade stabilization with coarse aggregate in pavement and floor slab areas should be increased if the project schedule requires that work proceed during adverse weather conditions.
- Earthwork construction during the late fall through early spring could be complicated as a result of wet weather and freezing temperatures. During cold weather, exposed subgrades should be protected from freezing before and after footing construction. Fill should never be placed while frozen or on frozen ground.
- Excavations extending greater than 4 ft in depth below the existing ground surface should be sloped or braced in accordance with current OSHA standards. Temporary shoring/earth retention systems, if required, should be designed by an adequately qualified professional engineer.
- Based on the observations made during our field exploration, we generally do not expect groundwater infiltration into utility, foundation or undercut excavations. However, water accumulating at the bottom of excavations as a result of precipitation or seepage from perched layers should be quickly removed, with dewatering means and methods being the contractor's responsibility.

## **RECOMMENDED CONSTRUCTION MONITORING**

The quality of the foundation, floor slab and pavement subgrades will be largely determined by the level of care exercised during site development. To check that earthwork and foundation construction proceed in accordance with our recommendations, the following operations should be monitored by CGC:

- Subgrade proof-rolling/compaction;
- Fill/backfill placement and compaction;
- Foundation excavation/subgrade preparation; and
- Concrete placement.



Geotechnical Exploration Report  
Proposed Kilkenny Farms Well and Water Storage  
CGC Project No. C24503  
November 8, 2024  
Page 11

\* \* \* \* \*

It has been a pleasure to serve you on this project. If you have any questions or need additional consultation, please contact us.

Sincerely,

**CGC, Inc.**

A handwritten signature in black ink, reading "Alex Bina".

Alex J. Bina, PE  
Consulting Professional

A handwritten signature in blue ink, reading "Tim F. Gassenheimer".

Tim F. Gassenheimer, PE  
Senior Staff Engineer

Encl: Appendix A - Field Exploration  
Appendix B - Soil Boring Location Exhibit  
Logs of Test Borings (7)  
Log of Test Boring-General Notes  
Unified Soil Classification System  
Appendix C - Document Qualifications  
Appendix D - Recommended Compacted Fill Specifications

Cc: Project Team at Strand Associates, Inc.

## **APPENDIX A**

### **FIELD EXPLORATION REPORT**

## APPENDIX A

### FIELD EXPLORATION

Subsurface conditions on this site were explored by drilling seven (7) Standard Penetration Test (SPT) soil borings to depths of 10 to 75 ft below current site, which were sampled at 2.5-ft intervals to a depth of 10 ft and at 5-ft intervals thereafter. The soil samples were obtained in general accordance with specifications for standard penetration testing, ASTM D1586, and the specific procedures used for drilling and sampling are described below.

1. Boring Procedures between Samples

The boring is extended downward, between samples, by a hollow-stem auger.

2. Standard Penetration Test and Split-Barrel Sampling of Soils  
(ASTM Designation: D1586)

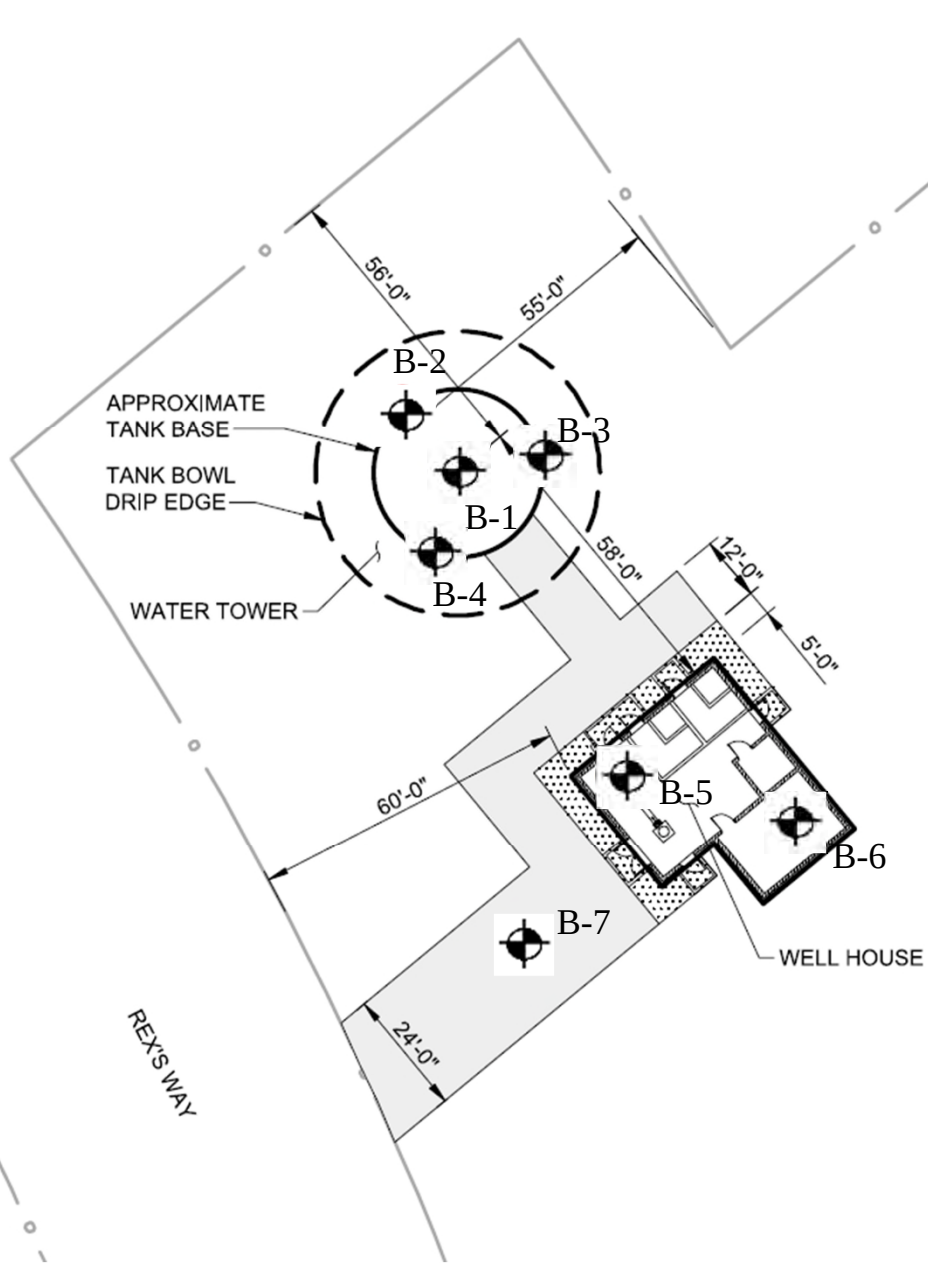
This method consists of driving a 2-inch outside diameter split-barrel sampler using a 140-pound weight falling freely through a distance of 30 inches. The sampler is first seated 6 inches into the material to be sampled and then driven 12 inches. The number of blows required to drive the sampler the final 12 inches is recorded on the log of borings and is known as the Standard Penetration Resistance.

