

**Dunes Community Development District
Water Treatment Plant**

Issue For Bid

**Reverse Osmosis Membrane
Feed Pump Replacement**

**Contract Documents and
Technical Specifications**

Volume 1 of 1

Prepared for:

***Dunes Community
Development District***

Issue Date:

September 2026



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TABLE OF CONTENTS

PROCUREMENT AND CONTRACTING DOCUMENTS GROUP

DIVISION 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS

000107	Seals Page
000110	Table of Contents
001116.16	Invitation to Bid
002113.16	Instructions to Bidders
003146	Permits
004113.16	Bid Form
005214.16	Agreement
006113.16	EJCDC – C-610 Performance Bond
006115.16	EJCDC – C-615 Payment Bond
007200.16	EJCDC – C-700 General Conditions
007300.16	Supplementary Conditions

SPECIFICATIONS GROUP

General Requirements Subgroup

DIVISION 01 - GENERAL REQUIREMENTS

011000	Summary
012500	Substitution Procedures
012600	Contract Modification Procedures
012900	Payment Procedures
013100	Project Management and Coordination
013200	Construction Progress Documentation
013233	Photographic Documentation
013300	Submittal Procedure
013513.24	Special Procedure for MOPO and Construction Sequence
014000	Quality Requirements
015000	Temporary Facilities and Controls
016000	Product Requirements
017700	Closeout Procedures
017823	Operation and Maintenance Data
017839	Project Record Documents
018839	Wind Performance Requirements

Facility Construction Subgroup

DIVISION 03 - CONCRETE

- 033010 Miscellaneous Cast-in-Place Concrete
- 036000 Grouting

DIVISION 05 - METALS

- 050519 Post-Installed Anchors and Reinforcing Bars
- 055000 Metal Fabrications

DIVISION 13 - SPECIAL CONSTRUCTION

- 133423.16 Fabricated Control Booths

Facility Services Subgroup

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

- 230513 Common Motor Requirements for HVAC Equipment
- 230529 Hangers and Supports for HVAC Piping and Equipment
- 230548.13 Vibration Controls for HVAC
- 230553 Identification for HVAC Piping and Equipment
- 230593 Testing, Adjusting, and Balancing for HVAC
- 232113 Hydronic Piping
- 233113 Metal Ducts
- 233300 Air Duct Accessories
- 233423 HVAC Power Ventilators
- 233713.23 Registers and Grilles
- 237416.11 Packaged, Small-Capacity, rooftop Air-Conditioning Units

DIVISION 26 - ELECTRICAL

- 260010 Supplemental Requirements for Electrical
- 260011 Facility Performance Requirements for Electrical
- 260505 Selective Demolition for Electrical
- 260510 Limited Electrical for Small Projects
- 260548 Vibration and Seismic Controls for Electrical Systems
- 260573 Power System Studies
- 262419.71 Motor Control Center Modifications
- 262813 Fuses
- 262816 Enclosed Switches and Circuit Breakers
- 262923.25 Variable-Frequency Motor Controllers Industrial
- 264313 Surge Protective Devices for Low-Voltage Electrical Power Circuits

Process Equipment Subgroup

DIVISION 40 - PROCESS INTERCONNECTIONS

- 400506 Couplings, Adapters, and Specials for Process Piping
- 400507 Hangers and Supports for Process Piping
- 400523 Stainless Steel Process Pipe and Tubing
- 400531 Thermoplastic Process Pipe

400563	Ball Valves
400565.35	Globe Body Silent Check Valves
400593.23	Low-Voltage Motor Requirements for Process Equipment
406100	Process Control and Enterprise Management Systems General Provisions
406121.20	Process Control System Testing
406733	Panel Wiring
406863	Configuration of HMI Software
406866	Configuration of Controller Software
407000	Instrumentation for Process Systems
407313	Pressure and Differential Pressure Gauges
407336	Pressure and Differential Pressure Switches

DIVISION 43 - PROCESS GAS AND LIQUID HANDLING, PURIFICATION AND STORAGE EQUIPMENT

432331.41	Vertical In-Line Multistage Centrifugal Pump
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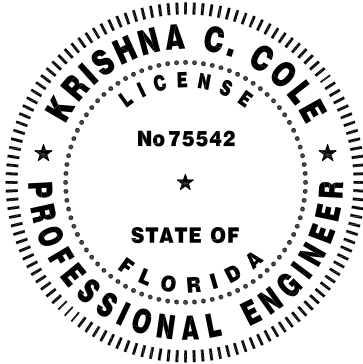
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DOCUMENT 000107 - SEALS PAGE

1.1 DESIGN PROFESSIONALS OF RECORD

A. Engineer:



This item has been digitally signed and sealed by
Krishna C. Cole on the date adjacent to the seal.
Signature must be verified on any electronic copies.

1. Krishna C. Cole.
2. License #75542.
3. Responsible for Divisions 01-49 Sections except where indicated as prepared by other design professionals of record.

B. Architect:



This item has been digitally signed and sealed by
Emily J. Oechslin on the date adjacent to the seal.
Signature must be verified on any electronic copies.

1. Emily Oechslin
2. License #AR98838
3. Responsible for Division 13.

C. Structural Engineer:



This item has been digitally signed and sealed by Kevin M. Francoforte on the date adjacent to the seal. Signature must be verified on any electronic copies.

1. Kevin M. Francoforte
2. License #73949
3. Responsible for Division 03 and 05 and Specification 018839

D. HVAC Engineer:



This item has been digitally signed and sealed by Joshua A. Garziona on the date adjacent to the seal. Signature must be verified on any electronic copies.

1. Joshua A. Garziona
2. License #82162
3. Responsible for Div 23

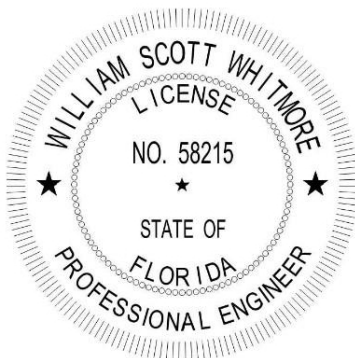
E. Electrical Engineer:



This item has been digitally signed and sealed by Spencer J. Perry on the date adjacent to the seal. Signature must be verified on any electronic copies.