During the field exploration, the driller visually classified the soil and prepared a field log. *Field screening of the soil samples for possible environmental contaminants was not conducted by the driller as these services were not part of CGC's work scope.* Water level observations were made in each boring during and after drilling and are shown at the bottom of each boring log. Upon completion of drilling, the borings were backfilled with bentonite to satisfy WDNR regulations, and the soil samples were delivered to our laboratory for visual classification and limited geotechnical laboratory testing. The soils were visually classified by a geotechnical engineer using the Unified Soil Classification System (USCS).

The final boring logs prepared by the engineer, along with a Soil Boring Location Exhibit and a description of the Unified Soil Classification System are presented in Appendix B.

**APPENDIX B**

**SOIL BORING LOCATION EXHIBIT  
LOGS OF TEST BORINGS (7)  
LOG OF TEST BORING-GENERAL NOTES  
UNIFIED SOIL CLASSIFICATION SYSTEM**



#### Legend

⊕ Denotes Boring Location

#### Notes:

1. Base map from Client.
2. Borings performed by ADC between October 10 and 14, 2024.
3. Locations are approximate.

Scale: Reduced



|                          |                                                                                      |                                                                                                                      |
|--------------------------|--------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|
| <b>Job No.</b><br>C24503 |  | <b>BORING LOCATION EXHIBIT</b><br>Well House No. 6 and Water Tower<br>Kilkenny Farms West<br>Village of Waunakee, WI |
| <b>Date:</b><br>11/2024  |                                                                                      |                                                                                                                      |



# LOG OF TEST BORING

Project **Proposed Well No. 6 and Water Tower**  
Location **Waunakee, WI**

Boring No. **B-1**  
Surface Elevation (ft) **951.5±**  
Job No. **C24503**  
Sheet **1** of **2**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

| SAMPLE |      |              |       |       | VISUAL CLASSIFICATION<br>and Remarks | SOIL PROPERTIES                                                                                       |                     |   |    |    |     |  |
|--------|------|--------------|-------|-------|--------------------------------------|-------------------------------------------------------------------------------------------------------|---------------------|---|----|----|-----|--|
| No.    | TYPE | Rec<br>(in.) | Moist | N     |                                      | Depth<br>(ft)                                                                                         | qu<br>(qa)<br>(tsf) | W | LL | PL | LOI |  |
| 1      |      | 12           | M     | 30    | 5                                    | Dense to Very Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles/Boulders (SM) |                     |   |    |    |     |  |
| 2      |      | 10           | M     | 65    |                                      |                                                                                                       |                     |   |    |    |     |  |
| 3      |      | 8            | M     | 50/5" |                                      |                                                                                                       |                     |   |    |    |     |  |
| 4      |      | 5            | M     | 50/3" |                                      |                                                                                                       |                     |   |    |    |     |  |
| 5      |      | 6            | M     | 50/4" | 10                                   |                                                                                                       |                     |   |    |    |     |  |
| 6      |      | 8            | M     | 50/3" |                                      |                                                                                                       |                     |   |    |    |     |  |
| 7      |      | 14           | M     | 74    | 15                                   | Very Dense, Light Brown Fine to Medium SAND, Trace Silt, Little Gravel (SP)                           |                     |   |    |    |     |  |
| 8      |      | 10           | M     | 50/5" |                                      |                                                                                                       |                     |   |    |    |     |  |
| 9      |      | 6            | M     | 50/5" | 25                                   | Very Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles/Boulders (SM)          |                     |   |    |    |     |  |
| 10     |      | 10           | M     | 50/4" |                                      |                                                                                                       |                     |   |    |    |     |  |
| 11     |      | 8            | W     | 50/5" |                                      |                                                                                                       |                     |   |    |    |     |  |
|        |      |              |       |       |                                      |                                                                                                       |                     |   |    |    |     |  |

| WATER LEVEL OBSERVATIONS                                                                                          |   |       |                             |         | GENERAL NOTES |                       |        |          |     |        |
|-------------------------------------------------------------------------------------------------------------------|---|-------|-----------------------------|---------|---------------|-----------------------|--------|----------|-----|--------|
| While Drilling                                                                                                    | ▽ | 38.5' | Upon Completion of Drilling |         | Start         | 10/11/24              | End    | 10/11/24 |     |        |
| Time After Drilling                                                                                               |   |       |                             | 24 Hour | Driller       | ADC                   | Chief  | KD       | Rig | CME-55 |
| Depth to Water                                                                                                    |   |       |                             | 38.5'   | Logger        | LD                    | Editor | AJB      |     |        |
| Depth to Cave in                                                                                                  |   |       |                             | 39'     | Drill Method  | 2.25" HSA; Autohammer |        |          |     |        |
| The stratification lines represent the approximate boundary between soil types and the transition may be gradual. |   |       |                             |         |               |                       |        |          |     |        |



## LOG OF TEST BORING

Project **Proposed Well No. 6 and Water Tower**  
Location **Waunakee, WI**

Boring No. **B-1**  
Surface Elevation **951.5±**  
Job No. **C24503**  
Sheet **2** of **2**

2921 PERRY STREET, MADISON, WIS. 53713 (608) 288-4100, FAX (608) 288-7887

| SAMPLE |      |              |       |       |               | VISUAL CLASSIFICATION<br>and Remarks |                                                                                              | SOIL PROPERTIES     |   |    |    |    |
|--------|------|--------------|-------|-------|---------------|--------------------------------------|----------------------------------------------------------------------------------------------|---------------------|---|----|----|----|
| No.    | TYPE | Rec<br>(in.) | Moist | N     | Depth<br>(ft) |                                      |                                                                                              | qu<br>(qa)<br>(tsf) | W | LL | PL | LI |
|        |      |              |       |       |               |                                      | Very Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles/Boulders (SM) |                     |   |    |    |    |
| 12     |      | 16           | W     | 50/3" | 45            |                                      | Very Dense, Light Brown Fine to Medium SAND, Trace Silt, Little Gravel (SP)                  |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
| 13     |      | 3            | W     | 50/4" | 50            |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
| 14     |      | 3            | W     | 50/4" | 55            |                                      | Very Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles/Boulders (SM) |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
| 15     |      | 8            | W     | 50/3" | 60            |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
| 16     |      | 6            | W     | 50/4" | 65            |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
| 17     |      | 0            | W     | 50/1" | 70            |                                      | (No Recovery in Sample 17)                                                                   |                     |   |    |    |    |
|        |      |              |       |       |               |                                      | End of Boring at 69.5 ft Due to Auger Refusal on Possible Cobble/Boulder                     |                     |   |    |    |    |
|        |      |              |       |       |               |                                      | Borehole Backfilled with Soil Cuttings and Bentonite Chips                                   |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
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|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
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|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
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|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
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|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
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|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
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|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
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|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
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|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
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|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
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|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
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|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |
|        |      |              |       |       |               |                                      |                                                                                              |                     |   |    |    |    |