1. Spencer J. Perry.
2. License #62587
3. Responsible for Division 26

F. Instrumentation and Controls Engineer:



This item has been digitally signed and sealed by William S. Whitmore on the date adjacent to the seal. Signature must be verified on any electronic copies.

1. William S. Whitmore
2. License #58215
3. Responsible for Specification sections 406100, 406121, 406733, 406863, 406866, 407000, 407313, 407336.

END OF DOCUMENT 000107

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SECTION 001116.16 - INVITATION TO BID (OUTSIDE OF MASS)

Dunes Community Development District (Name of Owner)

Reverse Osmosis Drinking Water Treatment Plant Refurbishments (Category of Improvement)

Reverse Osmosis Membrane Feed Pump Replacement (Contract Title)

2026-1 (Contract Number)

INVITATION TO BID

The Dunes Community Development District (OWNER) hereby invites qualified companies to submit bids for the Reverse Osmosis (RO) Feed Pump Replacement project that includes Work as summarized in Section 011000 and as required in the Contract Documents.

Work for this project at the OWNER's 1.44 MGD water treatment plant, located at 101 Jungle Hut Road, Palm Coast, FL, will replace four (4) existing single speed horizontal RO feed pumps with four (4) new vertical in-line RO feed pumps provided with speed control from four (4) new variable frequency drives (VFDs) installed in the existing electric room and associated wiring, piping, instrumentation, and valve modifications to relocate the pump and to install new pump bypass piping and valves. The project will also include the addition of a heated and cooled 10-foot by 14 foot in-plant modular office system to be installed as an operations control room within the existing administration building's maintenance room. The project will also include upgrades to the existing electrical room to accommodate the four (4) new VFDs; including modifications to the Motor Control Center (MCC-1), conduit and wiring from the pump motors and VFDs, replacement of the electric room's air conditioning system and ductwork, installation of housekeeping pads for the new VFDs, and electrical supply for the new operator control room. In addition, the four (4) existing RO process room ventilation fans will be replaced.

Deadline for Bids is October 6, 2026 by 2:00 PM. Bids shall be sent via email to Krishna Cole colekc@cdmsmith.com and a hard copy with bid security delivered to OWNER at 101 Jungle Hut Road, Palm Coast, FL 32137. Both the electronic and hard copy bids received after this deadline will not be considered.

Mandatory Pre-Bid Site Visit: Prospective bidders shall contact Earl Nash by phone at (386) 445-9045 or via email at enash@dunescdd.org to schedule a site visit. No site visits shall be scheduled after September 22, 2026 4:30 PM.

A Non-Mandatory Pre-Bid Conference will be held on September 15, 2026, at 9:00 AM at 101 Jungle Hut Road, Palm Coast, FL 32137 to discuss the requirements of the Contract Documents.

All technical questions related to this project should be directed in writing to Krishna Cole, PE, PMP by email at colekc@cdmsmith.com. Any questions regarding the procurement documents shall be directed to Krishna Cole, PE, PMP by email at colekc@cdmsmith.com. Deadline for questions is September 22, 2026 4:30 PM. Final Addendum to be issued by September 29, 2026 at 4:30 PM.

Bid documents include FEMA contract provisions for Public Assistance (PA) Grant Funds (see 005214.16A). Contractor shall follow all applicable State and Federal contract requirements to maintain compliance with the PA Grant requirements.

A Florida Department of Environmental Protection (FDEP) Permit to construct Potable Water System Components using Form 62-555.900(1) has been obtained (see 003146A). Contractor is required to obtain all applicable Flagler County Building Permits.

Each Bid shall be submitted in accordance with the Instructions to Bidders and shall be accompanied by a Bid Security in the amount of five percent (5%) of the Bid.

Bidders may not withdraw their Bids for a period of thirty days, excluding Saturdays, Sundays, and legal holidays after the actual date of the opening of the Bids.

The Successful Bidder must furnish a 100 percent Performance Bond and a 100 percent Payment Bond with a surety company acceptable to the Owner.

The work shall be awarded to the lowest responsible and responsive bidder whose qualifications shall enable the OWNER to take into consideration the proven skill and experience of the Bidder, facilities for satisfying the work, previous satisfactory performance, and such other abilities of the Bidder as will enable them to provide the Equipment/Material and applicable service. The OWNER reserves the right to waive any information in or to reject any or all Bids if deemed to be in its best interest.

Complete instructions for filing Bids are included in the Instructions to Bidders.

END OF DOCUMENT 001116.16

COVERSHEET

SECTION 002113.16 - INSTRUCTIONS TO BIDDERS

Dunes Community Development District (Name of Owner)

Reverse Osmosis Drinking Water Treatment Plant Refurbishments (Category of Improvements)

Reverse Osmosis Membrane Feed Pump Replacement (Contract Title)

2026-1 (Contract Number)

INSTRUCTIONS TO BIDDERS

ARTICLE 1. QUALIFICATIONS OF BIDDERS

1.1 Bidders may be investigated by OWNER to determine if they are qualified to perform the Work. All Bidders shall be prepared to submit within five days of OWNER's or ENGINEER's request, written evidence of such information and data necessary to make this determination.

1.2 The investigation of a Bidder will seek to determine whether the organization is adequate in size, is authorized to do business in the jurisdiction where the project is located, has had previous experience and whether available equipment and financial resources are adequate to assure OWNER that the Work will be completed in accordance with the terms of the Agreement. The amount of other work to which the Bidder is committed may also be considered.

1.3 In evaluating Bids, OWNER will consider the qualifications of only those Bidders whose Bids are in compliance with the prescribed requirements.

1.4 OWNER reserves the right to reject any Bid if the evidence submitted by, or the 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.

1.5 Licenses and Certification:

- (a) Valid Florida General Contractor license.
- (b) Certification from the appropriate authority for working with drinking water treatment systems.

1.6 Experience:

- (a) Bidder shall have a minimum of five (5) years of experience performing water treatment plant construction, rehabilitation, or equipment replacement projects.
- (b) Bidder shall have successfully completed a minimum of three (3) projects of similar size and complexity involving reverse osmosis systems, high-pressure or membrane feed pumps, VFDs, and associated electrical and controls modifications. At least two (2) projects shall have been performed at an operational drinking water treatment facility. Required reference information:

- a. Owner name and contact information
- b. Project name and location

- c. Construction value
- d. Year completed
- e. Description of work

1.7 Equipment, Resources, and Personnel:

- (a) Adequate manpower and resource for drinking water treatment plant refurbishments, ensuring timely project completion.
- (b) Experienced project managers, engineers, and foremen with a proven track record in drinking water treatment plant refurbishments. Provide resumes for:
 - a. Project Manager
 - b. Superintendent/Foreman
 - c. Electrical Lead/Superintendent
 - d. Process Control Lead
- (c) Training, licenses, and certifications for all personnel executing the work defined in these contract documents. Contractor must disclose:
 - a. OSHA citations classified as serious, willful, or repeat within five years
 - b. OSHA recordable incident rates for the last three years
 - c. EMR

1.8 Safety and Compliance:

- (a) Clean safety record with no major OSHA violations in the past 5 years.
- (b) Adherence to all federal, state, and local laws and regulations governing drinking water treatment plants and environmental standards.

ARTICLE 2. COPIES OF CONTRACT DOCUMENTS

2.1 Complete sets of Contract Documents shall be used in preparing Bids; neither OWNER nor ENGINEER assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Contract Documents.

2.2 OWNER and ENGINEER in making copies of Contract Documents available do so only for the purpose of obtaining Bids on the Work and do not confer a license or grant for any other use.

ARTICLE 3. EXAMINATION OF CONTRACT DOCUMENTS AND SITE

3.1 Before submitting a Bid, each Bidder must (a) examine the Contract Documents thoroughly, (b) visit the site to become familiar with local conditions that may in any manner affect cost, progress or performance of the Work, (c) become familiar with Federal, State and local laws, ordinances, rules and regulations that may in any manner affect cost, progress or performance of the Work; and (d) study and carefully correlate Bidder's observations with the requirements of the Contract Documents.

3.2 Before submitting a Bid, Bidders may, at their own expense, make such additional investigations and tests as they may deem necessary to determine their Bid for performance of the Work in accordance with the time, price and other terms and conditions of the Contract Documents.

3.3 On request, OWNER will provide each Bidder access to the site to conduct such investigations and tests as each Bidder deems necessary for the submission of a Bid.

3.4 The lands upon which the Work is to be performed, rights-of-way for access thereto and other lands designated for use by CONTRACTOR in performing the Work are identified in the Supplementary Conditions, General Requirements or on the Drawings.

3.5 The submission of a Bid will constitute an incontrovertible representation that the Bidder has complied with every requirement of this Article 3 and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance of the Work.

ARTICLE 4. INTERPRETATIONS

4.1 All questions about the meaning or intent of the Contract Documents shall be received in writing to CDM Smith, via email to colekc@cdmsmith.com Attn: Krishna Cole at least ten days before the date set herein for the opening of bids.

4.2 Written clarifications or interpretations will be issued by Addenda not later than five days before the bid opening date. Only questions answered by formal written Addenda will be binding. Oral and other clarifications or interpretations will be without legal effect. Addenda will be emailed to all parties recorded as having received the Contract Documents.

4.3 Bidders are responsible for determining that they have received all Addenda issued.

ARTICLE 5. PRE-BID CONFERENCE

5.1 A pre-bid conference will be held on **September 15, 2026 at 9:00 AM at 101 Jungle Hut Road, Palm Coast, FL 32137** to discuss the requirements of the Contract Documents.

ARTICLE 6. BID SECURITY

6.1 Each Bid must be accompanied by cash, bid bond, or a certified check on, or a treasurer's or cashier's check issued by, a responsible bank or trust company, payable to OWNER. The Bid Security shall be in the amount stated in the Invitation to Bid. Bid Security shall be sealed in a separate envelope from the Bid and then attached to the envelope containing the Bid. All Bid Securities except those of the three lowest responsible and eligible Bidders will be returned within five days, Saturdays, Sundays, and legal holidays excluded, after opening of the Bids. All Bid Securities will be returned on the execution of the Agreement or if no award is made, within thirty days, excluding Saturdays, Sundays and legal holidays after the actual date of opening of the Bids, unless forfeited under the conditions herein stipulated.

6.2 In case a party to whom a Contract is awarded shall fail or neglect to execute the Agreement and furnish the satisfactory bonds within the time specified, OWNER may determine that the Bidder has abandoned the Contract, and thereupon the Bid Forms and acceptance shall be null and void and the Bid Security accompanying the Bid Form shall be forfeited to OWNER as liquidated damages for such failure or neglect and to indemnify said OWNER for any loss which may be sustained by failure of the Bidder to execute the Agreement and furnish the bonds as aforesaid, provided that the amount forfeited to OWNER shall not exceed the difference between the Bid Price of said Bidder and that of the next lowest responsible and eligible bidder and provided further that, in case of death, disability, or other unforeseen circumstances affecting the Bidder, such Bid Security may be returned to the Bidder. After execution of

the Agreement and acceptance of the bonds by OWNER, the Bid Security accompanying the Bid Form of the Successful Bidder will be returned.

ARTICLE 7. PERFORMANCE, PAYMENT AND OTHER BONDS

7.1 Performance, Payment and other Bonds shall be provided in accordance with Article 6 of the Conditions of the Contract.

7.2 All Bonds required as Contract Security shall be furnished with the executed Agreement.

7.3 Permit fees will be reimbursed by the OWNER, but not for re-inspections which will only be paid once.

ARTICLE 8. BID FORM

8.1 Each Bid shall be submitted on the Bid Form on the perforated pages appended to the Project Manual. The Bid Form shall be removed and submitted separately. All blank spaces for Bid prices must be filled in with the unit price for the item or the lump sum for which the Bid is made.

8.2 Bid Forms shall be completed in ink or by typewriter. The Bid price of each item on the form shall be stated in words, and figures. If unit prices are required on the Bid Form, discrepancies between unit prices and their respective total amounts will be resolved in favor of the unit prices. Discrepancies between words and figures will be resolved in favor of words. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

8.3 Bids by corporations shall be executed in the corporate name by the president or a vice-president (or other corporate officer accompanied by evidence of authority to sign) and the corporate seal shall be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown below the signature.