# LOG OF TEST BORING

Project Proposed Well No. 6 and Water Tower  
Location Waunakee, WI

Boring No. **B-2**  
Surface Elevation (ft) 951.5±  
Job No. **C24503**  
Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

| SAMPLE                                                     |      |              |       |       | VISUAL CLASSIFICATION<br>and Remarks | SOIL PROPERTIES                                                                                       |                     |   |    |    |     |  |
|------------------------------------------------------------|------|--------------|-------|-------|--------------------------------------|-------------------------------------------------------------------------------------------------------|---------------------|---|----|----|-----|--|
| No.                                                        | TYPE | Rec<br>(in.) | Moist | N     |                                      | Depth<br>(ft)                                                                                         | qu<br>(qa)<br>(tsf) | W | LL | PL | LOI |  |
| 1                                                          |      | 10           | M     | 49    | 5                                    | Dense to Very Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles/Boulders (SM) |                     |   |    |    |     |  |
| 2                                                          |      | 14           | M     | 60    |                                      |                                                                                                       |                     |   |    |    |     |  |
| 3                                                          |      | 12           | M     | 93    |                                      |                                                                                                       |                     |   |    |    |     |  |
| 4                                                          |      | 14           | M     | 69    |                                      |                                                                                                       |                     |   |    |    |     |  |
| 5                                                          |      | 12           | M     | 40    | 10                                   | Dense, Light Brown Fine to Medium SAND, Trace Silt, Little Gravel (SP)                                |                     |   |    |    |     |  |
| 6                                                          |      | 14           | M     | 49    |                                      |                                                                                                       |                     |   |    |    |     |  |
| 7                                                          |      | 12           | M     | 74    | 20                                   | Very Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles/Boulders (SM)          |                     |   |    |    |     |  |
| 8                                                          |      | 10           | M     | 60    |                                      |                                                                                                       |                     |   |    |    |     |  |
| 9                                                          |      | 16           | M     | 50/3" | 30                                   | Very Dense, Light Brown Fine to Medium SAND, Trace Silt, Little Gravel (SP)                           |                     |   |    |    |     |  |
| 10                                                         |      | 10           | M     | 50/5" |                                      |                                                                                                       |                     |   |    |    |     |  |
| End of Boring at 35 ft                                     |      |              |       |       |                                      |                                                                                                       |                     |   |    |    |     |  |
| Borehole Backfilled with Soil Cuttings and Bentonite Chips |      |              |       |       |                                      |                                                                                                       |                     |   |    |    |     |  |

| WATER LEVEL OBSERVATIONS                                                                                          |                                        |                             |  |         | GENERAL NOTES |                       |
|-------------------------------------------------------------------------------------------------------------------|----------------------------------------|-----------------------------|--|---------|---------------|-----------------------|
| While Drilling                                                                                                    | <input checked="" type="checkbox"/> NW | Upon Completion of Drilling |  |         | Start         | End                   |
| Time After Drilling                                                                                               |                                        |                             |  | 15 Min. | Driller       | Chief                 |
| Depth to Water                                                                                                    |                                        |                             |  | NW      | Logger        | Editor                |
| Depth to Cave in                                                                                                  |                                        |                             |  | 20.5'   | Drill Method  | 2.25" HSA; Autohammer |
| The stratification lines represent the approximate boundary between soil types and the transition may be gradual. |                                        |                             |  |         |               |                       |



# LOG OF TEST BORING

Project **Proposed Well No. 6 and Water Tower**  
Location **Waunakee, WI**

Boring No. **B-3**  
Surface Elevation (ft) **951.5±**  
Job No. **C24503**  
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

| SAMPLE                                                     |      |              |       |       | VISUAL CLASSIFICATION<br>and Remarks | SOIL PROPERTIES                                                                                              |                     |   |    |    |     |  |
|------------------------------------------------------------|------|--------------|-------|-------|--------------------------------------|--------------------------------------------------------------------------------------------------------------|---------------------|---|----|----|-----|--|
| No.                                                        | TYPE | Rec<br>(in.) | Moist | N     |                                      | Depth<br>(ft)                                                                                                | qu<br>(qa)<br>(tsf) | W | LL | PL | LOI |  |
| 1                                                          |      | 10           | M     | 15    | 5                                    | Medium Dense to Very Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles/Boulders (SM) |                     |   |    |    |     |  |
| 2                                                          |      | 14           | M     | 32    |                                      |                                                                                                              |                     |   |    |    |     |  |
| 3                                                          |      | 12           | M     | 76    |                                      |                                                                                                              |                     |   |    |    |     |  |
| 4                                                          |      | 6            | M     | 50/4" |                                      |                                                                                                              |                     |   |    |    |     |  |
| 5                                                          |      | 6            | M     | 50/5" |                                      |                                                                                                              |                     |   |    |    |     |  |
| 6                                                          |      | 10           | M     | 50/5" |                                      |                                                                                                              |                     |   |    |    |     |  |
| 7                                                          |      | 14           | M     | 57    | 20                                   | Very Dense, Light Brown Fine to Medium SAND, Trace Silt, Little Gravel (SP)                                  |                     |   |    |    |     |  |
| 8                                                          |      | 16           | M     | 50/4" |                                      |                                                                                                              |                     |   |    |    |     |  |
| 9                                                          |      | 2            | M     | 50/3" |                                      |                                                                                                              |                     |   |    |    |     |  |
| 10                                                         |      | 14           | W     | 50/4" | 35                                   | Very Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles/Boulders (SM)                 |                     |   |    |    |     |  |
|                                                            |      |              |       |       |                                      |                                                                                                              |                     |   |    |    |     |  |
| End of Boring at 35 ft                                     |      |              |       |       |                                      |                                                                                                              |                     |   |    |    |     |  |
| Borehole Backfilled with Soil Cuttings and Bentonite Chips |      |              |       |       |                                      |                                                                                                              |                     |   |    |    |     |  |
| 40                                                         |      |              |       |       |                                      |                                                                                                              |                     |   |    |    |     |  |

| WATER LEVEL OBSERVATIONS                                                                                          |   |       |                             |         | GENERAL NOTES |                       |        |          |     |        |
|-------------------------------------------------------------------------------------------------------------------|---|-------|-----------------------------|---------|---------------|-----------------------|--------|----------|-----|--------|
| While Drilling                                                                                                    | ▽ | 33.5' | Upon Completion of Drilling |         | Start         | 10/14/24              | End    | 10/14/24 |     |        |
| Time After Drilling                                                                                               |   |       |                             | 10 Min. | Driller       | ADC                   | Chief  | KD       | Rig | CME-55 |
| Depth to Water                                                                                                    |   |       |                             | NW      | Logger        | LD                    | Editor | AJB      |     |        |
| Depth to Cave in                                                                                                  |   |       |                             | 20'     | Drill Method  | 2.25" HSA; Autohammer |        |          |     |        |
| The stratification lines represent the approximate boundary between soil types and the transition may be gradual. |   |       |                             |         |               |                       |        |          |     |        |



# LOG OF TEST BORING

Project Proposed Well No. 6 and Water Tower  
Location Waunakee, WI

Boring No. **B-4**  
Surface Elevation (ft) 951.5±  
Job No. **C24503**  
Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

| SAMPLE                                                     |      |              |       |       | VISUAL CLASSIFICATION<br>and Remarks | SOIL PROPERTIES |                     |   |    |    |     |
|------------------------------------------------------------|------|--------------|-------|-------|--------------------------------------|-----------------|---------------------|---|----|----|-----|
| No.                                                        | TYPE | Rec<br>(in.) | Moist | N     |                                      | Depth<br>(ft)   | qu<br>(qa)<br>(tsf) | W | LL | PL | LOI |
| 1                                                          |      | 14           | M     | 49    |                                      |                 |                     |   |    |    |     |
| 2                                                          |      | 8            | M     | 76    |                                      |                 |                     |   |    |    |     |
| 3                                                          |      | 4            | M     | 50/5" |                                      |                 |                     |   |    |    |     |
| 4                                                          |      | 3            | M     | 50/2" |                                      |                 |                     |   |    |    |     |
| 5                                                          |      | 6            | M     | 50/5" |                                      |                 |                     |   |    |    |     |
| 6                                                          |      | 10           | M     | 50/4" |                                      |                 |                     |   |    |    |     |
| 7                                                          |      | 14           | M     | 87    |                                      |                 |                     |   |    |    |     |
| 8                                                          |      | 10           | M     | 50/4" |                                      |                 |                     |   |    |    |     |
| 9                                                          |      | 8            | M     | 50/4" |                                      |                 |                     |   |    |    |     |
| 10                                                         |      | 16           | M     | 50/5" |                                      |                 |                     |   |    |    |     |
| End of Boring at 35 ft                                     |      |              |       |       |                                      |                 |                     |   |    |    |     |
| Borehole Backfilled with Soil Cuttings and Bentonite Chips |      |              |       |       |                                      |                 |                     |   |    |    |     |

| WATER LEVEL OBSERVATIONS                                                                                          |                                     |    |                             |         | GENERAL NOTES |                       |        |          |     |        |
|-------------------------------------------------------------------------------------------------------------------|-------------------------------------|----|-----------------------------|---------|---------------|-----------------------|--------|----------|-----|--------|
| While Drilling                                                                                                    | <input checked="" type="checkbox"/> | NW | Upon Completion of Drilling |         | Start         | 10/14/24              | End    | 10/14/24 |     |        |
| Time After Drilling                                                                                               |                                     |    |                             | 20 Min. | Driller       | ADC                   | Chief  | KD       | Rig | CME-55 |
| Depth to Water                                                                                                    |                                     |    |                             | NW      | Logger        | LD                    | Editor | AJB      |     |        |
| Depth to Cave in                                                                                                  |                                     |    |                             | 19.5'   | Drill Method  | 2.25" HSA; Autohammer |        |          |     |        |
| The stratification lines represent the approximate boundary between soil types and the transition may be gradual. |                                     |    |                             |         |               |                       |        |          |     |        |



# LOG OF TEST BORING

Project **Proposed Well No. 6 and Water Tower**  
Location **Waunakee, WI**

Boring No. **B-5**  
Surface Elevation (ft) **952±**  
Job No. **C24503**  
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

| SAMPLE |      |              |       |    | VISUAL CLASSIFICATION<br>and Remarks                                                         | SOIL PROPERTIES |                     |   |    |    |     |
|--------|------|--------------|-------|----|----------------------------------------------------------------------------------------------|-----------------|---------------------|---|----|----|-----|
| No.    | TYPE | Rec<br>(in.) | Moist | N  |                                                                                              | Depth<br>(ft)   | qu<br>(qa)<br>(tsf) | W | LL | PL | LOI |
| 1      |      | 12           | M     | 53 | Very Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles/Boulders (SM) |                 |                     |   |    |    |     |
| 2      |      | 10           | M     | 62 |                                                                                              |                 |                     |   |    |    |     |
| 3      |      | 12           | M     | 71 |                                                                                              |                 |                     |   |    |    |     |
| 4      |      | 16           | M     | 68 |                                                                                              |                 |                     |   |    |    |     |
| 5      |      | 14           | M     | 79 |                                                                                              |                 |                     |   |    |    |     |
| 6      |      | 16           | M     | 54 | Very Dense, Light Brown Fine to Medium SAND, Trace Silt, Little Gravel (SP)                  |                 |                     |   |    |    |     |
| 7      |      | 14           | M     | 67 | Very Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles/Boulders (SM) |                 |                     |   |    |    |     |
| 8      |      | 16           | M     | 75 | End of Boring at 25 ft                                                                       |                 |                     |   |    |    |     |
|        |      |              |       |    | Borehole Backfilled with Soil Cuttings and Bentonite Chips                                   |                 |                     |   |    |    |     |

| WATER LEVEL OBSERVATIONS                                                                                          |                                     |    |                             |         | GENERAL NOTES |                       |        |          |     |        |
|-------------------------------------------------------------------------------------------------------------------|-------------------------------------|----|-----------------------------|---------|---------------|-----------------------|--------|----------|-----|--------|
| While Drilling                                                                                                    | <input checked="" type="checkbox"/> | NW | Upon Completion of Drilling |         | Start         | 10/10/24              | End    | 10/10/24 |     |        |
| Time After Drilling                                                                                               |                                     |    |                             | 10 Min. | Driller       | ADC                   | Chief  | KD       | Rig | CME-55 |
| Depth to Water                                                                                                    |                                     |    |                             | NW      | Logger        | LD                    | Editor | AJB      |     |        |
| Depth to Cave in                                                                                                  |                                     |    |                             | 15.5'   | Drill Method  | 2.25" HSA; Autohammer |        |          |     |        |
| The stratification lines represent the approximate boundary between soil types and the transition may be gradual. |                                     |    |                             |         |               |                       |        |          |     |        |



# LOG OF TEST BORING

Project **Proposed Well No. 6 and Water Tower**  
Location **Waunakee, WI**

Boring No. **B-6**  
Surface Elevation (ft) **952±**  
Job No. **C24503**  
Sheet **1** of **1**