8.4 Bids by Limited Liability Companies shall be executed in the Limited Liability name by the Manager (or other Limited Liability Company officer/representative accompanied by evidence of authority to sign.) The Limited Liability Company address and state where the Limited Liability Company was formed shall be shown below the signature.

8.5 Bids by partnerships shall be executed in the partnership name and signed by a partner, whose title shall appear under the signature. The official address of the partnership shall be shown below the signature.

8.6 All names shall be typed or printed below the signature.

8.7 The Bid shall contain an acknowledgement of receipt of all Addenda (the numbers of which shall be filled in on the Bid Form).

8.8 The address to which communications regarding the Bid are to be directed shall be shown.

8.9 Bids shall be submitted via email to Krishna Cole at colekc@cdmsmith.com by October 6, 2026 by 02:00 PM and a hardcopy with bid security delivered to the Owner at 101 Jungle Hut Road, Palm Coast, FL 32137. Both the electronic and hard copy bids received after this deadline will not be considered.

ARTICLE 9. RECEIPT OF BIDS

9.1 Sealed Bids for the work of this Contract will be received at the time and place indicated in the Invitation to Bid.

9.2 OWNER may consider informal any Bid not prepared and submitted in accordance with the provisions hereof.

9.3 Bidders are cautioned that it is the responsibility of each individual bidder to assure that their bid is in the possession of the responsible official or the designated alternate prior to the stated time and at the place of the Bid Opening. Owner is not responsible for bids delayed by mail and/or delivery services, of any nature.

ARTICLE 10. MODIFICATION AND WITHDRAWAL OF BIDS

10.1 Bids may be modified only 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 at any time prior to the opening of Bids.

10.2 Bids may be withdrawn prior to the scheduled time (or authorized postponement thereof) for the opening of Bids.

10.3 Any Bid received after the time and date specified for receiving bids shall not be considered. No Bid may be withdrawn for a period of 120 days after the actual date of the opening of the Bids.

ARTICLE 11. AWARD OF CONTRACT

11.1 The Contract will be awarded to the lowest responsible and eligible Bidder (Successful Bidder). Such a Bidder shall possess the skill, ability, and integrity necessary for the faithful performance of the work. The term "lowest responsible and eligible Bidder" as used herein shall mean the Bidder whose Bid is the lowest of those Bidders possessing the skill, ability and integrity necessary to the faithful performance of the Work.

11.2 OWNER reserves the right to reject any and all Bids, to waive any and all informalities if it is in Owner's best interest to do so, and the right to disregard all nonconforming, non-responsive or conditional Bids.

11.3 A Bid which includes for any item a Bid Price that is abnormally low or high may be rejected as unbalanced.

11.4 OWNER also reserves the right to reject the Bid of any Bidder that OWNER considers to be unqualified relative to Article 1 above.

11.5 If the Contract is to be awarded, OWNER will give the Successful Bidder a Notice of Award within thirty days, excluding Saturdays, Sundays, and legal holidays, after the actual date of the opening of the Bids. All bids shall remain open for thirty days, excluding Saturdays, Sundays, and legal holidays, after the actual date of the opening of the Bids but OWNER may, at OWNER's sole discretion, release any Bid and return the Bid Security prior to that date.

ARTICLE 12. EXECUTION OF AGREEMENT

12.1 When OWNER gives a Notice of Award to the Successful Bidder, it will be accompanied by at least six unsigned copies of the Agreement and all other applicable Contract Documents. Within five days, excluding Saturdays, Sundays and legal holidays, after the date of receipt of such notification CONTRACTOR shall execute and return all copies of the Agreement and all other applicable Contract Documents to OWNER.

ARTICLE 13. SAFETY AND HEALTH REGULATIONS

13.1 This project is subject to the Safety and Health Regulations (CFR 29, Part 1926 and all subsequent amendments) as promulgated by the U.S. Department of Labor on June 24, 1974 and CFR 29, Part 1910, General Industry Safety and Health Regulations Identified as Applicable to Construction.

13.2 The Successful Bidder shall comply with the Department of Labor Safety and Health Regulations for Construction promulgated under the Occupational Safety and Health Act of 1970 (PL-91-596) and under Section 107 of the Contract Work Hours and Safety Standards Act (PL-91-54).

13.3 The Successful Bidder shall have a competent person or persons, as required under the Occupational Safety and Health Act, on the Site to inspect the Work and to supervise the conformance of the Work with the regulations of the Act.

ARTICLE 14. FEMA CONTRACT PROVISIONS (IF APPLICABLE)

14.1 At this time the OWNER has not requested funding from FEMA for this project. However, in the event that FEMA funding is provided for this project, the Successful Bidder shall comply with the FEMA Contract Provisions included in Exhibit A for Public Assistance Grant Funding.

ARTICLE 15. AMERICAN IRON AND STEEL REQUIREMENT

15.1 PART NOT USED

ARTICLE 16. BONDS AND INSURANCE

16.1 Upon award of the contract, the Bidder, simultaneously with the execution of the Agreement, shall furnish certificates of insurance, insurance certification, performance bond, and payment bond. The forms of the bonds and insurance certification, including bond amounts and duration and insurance coverage required are included in the Bidding Documents.

16.2 The Successful Bidder shall, before commencing the work, record said Payment and Performances Bond in the public records of the County where the improvement is located in accordance with FS 255.05.

ARTICLE 17. CONTRACT TIME – LIQUIDATED DAMAGES

17.1 The following will be made a part of the Agreement:

The Contractor shall have five (5) days to return the signed Agreement from the time the Contractor receives a “Notice of Award”. The OWNER will return a “fully executed” Agreement to the Contractor no later than five (5) days after the return of the executed Agreement originals.

The Contractor will furnish a recorded original of the Public Construction Bond three (3) business days after receipt of the fully executed Contract (the Public Construction Bond must be recorded after

the Contract is fully executed by all parties including the County Clerk). Upon receipt of the recorded Public Construction Bond, the OWNER will issue a Notice to Proceed. If the Contractor fails to meet any of the dates and timeframes set forth in this section, or fails to execute the Contract, or to provide a Public Construction Bond, the City may elect at its option to consider the Contractor non-responsive and Contract with the next best Bidder.