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

| SAMPLE |      |              |       |       | VISUAL CLASSIFICATION<br>and Remarks | SOIL PROPERTIES                                                                                       |                     |   |    |    |     |  |
|--------|------|--------------|-------|-------|--------------------------------------|-------------------------------------------------------------------------------------------------------|---------------------|---|----|----|-----|--|
| No.    | TYPE | Rec<br>(in.) | Moist | N     |                                      | Depth<br>(ft)                                                                                         | qu<br>(qa)<br>(tsf) | W | LL | PL | LOI |  |
| 1      |      | 12           | M     | 38    | 5                                    | Dense to Very Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles/Boulders (SM) |                     |   |    |    |     |  |
| 2      |      | 14           | M     | 65    |                                      |                                                                                                       |                     |   |    |    |     |  |
| 3      |      | 12           | M     | 55    |                                      |                                                                                                       |                     |   |    |    |     |  |
| 4      |      | 10           | M     | 32    | 10                                   | Dense, Light Brown Fine to Medium SAND, Trace Silt, Little Gravel (SP)                                |                     |   |    |    |     |  |
| 5      |      | 10           | M     | 78    |                                      |                                                                                                       |                     |   |    |    |     |  |
| 6      |      | 14           | M     | 62    | 15                                   | Very Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles/Boulders (SM)          |                     |   |    |    |     |  |
|        |      |              |       |       |                                      |                                                                                                       |                     |   |    |    |     |  |
| 7      |      | 14           | M     | 48    | 20                                   | Dense to Very Dense, Light Brown Fine SAND, Little to Some Silt and Gravel (SP-SM/SM)                 |                     |   |    |    |     |  |
|        |      |              |       |       |                                      |                                                                                                       |                     |   |    |    |     |  |
| 8      |      | 10           | M     | 50/5" | 25                                   | End of Boring at 25 ft<br><br>Borehole Backfilled with Soil Cuttings and Bentonite Chips              |                     |   |    |    |     |  |
|        |      |              |       |       |                                      |                                                                                                       |                     |   |    |    |     |  |
|        |      |              |       |       | 30                                   |                                                                                                       |                     |   |    |    |     |  |
|        |      |              |       |       |                                      |                                                                                                       |                     |   |    |    |     |  |
|        |      |              |       |       |                                      |                                                                                                       |                     |   |    |    |     |  |
|        |      |              |       |       |                                      |                                                                                                       |                     |   |    |    |     |  |
|        |      |              |       |       | 35                                   |                                                                                                       |                     |   |    |    |     |  |
|        |      |              |       |       |                                      |                                                                                                       |                     |   |    |    |     |  |
|        |      |              |       |       |                                      |                                                                                                       |                     |   |    |    |     |  |
|        |      |              |       |       |                                      |                                                                                                       |                     |   |    |    |     |  |
|        |      |              |       |       | 40                                   |                                                                                                       |                     |   |    |    |     |  |
|        |      |              |       |       |                                      |                                                                                                       |                     |   |    |    |     |  |
|        |      |              |       |       |                                      |                                                                                                       |                     |   |    |    |     |  |
|        |      |              |       |       |                                      |                                                                                                       |                     |   |    |    |     |  |

| WATER LEVEL OBSERVATIONS                                                                                          |                                     |    |                             |         | GENERAL NOTES |                       |
|-------------------------------------------------------------------------------------------------------------------|-------------------------------------|----|-----------------------------|---------|---------------|-----------------------|
| While Drilling                                                                                                    | <input checked="" type="checkbox"/> | NW | Upon Completion of Drilling |         | Start         | 10/14/24              |
| Time After Drilling                                                                                               |                                     |    |                             | 15 Min. | End           | 10/14/24              |
| Depth to Water                                                                                                    |                                     |    |                             | NW      | Driller       | ADC                   |
| Depth to Cave in                                                                                                  |                                     |    |                             | 12'     | Chief         | KD                    |
|                                                                                                                   |                                     |    |                             |         | Logger        | LD                    |
|                                                                                                                   |                                     |    |                             |         | Editor        | AJB                   |
|                                                                                                                   |                                     |    |                             |         | Drill Method  | 2.25" HSA; Autohammer |
| The stratification lines represent the approximate boundary between soil types and the transition may be gradual. |                                     |    |                             |         |               |                       |

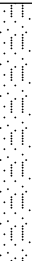


# LOG OF TEST BORING

Project Proposed Well No. 6 and Water Tower  
Location Waunakee, WI

Boring No. **B-7**  
Surface Elevation (ft) 951.5±  
Job No. **C24503**  
Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

| SAMPLE                                                     |      |              |       |       | VISUAL CLASSIFICATION<br>and Remarks |                                                                                   | SOIL PROPERTIES                                                                                              |                     |   |    |    |     |
|------------------------------------------------------------|------|--------------|-------|-------|--------------------------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|---------------------|---|----|----|-----|
| No.                                                        | TYPE | Rec<br>(in.) | Moist | N     |                                      |                                                                                   | Depth<br>(ft)                                                                                                | qu<br>(qa)<br>(tsf) | W | LL | PL | LOI |
|                                                            |      |              |       |       |                                      |  | Medium Dense to Very Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles/Boulders (SM) |                     |   |    |    |     |
| 1                                                          |      | 10           | M     | 30    |                                      |                                                                                   |                                                                                                              |                     |   |    |    |     |
|                                                            |      |              |       |       |                                      |                                                                                   |                                                                                                              |                     |   |    |    |     |
| 2                                                          |      | 14           | M     | 48    |                                      |                                                                                   |                                                                                                              |                     |   |    |    |     |
|                                                            |      |              |       |       |                                      |                                                                                   |                                                                                                              |                     |   |    |    |     |
| 3                                                          |      | 2            | M     | 50/5" |                                      |                                                                                   |                                                                                                              |                     |   |    |    |     |
|                                                            |      |              |       |       |                                      |  | Dense, Light Brown Fine to Medium SAND, Trace Silt, Little Gravel (SP)                                       |                     |   |    |    |     |
| 4                                                          |      | 10           | M     | 42    |                                      |                                                                                   |                                                                                                              |                     |   |    |    |     |
| End of Boring at 10 ft                                     |      |              |       |       |                                      |                                                                                   |                            |                     |   |    |    |     |
| Borehole Backfilled with Soil Cuttings and Bentonite Chips |      |              |       |       |                                      |                                                                                   |                                                                                                              |                     |   |    |    |     |
|                                                            |      |              |       |       |                                      |                                                                                   |                                                                                                              |                     |   |    |    |     |
|                                                            |      |              |       |       |                                      |                                                                                   |                                                                                                              |                     |   |    |    |     |
|                                                            |      |              |       |       |                                      |                                                                                   |                                                                                                              |                     |   |    |    |     |
|                                                            |      |              |       |       |                                      |                                                                                   |                                                                                                              |                     |   |    |    |     |
|                                                            |      |              |       |       |                                      |                                                                                   |                                                                                                              |                     |   |    |    |     |
|                                                            |      |              |       |       |                                      |                                                                                   |                                                                                                              |                     |   |    |    |     |
|                                                            |      |              |       |       |                                      |                                                                                   |                                                                                                              |                     |   |    |    |     |
|                                                            |      |              |       |       |                                      |                                                                                   |                                                                                                              |                     |   |    |    |     |
|                                                            |      |              |       |       |                                      |                                                                                   |                                                                                                              |                     |   |    |    |     |
|                                                            |      |              |       |       |                                      |                                                                                   |                                                                                                              |                     |   |    |    |     |

| WATER LEVEL OBSERVATIONS                                                                                          |                                        |                             |  |         | GENERAL NOTES |                       |        |          |
|-------------------------------------------------------------------------------------------------------------------|----------------------------------------|-----------------------------|--|---------|---------------|-----------------------|--------|----------|
| While Drilling                                                                                                    | <input checked="" type="checkbox"/> NW | Upon Completion of Drilling |  |         | Start         | 10/14/24              | End    | 10/14/24 |
| Time After Drilling                                                                                               |                                        |                             |  | 10 Min. | Driller       | ADC                   | Chief  | KD       |
| Depth to Water                                                                                                    |                                        |                             |  | NW      | Logger        | LD                    | Editor | AJB      |
| Depth to Cave in                                                                                                  |                                        |                             |  | 3.6'    | Drill Method  | 2.25" HSA; Autohammer |        |          |
| The stratification lines represent the approximate boundary between soil types and the transition may be gradual. |                                        |                             |  |         |               |                       |        |          |

## LOG OF TEST BORING General Notes

### DESCRIPTIVE SOIL CLASSIFICATION

#### Grain Size Terminology

| Soil Fraction       | Particle Size               | U.S. Standard Sieve Size |
|---------------------|-----------------------------|--------------------------|
| Boulders .....      | Larger than 12" .....       | Larger than 12"          |
| Cobbles .....       | 3" to 12" .....             | 3" to 12"                |
| Gravel: Coarse..... | ¾" to 3" .....              | ¾" to 3"                 |
| Fine .....          | 4.76 mm to ¾" .....         | #4 to ¾"                 |
| Sand: Coarse.....   | 2.00 mm to 4.76 mm.....     | #10 to #4                |
| Medium .....        | 0.42 to mm to 2.00 mm ..... | #40 to #10               |
| Fine .....          | 0.074 mm to 0.42 mm.....    | #200 to #40              |
| Silt.....           | 0.005 mm to 0.074 mm.....   | Smaller than #200        |
| Clay.....           | Smaller than 0.005 mm.....  | Smaller than #200        |

Plasticity characteristics differentiate between silt and clay.

#### General Terminology

Physical Characteristics  
Color, moisture, grain shape, fineness, etc.  
Major Constituents  
Clay, silt, sand, gravel  
Structure  
Laminated, varved, fibrous, stratified,  
cemented, fissured, etc.  
Geologic Origin  
Glacial, alluvial, eolian, residual, etc.

#### Relative Density

| Term              | "N" Value |
|-------------------|-----------|
| Very Loose.....   | 0 - 4     |
| Loose.....        | 4 - 10    |
| Medium Dense..... | 10 - 30   |
| Dense.....        | 30 - 50   |
| Very Dense.....   | Over 50   |

#### Relative Proportions Of Cohesionless Soils

| Proportional<br>Term | Defining Range by<br>Percentage of Weight |
|----------------------|-------------------------------------------|
| Trace.....           | 0% - 5%                                   |
| Little .....         | 5% - 12%                                  |
| Some.....            | 12% - 35%                                 |
| And .....            | 35% - 50%                                 |

#### Consistency

| Term            | q <sub>u</sub> -tons/sq. ft |
|-----------------|-----------------------------|
| Very Soft.....  | 0.0 to 0.25                 |
| Soft.....       | 0.25 to 0.50                |
| Medium.....     | 0.50 to 1.0                 |
| Stiff.....      | 1.0 to 2.0                  |
| Very Stiff..... | 2.0 to 4.0                  |
| Hard.....       | Over 4.0                    |

#### Organic Content by Combustion Method

| Soil Description          | Loss on Ignition |
|---------------------------|------------------|
| Non Organic.....          | Less than 4%     |
| Organic Silt/Clay.....    | 4 - 12%          |
| Sedimentary Peat.....     | 12% - 50%        |
| Fibrous and Woody Peat... | More than 50%    |

#### Plasticity

| Term                 | Plastic Index |
|----------------------|---------------|
| None to Slight.....  | 0 - 4         |
| Slight.....          | 5 - 7         |
| Medium.....          | 8 - 22        |
| High to Very High .. | Over 22       |

The penetration resistance, N, is the summation of the number of blows required to effect two successive 6" penetrations of the 2" split-barrel sampler. The sampler is driven with a 140 lb. weight falling 30" and is seated to a depth of 6" before commencing the standard penetration test.

## SYMBOLS

### Drilling and Sampling

CS – Continuous Sampling  
RC – Rock Coring: Size AW, BW, NW, 2"W  
RQD – Rock Quality Designation  
RB – Rock Bit/Roller Bit  
FT – Fish Tail  
DC – Drove Casing  
C – Casing: Size 2 ½", NW, 4", HW  
CW – Clear Water  
DM – Drilling Mud  
HSA – Hollow Stem Auger  
FA – Flight Auger  
HA – Hand Auger  
COA – Clean-Out Auger  
SS - 2" Dia. Split-Barrel Sample  
2ST – 2" Dia. Thin-Walled Tube Sample  
3ST – 3" Dia. Thin-Walled Tube Sample  
PT – 3" Dia. Piston Tube Sample  
AS – Auger Sample  
WS – Wash Sample  
PTS – Peat Sample  
PS – Pitcher Sample  
NR – No Recovery  
S – Sounding  
PMT – Borehole Pressuremeter Test  
VS – Vane Shear Test  
WPT – Water Pressure Test

### Laboratory Tests

q<sub>a</sub> – Penetrometer Reading, tons/sq ft  
q<sub>a</sub> – Unconfined Strength, tons/sq ft  
W – Moisture Content, %  
LL – Liquid Limit, %  
PL – Plastic Limit, %  
SL – Shrinkage Limit, %  
LI – Loss on Ignition  
D – Dry Unit Weight, lbs/cu ft  
pH – Measure of Soil Alkalinity or Acidity  
FS – Free Swell, %

### Water Level Measurement

▽ - Water Level at Time Shown  
NW – No Water Encountered  
WD – While Drilling  
BCR – Before Casing Removal  
ACR – After Casing Removal  
CW – Cave and Wet  
CM – Caved and Moist

Note: Water level measurements shown on the boring logs represent conditions at the time indicated and may not reflect static levels, especially in cohesive soils.