The work to be performed per the project, under this Agreement, shall be commenced within ten (10) calendar days of the date of the Notice to Proceed, in writing for the project

17.2 Substantial Completion shall be **within 365 days from Notice to Proceed (NTP).**

17.3 Final completion for the project shall be thirty (30) consecutive calendar days after substantial completion.

17.4 Conditions under which Liquidated Damages are Imposed:

Should the Contractor or, in case of his default, the Surety fail to complete the work within the time stipulated in the contract, or within such extra time as may have been granted by the OWNER, the Contractor or, in case of his default, the Surety shall pay to the OWNER, not as a penalty but as liquidated damages, the amount of \$2,000 per day for each calendar day beyond the Contract Limit for Substantial Completion or extension or extension and thereof that the work remains incomplete in accordance with the terms of the Agreement. Contractor or, in case of his default, the Surety shall pay to the OWNER, not as a penalty but as liquidated damages, the amount of \$500 per day for each calendar day beyond the Contract Limit for Final Completion or extension or extension and thereof that the work remains incomplete in accordance with the terms of the Agreement.

All additional fees and costs incurred by the Engineer and OWNER resulting from the Contractor's failure to complete the work will be charged to the Contractor.

ARTICLE 18. APPROVED HOURS OF OPERATION

18.1 The approved hours of operation for construction activities for this project are Monday through Friday from 7 AM to 3:30 PM and shall not include holidays observed by the OWNER. Overtime, holiday, nighttime, or weekend hours must be approved in advance by OWNER on a case-by-case basis.

ARTICLE 19. PROJECT SCHEDULE

Bidders are to include with their Bid a detailed construction schedule for the project from Notice to Proceed through Final Completion in number of days. The Schedule shall include activities for procurement of major material items - submittals and approval, manufacture, and delivery; right of way permitting; mobilization and clearing and grubbing; construction sequencing, planned utility outages, and restoration; cleaning, pressure testing, and clearance; and all other activities to indicate how the Bidder intends to perform the project within the allotted contract time. The duration and schedule of project shall be given due consideration in the selection of Contractor.

END OF DOCUMENT 002113.16

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SECTION 003146 - PERMITS

1.1 PERMIT INFORMATION

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of the Bidders' own investigations. This Document and its attachments are not part of the Contract Documents.
- B. Permit: 62-555.900(1) Application for a Specific Permit to Construct Potable Water System Components shall be obtained by the OWNER.
- C. Permit: All applicable Flagler County Building Permits shall be obtained by the contractor.

END OF SECTION 003146

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SECTION 004113.16 - BID FORM

BID FORM
TO

Dunes Community Development District (Name of Owner)

Reverse Osmosis Drinking Water Treatment Plant Refurbishments (Category of Improvements)

Reverse Osmosis Membrane Feed Pump Replacement (Contract Title)

2026-1 (Contract Number)

The undersigned declares that the only persons or parties interested in this Bid as principals are as stated; that the Bid is made without any collusion with other persons, firms, or corporations; that all the Contract Documents as prepared by CDM Smith, 4651 Salisbury Rd, Suite 420, Jacksonville, FL 32256 and dated September 2026 have been carefully examined; that the undersigned is fully informed in regard to all conditions pertaining to the Work and the place where it is to be done, and from them the undersigned makes this Bid. These prices shall cover all expenses incurred in performing the Work required under the Contract Documents, of which this Bid Form is a part.

If a Notice of Award accompanied by at least six unsigned copies of the Agreement and all other applicable Contract Documents is delivered to the undersigned within 120 days after the actual date of the opening of the Bids, the undersigned will within five days, excluding Saturdays, Sundays, and legal holidays, after the date of receipt of such notification, execute and return all copies of the Agreement and all other applicable Contract Documents to OWNER. The premiums for all Bonds required shall be paid by CONTRACTOR and shall be included in the Contract Price. The undersigned Bidder further agrees that the Bid Security accompanying this Bid shall become the property of OWNER if the Bidder fails to execute the Agreement as stated above.

The undersigned hereby agrees that the Contract Time shall commence twenty days following the Effective Date of the Agreement and to fully complete the Work within the calendar days (submitted by the Bidder) from the Effective Date of the Agreement and in accordance with the terms as stated in the Agreement. The undersigned further agrees to pay OWNER, as liquidated damages, \$2,000 per day for each calendar day beyond Substantial Completion or extension thereof that the Work remains incomplete, in accordance with the terms of the Agreement. Additionally, the undersigned further agrees to pay OWNER, as liquidated damages, \$500 per day for each calendar day beyond Final Completion or extension thereof that the Work remains incomplete, in accordance with the terms of the Agreement.

The undersigned acknowledges receipt of addenda numbered:

In accordance with the above understanding, the undersigned proposes to perform the Work, furnish all materials and complete the Work in its entirety in the manner and under the conditions required at the prices listed as follows:

FOR: Construction of the REVERSE OSMOSIS MEMBRANE FEED PUMP REPLACEMENT in accordance with the plans and specifications.

All bid items shall include costs and baseline schedule for installing all materials, equipment, and supplies necessary to complete the Work. Bid items shall also include all other labor, permit fees, taxes, insurance, miscellaneous costs, overhead, and profit.

Bidders are instructed to provide a Lump Sum Total price on this bid form.

List the equipment information included in the Lump Sum Total (all information is to be filled in including bid alternate information):

Modular Office Make: _____ Model No.: _____ Qty 1
Electric Room AC Package Unit Make: _____ Model No.: _____ Qty 1
4" – SS Butterfly Valve Make: _____ Model No.: _____ Qty 4
4" – SS Globe Silent Check Valve Make: _____ Model No.: _____ Qty 4
Process Room Vent Fans Make: _____ Model No.: _____ Qty 4
VFD Make: _____ Model No.: _____ Qty 4
Pump Motor Make: _____ Model No.: _____ Qty 5
Vertical Inline Pump Make: Afton Pumps Inc. Model No.: _____ Qty 5

Mark acknowledging ☐ YES, I understand the fifth vertical inline pump and motor is a spare and installation cost for the spare is not included in the Lump Sum Total. Owner reserves the right to self-purchase the spare pump and motor.

In accordance with the above understanding, the undersigned proposes to perform the Work of the project as submitted with this bid form. The successful Bidder will furnish all materials, and complete the Work in its entirety in the manner and under the conditions required:

Lump Sum Total: \$ _____
(amount numerically)

Deduct to Lump Sum Total for self-purchase of spare: \$(_____)
(amount numerically)

Provide the following information for a bid alternate if Grundfos feed pumps are selected by OWNER.

Grundfos Vertical Inline Multistage Pump & Motor Model No.: _____ Qty 5

Deduct to Lump Sum Total for Bid Alternate: \$(_____)
(amount numerically)

The undersigned agrees that extra work, if any, will be performed and will be paid for in accordance with Article 11 of the General Conditions of the Contract.

The above prices shall include all labor, materials, equipment, delegated design, fabrications, removal, overhead, profit, insurance and incidentals required to complete the Work.

The names and residences of all persons and parties interested in the foregoing Bid as principals are as follows: (Give first and last names in full. In the case of a corporation, see Article 8.3 of the Instructions to Bidders, in the case of a limited liability company [LLC], see Article 8.4 of the Instructions to Bidders, in the case of a partnership, see Article 8.5 of the Instructions to Bidders.)

The undersigned hereby certifies that he/she is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the work.

The undersigned hereby certifies under the penalties of perjury that this bid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used in this section, the word "person" shall mean any natural person, joint venture, partnership, corporation, or other business or legal entity.

Social Security Number
or Federal Identification
Number

Signature of Individual or
Corporate Name

By: _____
Corporate Officer
(if applicable)

Notice of acceptance should be mailed, faxed, or delivered to the following:

(Name)

By: _____
(Title)

(Business Address)

(City and State)

Date _____

If the Bidder is a corporation, indicate State of incorporation under signature, and affix corporate seal; if a partnership, give full names and residential addresses, if different from business address.

END OF SECTION 004113.16

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SECTION 005214.16 - AGREEMENT

Dunes Community Development District (Name of Owner)

Reverse Osmosis Drinking Water Treatment Plant Refurbishments (Category of Improvements)

Reverse Osmosis Membrane Feed Pump Replacement (Contract Title)

2026-1 (Contract Number)

AGREEMENT

THIS AGREEMENT made as of the _____ day of _____ in the year 20__ by and

between Dunes Community Development District

with legal address and principal place of business at 101 Jungle Hut Road, Palm Coast, FL 32137

hereinafter called OWNER and _____

with legal address and principal place of business at _____

_____ hereinafter called CONTRACTOR. OWNER and CONTRACTOR in consideration of the mutual covenants hereinafter set forth, agree as follows:

ARTICLE 1. WORK

1.1 CONTRACTOR shall perform the Work as specified or indicated in the Contract Documents. The Work is as described below:

The project, at the OWNER's 1.44 MGD water treatment plant, located at 101 Jungle Hut Road, Palm Coast, FL, will replace four (4) existing single speed horizontal RO feed pumps with four (4) new vertical in-line RO feed pumps provided with speed control from four (4) new variable frequency drives (VFDs) installed in the existing electric room and associated wiring, piping, instrumentation, and valve modifications to relocate the pump and to install new pump bypass piping and valves. The project will also include the addition of a heated and cooled 10-foot by 14 foot in-plant modular office system to be installed as an operations control room within the existing administration building's maintenance room. The project will also include upgrades to the existing electrical room to accommodate the four (4) new VFDs; including modifications to the Motor Control Center (MCC-1), conduit and wiring from the pump motors and VFDs, replacement of the electric room's air conditioning system and ductwork, installation of housekeeping pads for the new VFDs, and electrical supply for the new operator control room. In addition, the four (4) existing RO process room ventilation fans will be replaced.

ARTICLE 2. ENGINEER

2.1 The Project has been designed by CDM Smith Inc. who will act as ENGINEER in connection with completion of the Work in accordance with the Contract Documents.

ARTICLE 3. CONTRACT TIME

3.1 The Work will be Substantially Completed at least **365 calendar days** from the date of this Agreement and Final Completion will be 30 calendar days from Substantial Completion.

3.2 CONTRACTOR agrees that the Work shall be prosecuted regularly, diligently and uninterruptedly and at such rate of progress as will ensure Substantial Completion thereof within the Contract Time stated above. It is expressly understood and agreed, by and between CONTRACTOR and OWNER that the Contract Time is reasonable for the completion of the Work, taking into consideration equipment and material lead times, CONTRACTORs labor availability, local weather, OWNER's hours of operation, coordination activities with the OWNER, permit requirements, and the plant operational requirements and construction sequencing as outlined in Section 013513.24 Special Procedure for Maintenance of Plant Operations and Construction Sequencing.

ARTICLE 4. CONTRACT PRICE.

4.1 OWNER will pay CONTRACTOR for performance of the Work in accordance with the Contract Documents in current funds at the Lump Sum Price agreed upon in the CONTRACTOR's Bid Form attached to this Agreement.

ARTICLE 5. APPLICATIONS FOR PAYMENT

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

ARTICLE 6. PROGRESS AND FINAL PAYMENTS

6.1 OWNER will make progress payments on account of the Contract Price on the basis of CONTRACTOR's Applications for Payment as recommended by ENGINEER, monthly during construction as provided below. All progress payments will be on the basis of the progress of the Work measured by the schedule of values provided for in Paragraph 15.01. of the Conditions of the Contract.

6.2 Prior to Substantial Completion, progress payments will be in an amount equal to ninety-five percent (95%) of the value of the Work completed and ninety five percent (95%) of the value of materials and equipment not incorporated in the Work but delivered and suitably stored, less, in each case, the aggregate of payments previously made.

6.3 Upon Substantial Completion, OWNER will pay an amount sufficient to increase total payments to CONTRACTOR to ninety-nine percent (99%) of the Contract Price, less retainages as ENGINEER shall determine, in accordance with Paragraph 15.01. of the Conditions of the Contract.

6.4 Upon final inspection and acceptance of the Work, in accordance with Paragraph 15.06. of the Conditions of the Contract, OWNER will pay the remainder of the Contract Price as recommended by ENGINEER.

6.5 Acceptable Record Drawings shall be submitted with Payment Applications or Payment will be withheld. Acceptable shall be solely defined by the OWNER.