# CGC, Inc.

Madison - Milwaukee

## Unified Soil Classification System

### UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

#### COARSE-GRAINED SOILS

(more than 50% of material is larger than No. 200 sieve size)

|                                                                                                                               |                                                                                                                                                      |
|-------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Clean Gravels (Less than 5% fines)                                                                                            |                                                                                                                                                      |
| <b>GRAVELS</b><br>More than 50% of coarse fraction larger than No. 4 sieve size                                               |  GW Well-graded gravels, gravel-sand mixtures, little or no fines   |
|                                                                                                                               |  GP Poorly-graded gravels, gravel-sand mixtures, little or no fines |
| Gravels with fines (More than 12% fines)                                                                                      |                                                                                                                                                      |
|  GM Silty gravels, gravel-sand-silt mixtures |                                                                                                                                                      |
|                                                                                                                               |  GC Clayey gravels, gravel-sand-clay mixtures                       |

|                                                                                                                        |                                                                                                                                                |
|------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| Clean Sands (Less than 5% fines)                                                                                       |                                                                                                                                                |
| <b>SANDS</b><br>50% or more of coarse fraction smaller than No. 4 sieve size                                           |  SW Well-graded sands, gravelly sands, little or no fines    |
|                                                                                                                        |  SP Poorly graded sands, gravelly sands, little or no fines |
| Sands with fines (More than 12% fines)                                                                                 |                                                                                                                                                |
|  SM Silty sands, sand-silt mixtures |                                                                                                                                                |
|                                                                                                                        |  SC Clayey sands, sand-clay mixtures                        |

#### FINE-GRAINED SOILS

(50% or more of material is smaller than No. 200 sieve size.)

|                                                       |                                                                                                                                                                                                           |
|-------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>SILTS AND CLAYS</b><br>Liquid limit less than 50%  |  ML Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity |
|                                                       |  CL Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays                  |
|                                                       |  OL Organic silts and organic silty clays of low plasticity                                                            |
| <b>SILTS AND CLAYS</b><br>Liquid limit 50% or greater |  MH Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts                                |
|                                                       |  CH Inorganic clays of high plasticity, fat clays                                                                      |
|                                                       |  OH Organic clays of medium to high plasticity, organic silts                                                          |
| <b>HIGHLY ORGANIC SOILS</b>                           |  PT Peat and other highly organic soils                                                                                |

### LABORATORY CLASSIFICATION CRITERIA

GW  $C_u = \frac{D_{60}}{D_{10}}$  greater than 4;  $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$  between 1 and 3

GP Not meeting all gradation requirements for GW

|    |                                                        |                                                                                             |
|----|--------------------------------------------------------|---------------------------------------------------------------------------------------------|
| GM | Atterberg limits below "A" line or P.I. less than 4    | Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols |
| GC | Atterberg limits above "A" line or P.I. greater than 7 |                                                                                             |

SW  $C_u = \frac{D_{60}}{D_{10}}$  greater than 4;  $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$  between 1 and 3

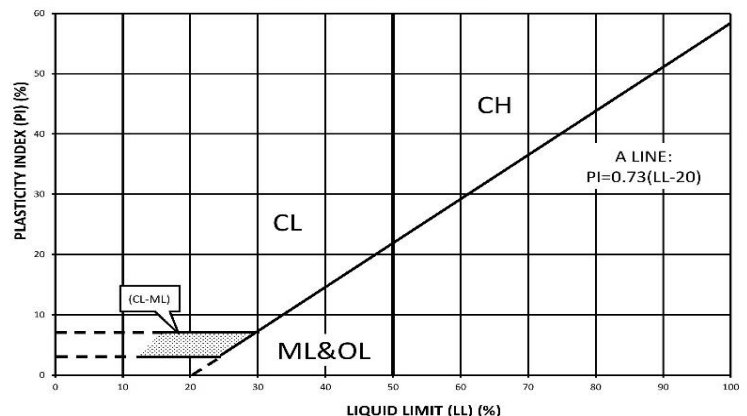
SP Not meeting all gradation requirements for GW

|    |                                                          |                                                                                                             |
|----|----------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| SM | Atterberg limits below "A" line or P.I. less than 4      | Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols |
| SC | Atterberg limits above "A" line with P.I. greater than 7 |                                                                                                             |

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent ..... GW, GP, SW, SP  
More than 12 percent ..... GM, GC, SM, SC  
5 to 12 percent ..... Borderline cases requiring dual symbols

### PLASTICITY CHART





## **APPENDIX C**

### **DOCUMENT QUALIFICATIONS**

## APPENDIX C

### DOCUMENT QUALIFICATIONS

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#### I. GENERAL RECOMMENDATIONS/LIMITATIONS

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CGC, Inc. should be provided the opportunity for a general review of the final design and specifications to confirm that earthwork and foundation requirements have been properly interpreted in the design and specifications. CGC should be retained to provide soil engineering services during excavation and subgrade preparation. This will allow us to observe that construction proceeds in compliance with the design concepts, specifications and recommendations, and also will allow design changes to be made in the event that subsurface conditions differ from those anticipated prior to the start of construction. CGC does not assume responsibility for compliance with the recommendations in this report unless we are retained to provide construction testing and observation services.

This report has been prepared in accordance with generally accepted soil and foundation engineering practices and no other warranties are expressed or implied. The opinions and recommendations submitted in this report are based on interpretation of the subsurface information revealed by the test borings indicated on the location plan. The report does not reflect potential variations in subsurface conditions between or beyond these borings. Therefore, variations in soil conditions can be expected between the boring locations and fluctuations of groundwater levels may occur with time. The nature and extent of the variations may not become evident until construction.

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#### II. IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

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Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes. While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. *No one except you* should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one - not even you* - should apply the report for any purpose or project except the one originally contemplated.

##### READ THE FULL REPORT

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

##### A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, *do not rely on a geotechnical engineering report* that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes - even minor ones - and request an assessment of their impact. *CGC cannot accept responsibility or liability for problems that occur because our reports do not consider developments of which we were not informed.*

##### SUBSURFACE CONDITIONS CAN CHANGE

A geotechnical engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

##### MOST GEOTECHNICAL FINDINGS ARE PROFESSIONAL OPINION

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgement to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ - sometimes significantly - from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most

effective method of managing the risks associated with unanticipated conditions.

#### **A REPORT'S RECOMMENDATIONS ARE NOT FINAL**

Do not over-rely on the confirmation-dependent recommendations included in your report. *Those confirmation-dependent recommendations are not final*, because geotechnical engineers develop them principally from judgement and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *CGC cannot assume responsibility or liability for the report's confirmation-dependent recommendations if we do not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

#### **A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION**

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical engineering report. Confront that risk by having CGC participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

#### **DO NOT REDRAW THE ENGINEER'S LOGS**

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

#### **GIVE CONSTRUCTORS A COMPLETE REPORT AND GUIDANCE**

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time to perform additional study.* Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

#### **READ RESPONSIBILITY PROVISIONS CLOSELY**

Some clients, design professionals, and constructors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic

expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineer's responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

#### **ENVIRONMENTAL CONCERNS ARE NOT COVERED**

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

#### **OBTAIN PROFESSIONAL ASSISTANCE TO DEAL WITH MOLD**

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention.*** ***Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

#### **RELY ON YOUR GEOTECHNICAL ENGINEER FOR ADDITIONAL ASSISTANCE**

Membership in the Geotechnical Business Council (GBC) of Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with CGC, a member of GBC, for more information.