ARTICLE 7. LIQUIDATED DAMAGES

7.1 OWNER and CONTRACTOR recognize that time is of the essence of this Agreement and that OWNER will suffer financial loss if the Work is not completed within the Contract Time specified in Article 3 above, plus any extensions thereof allowed in accordance with Article 11 of the General Conditions. They 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) CONTRACTOR shall pay OWNER \$2,000 per day for each calendar day of delay until the Work is Substantially Complete. Additionally, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty), after Substantial Completion, CONTRACTOR shall pay OWNER \$500 per day for each calendar day of delay until the Work is Finally Complete.

7.2 Provided, that CONTRACTOR shall not be charged with liquidated damages or any excess cost when the delay in completion of the Work is for reasons included in Paragraph 4.05. of the General Conditions.

7.3 Provided, further, that CONTRACTOR shall furnish OWNER the required notification of such delays in accordance with Paragraph 11.06. of the General Conditions.

ARTICLE 8. ASSURANCE

8.1 CONTRACTOR has familiarized himself with the nature and extent of the Contract Documents, Work, locality, and with all local conditions and Federal, State and local laws, ordinances, rules and regulations that in any manner may affect cost, progress or performance of the Work.

8.2 CONTRACTOR has studied carefully all reports of investigations and tests of subsurface and latent physical conditions at the site or otherwise affecting cost, progress or performance of the Work which were relied upon by ENGINEER in the preparation of the Drawings and Specifications and which have been identified in Article 5 of the Supplementary Conditions.

8.3 CONTRACTOR has made or caused to be made examinations, investigations and tests and studies of such reports and related data [in addition to those referred to in the above paragraph] as CONTRACTOR deems necessary for the performance of the Work at the Contract Price within the Contract Time and in accordance with the other terms and conditions of the Contract Documents; and no additional examinations, investigations, tests, reports or similar data are or will be required for such purposes.

8.4 CONTRACTOR has correlated the results of all such observations, examinations, investigations, tests, reports and data with the terms and conditions of the Contract Documents.

8.5 CONTRACTOR has given ENGINEER written notice of any conflict, error or discrepancy that CONTRACTOR has discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to CONTRACTOR.

8.6 CONTRACTOR agrees that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance of the Work.

ARTICLE 9. CONTRACT DOCUMENTS

9.1 The Contract Documents which comprise the Contract between OWNER and CONTRACTOR are attached hereto and made a part hereof and consist of the following:

9.1.1 Invitation To Bid.

9.1.2 Instructions To Bidders.

9.1.3 Bid Form.

9.1.4 This Agreement.

9.1.5 Performance Bond, EJCDC Document C-610, 2018 edition, Payment Bond, EJCDC Document C-615, 2018 edition, and other required Bonds.

9.1.6 General Conditions, EJCDC Document No. C-700, 2018 edition.

9.1.7 Supplementary Conditions.

9.1.8 Specifications (as listed in Table of Contents).

9.1.9 Drawings, numbered Sheets G-0 through G-1, A-1 through A-2, S-1, M-1 through M-5, MD-1, H-1 through H-4, HD-1, E-1 through E-10, ED-1, I-1 through I-5, and ID-1 inclusive and dated September 2026.

9.1.10 Addenda Number(s) #.

9.1.11 Any modification, including Change Orders, duly delivered after execution of Agreement.

ARTICLE 10. MISCELLANEOUS

10.1 Terms used in this Agreement which are defined in Article 1 of the Conditions of the Contract shall have the meanings assigned in the Conditions of the Contract.

10.2 Neither OWNER nor CONTRACTOR shall, without the prior written consent of the other, assign or sublet in whole or in part any interest under any of the Contract Documents; and, specifically but without limitation, CONTRACTOR shall not assign any monies due or to become due without the prior written consent of OWNER. In case CONTRACTOR assigns all or any part of any monies due or to become due under this Contract, the instrument of assignment shall contain a clause substantially to the effect that it is agreed that the right of the assignee in and to any monies due or to become due to CONTRACTOR shall be subject to prior claims of all persons, firms and corporations for services rendered or materials supplied for the performance of the Work called for in this Contract.

10.3 OWNER and CONTRACTOR each binds themselves, their partners, successors, assigns and legal representatives in respect to all covenants, agreements and obligations contained in the Contract Documents.

10.4 The Contract Documents constitute the entire agreement between OWNER and CONTRACTOR and may only be altered, amended or repealed by a Modification.

ARTICLE 11. FEDERAL REQUIREMENTS

11.1 During the performance of this contract, the CONTRACTOR agrees to the Equal Employment Opportunity Act as follows:

(1) The CONTRACTOR will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, or national origin. The CONTRACTOR will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, sexual orientation, gender identity, or national origin. Such action shall include, but not be limited to the following: Employment, upgrading, demotion, or transfer, recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The CONTRACTOR agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.

(2) The CONTRACTOR will, in all solicitations or advertisements for employees placed by or on behalf of the CONTRACTOR, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, or national origin.

(3) The CONTRACTOR will not discharge or in any other manner discriminate against any employee or applicant for employment because such employee or applicant has inquired about, discussed, or disclosed the compensation of the employee or applicant or another employee or applicant. This provision shall not apply to instances in which an employee who has access to the compensation information of other employees or applicants as a part of such employee's essential job functions discloses the compensation of such other employees or applicants to individuals who do not otherwise have access to such information, unless such disclosure is in response to a formal complaint or charge, in furtherance of an investigation, proceeding, hearing, or action, including an investigation conducted by the employer, or is consistent with the CONTRACTOR's legal duty to furnish information.

(4) The CONTRACTOR will send to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, a notice to be provided by the agency contracting officer, advising the labor union or workers' representative of the CONTRACTOR's commitments under section 202 of Executive Order 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(5) The CONTRACTOR will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

(6) The CONTRACTOR will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(7) In the event of the CONTRACTOR's non-compliance with the nondiscrimination clauses of this contract or with any of such rules, regulations, or orders, this contract may be canceled, terminated or suspended in whole or in part and the CONTRACTOR may be declared ineligible for further

Government contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

(8) The CONTRACTOR will include the provisions of paragraphs (1) through (8) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The CONTRACTOR will take such action with respect to any subcontract or purchase order as may be directed by the Secretary of Labor as a means of enforcing such provisions including sanctions for noncompliance: Provided, however, that in the event the CONTRACTOR becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction, the CONTRACTOR may request the United States to enter into such litigation to protect the interests of the United States.