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Geotechnical Business Council  
of the Geoprofessional Business Association  
8811 Colesville Road, Suite G 106  
Silver Spring, MD 20910

## **APPENDIX D**

### **RECOMMENDED COMPACTED FILL SPECIFICATIONS**

## **APPENDIX D**

### **CGC, INC.**

#### **RECOMMENDED COMPACTED FILL SPECIFICATIONS**

##### **General Fill Materials**

Proposed fill shall contain no vegetation, roots, topsoil, peat, ash, wood or any other non-soil material which by decomposition might cause settlement. Also, fill shall never be placed while frozen or on frozen surfaces. Rock, stone or broken concrete greater than 6 in. in the largest dimension shall not be placed within 10 ft of the building area. Fill used greater than 10 ft beyond the building limits shall not contain rock, boulders or concrete pieces greater than a 2 sq ft area and shall not be placed within the final 2 ft of finish subgrade or in designated utility construction areas. Fill containing rock, boulders or concrete pieces should include sufficient finer material to fill voids among the larger fragments.

##### **Special Fill Materials**

In certain cases, special fill materials may be required for specific purposes, such as stabilizing subgrades, backfilling undercut excavations or filling behind retaining walls. For reference, WisDOT gradation specifications for various types of granular fill are attached in Table 1.

##### **Placement Method**

The approved fill shall be placed, spread and leveled in layers generally not exceeding 10 in. in thickness before compaction. The fill shall be placed at moisture content capable of achieving the desired compaction level. For clay soils or granular soils containing an appreciable amount of cohesive fines, moisture conditioning will likely be required.

It is the Contractor's responsibility to provide all necessary compaction equipment and other grading equipment that may be required to attain the specified compaction. Hand-guided vibratory or tamping compactors will be required whenever fill is placed adjacent to walls, footings, columns or in confined areas.

##### **Compaction Specifications**

Maximum dry density and optimum moisture content of the fill soil shall be determined in accordance with modified Proctor methods (ASTM D1557). The recommended field compaction as a percentage of the maximum dry density is shown in Table 2. Note that these compaction guidelines would generally not apply to coarse gravel/stone fill. Instead, a method specification would apply (e.g., compact in thin lifts with a vibratory compactor until no further consolidation is evident).

##### **Testing Procedures**

Representative samples of proposed fill shall be submitted to CGC, Inc. for optimum moisture-maximum density determination (ASTM D1557) prior to the start of fill placement. The sample size should be approximately 50 lb.

CGC, Inc. shall be retained to perform field density tests to determine the level of compaction being achieved in the fill. The tests shall generally be conducted on each lift at the beginning of fill placement and at a frequency mutually agreed upon by the project team for the remainder of the project.

**Table 1**  
**Gradation of Special Fill Materials**

| Material   | WisDOT<br>Section 311     | WisDOT<br>Section 312         | WisDOT Section 305         |                                |                              | WisDOT Section 209              |                                 | WisDOT<br>Section 210 |
|------------|---------------------------|-------------------------------|----------------------------|--------------------------------|------------------------------|---------------------------------|---------------------------------|-----------------------|
|            | Breaker Run               | Select<br>Crushed<br>Material | 3-in. Dense<br>Graded Base | 1 1/4-in. Dense<br>Graded Base | 3/4-in. Dense<br>Graded Base | Grade 1<br>Granular<br>Backfill | Grade 2<br>Granular<br>Backfill | Structure<br>Backfill |
| Sieve Size | Percent Passing by Weight |                               |                            |                                |                              |                                 |                                 |                       |
| 6 in.      | 100                       |                               |                            |                                |                              |                                 |                                 |                       |
| 5 in.      |                           | 90-100                        |                            |                                |                              |                                 |                                 |                       |
| 3 in.      |                           |                               | 90-100                     |                                |                              |                                 |                                 | 100                   |
| 1 1/2 in.  |                           | 20-50                         | 60-85                      |                                |                              |                                 |                                 |                       |
| 1 1/4 in.  |                           |                               |                            | 95-100                         |                              |                                 |                                 |                       |
| 1 in.      |                           |                               |                            |                                | 100                          |                                 |                                 |                       |
| 3/4 in.    |                           |                               | 40-65                      | 70-93                          | 95-100                       |                                 |                                 |                       |
| 3/8 in.    |                           |                               |                            | 42-80                          | 50-90                        |                                 |                                 |                       |
| No. 4      |                           |                               | 15-40                      | 25-63                          | 35-70                        | 100 (2)                         | 100 (2)                         | 25-100                |
| No. 10     |                           | 0-10                          | 10-30                      | 16-48                          | 15-55                        |                                 |                                 |                       |
| No. 40     |                           |                               | 5-20                       | 8-28                           | 10-35                        | 75 (2)                          |                                 |                       |
| No. 100    |                           |                               |                            |                                |                              | 15 (2)                          | 30 (2)                          |                       |
| No. 200    |                           |                               | 2-12                       | 2-12                           | 5-15                         | 8 (2)                           | 15 (2)                          | 15 (2)                |

**Notes:**

1. Reference: Wisconsin Department of Transportation *Standard Specifications for Highway and Structure Construction*.
2. Percentage applies to the material passing the No. 4 sieve, not the entire sample.
3. Per WisDOT specifications, both breaker run and select crushed material can include concrete that is 'substantially free of steel, building materials and other deleterious material'.

**Table 2**  
**Compaction Guidelines**

| Area                                               | Percent Compaction (1) |             |
|----------------------------------------------------|------------------------|-------------|
|                                                    | Clay/Silt              | Sand/Gravel |
| <b><u>Within 10 ft of building lines</u></b>       |                        |             |
| Footing bearing soils                              | 93 - 95                | 95          |
| Under floors, steps and walks                      |                        |             |
| - Lightly loaded floor slab                        | 90                     | 90          |
| - Heavily loaded floor slab and thicker fill zones | 92                     | 95          |
| <b><u>Beyond 10 ft of building lines</u></b>       |                        |             |
| Under walks and pavements                          |                        |             |
| - Less than 2 ft below subgrade                    | 92                     | 95          |
| - Greater than 2 ft below subgrade                 | 90                     | 90          |
| Landscaping                                        | 85                     | 90          |

**Notes:**

1. Based on Modified Proctor Dry Density (ASTM D 1557)

For more location information  
please visit [www.strand.com](http://www.strand.com)

## Office Locations

Ames, Iowa | 515.233.0000

Brenham, Texas | 979.836.7937

Cincinnati, Ohio | 513.861.5600

Columbus, Indiana | 812.372.9911

Columbus, Ohio | 614.835.0460

Joliet, Illinois | 815.744.4200

Lexington, Kentucky | 859.225.8500

Louisville, Kentucky | 502.583.7020

Madison, Wisconsin\* | 608.251.4843

Milwaukee, Wisconsin | 414.271.0771

Nashville, Tennessee | 615.800.5888

Phoenix, Arizona | 602.437.3733

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