11.2 Compliance with the Contract Work Hours and Safety Standards Act as follows:

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

(2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (b)(1) of this section the CONTRACTOR and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such CONTRACTOR and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (b)(1) of this section, in the sum of \$31 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (b)(1) of this section.

(3) Withholding for unpaid wages and liquidated damages. The (write in the name of the Federal agency or the loan or grant recipient) shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the CONTRACTOR or subcontractor under any such contract or any other Federal contract with the same prime CONTRACTOR, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime CONTRACTOR, such sums as may be determined to be necessary to satisfy any liabilities of such CONTRACTOR or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b)(2) of this section.

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

11.3 Clean Air Act requirements:

- (1) The CONTRACTOR agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act at 42 U.S.C. § 7401 et. seq.
- (2) The CONTRACTOR agrees to report each violation to the OWNER and understands and agrees that the OWNER will, in turn, report each violation as required to assure notification to the Federal Emergency Management Agency, and the appropriate Environmental Protection Agency Regional Office.
- (3) The CONTRACTOR agrees to include these requirements in each subcontract exceeding \$150,000 financed in whole or in part with Federal assistance provided by FEMA.

11.4 Federal Water Pollution Control Act requirements:

- (1) The CONTRACTOR agrees to comply with all applicable standards, orders or regulations issued pursuant to the Federal Water Pollution Control Act at 33 U.S.C. § 1251 et. seq.
- (2) The CONTRACTOR agrees to report each violation to the OWNER and understands and agrees that the OWNER will, in turn, report each violation as required to assure notification to the Federal Emergency Management Agency, and the appropriate Environmental Protection Agency Regional Office.
- (3) The CONTRACTOR agrees to include these requirements in each subcontract exceeding \$150,000 financed in whole or in part with Federal assistance provided by FEMA.

11.5 Suspension and Debarment

- (1) This Contract is a covered transaction for purposes of 2 C.F.R. pt. 180 and 2 C.F.R. pt. 3000. As such the CONTRACTOR is required to verify that none of the CONTRACTOR, its principals (defined at 2 C.F.R. § 180.995), or its affiliates (defined at 2 C.F.R. § 180.905) are excluded (defined at 2 C.F.R. § 180.940) or disqualified (defined at 2 C.F.R. § 180.935).
- (2) The CONTRACTOR must comply with 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C, and 7 must include a requirement to comply with these regulations in any lower tier covered transaction it enters into.
- (3) The certification in this clause is a material representation of fact relied upon by the OWNER. If it is later determined that the CONTRACTOR did not comply with 2 C.F.R. pt. 180, subpart C and 2 C.F.R. pt. 3000, subpart C, in addition to remedies available to the OWNER, the Federal Government may pursue available remedies, including but not limited to suspension and/or debarment.
- (4) The CONTRACTOR agrees to comply with the requirements of 49 CFR 29, Subpart C while this offer is valid and throughout the period of any contract that may arise from this offer. The bidder or proposer further agrees to include a provision requiring such compliance in its lower tier covered transactions.

11.6 Byrd Anti-Lobbying Amendment, 31 U.S.C. § 1352 (as amended).

- (1) CONTRACTORS who apply or bid for an award of \$100,000 or more shall file the required certification. Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or

employee of any agency, a Member of Congress, officer or employee of Congress, or an employee of a Member of Congress in connection with obtaining any Federal contract, grant, or any other award covered by 31 U.S.C. § 1352. Each tier shall also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the recipient who in turn will forward the certification(s) to the awarding agency.

11.7 The following access to records requirements apply to this contract:

- (1) The CONTRACTOR agrees to provide OWNER, the FEMA Administrator, the Comptroller General of the United States, or any of their authorized representatives access to any books, documents, papers, and records of the CONTRACTOR which are directly pertinent to this contract for the purposes of making audits, examinations, excerpts, and transcriptions.
- (2) The CONTRACTOR agrees to permit any of the foregoing parties to reproduce by any means whatsoever or to copy transcriptions as reasonably needed.
- (3) The CONTRACTOR agrees to provide the FEMA Administrator or his authorized representative access to construction or other work sires pertaining to the work being completed under the contract.
- (4) In compliance with the Disaster Recovery Act of 2018, the OWNER and the CONTRACTOR acknowledge and agree that no language in this contract is intended to prohibit audits or internal reviews by the FEMA Administrator or the Comptroller General of the United States.

11.8 The CONTRACTOR acknowledges that FEMA financial assistance may be used to fund all or a portion of the contract. The CONTRACTOR will comply with all applicable Federal law, regulations, executive orders, FEMA policies, procedures and directives.

11.9 The Federal Government is not a party to this contract and is not subject to any obligations or liabilities to the non-Federal entity, CONTRACTOR, or any other party pertaining to any matter resulting from the Agreement.

11.10 The Agreement acknowledges that 31 U.S.C. Chap. 38 (Administrative Remedies for False Claims and Statements) applies to the Contractor's actions pertaining to this contract.

IN WITNESS WHEREOF, the parties hereto have signed this Agreement in sextuple. Four copies each have been delivered to OWNER and one copy each to CONTRACTOR and ENGINEER. All portions of the Contract Documents have been signed or identified by OWNER and CONTRACTOR or by ENGINEER on their behalf.

This Agreement shall become effective on _____, 20__.

CONTRACTOR

OWNER

BY

BY

(CORPORATE SEAL)

(CORPORATE SEAL)

Attest

Attest

Address for giving notices

Address for giving notices

Note: If CONTRACTOR is a corporation, an affidavit giving the principal the right to sign the Agreement must accompany the executed Agreement.

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Contract Provisions Guide

Navigating Contract Provisions for Recipient and Subrecipient
Contracts Under FEMA Awards

Version 2, Effective October 1, 2024

(FI-207-21-0001)

Procurement Under Grants Division



FEMA

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Introduction

Recipients and subrecipients of grant funding from the Federal Emergency Management Agency (FEMA) will often use contractors to help them carry out work under their awards. These contracts are a commercial transaction between the recipients and subrecipients and their contractor, and FEMA has no contractual relationship with the recipient's or subrecipient's contractors. Although FEMA is not a party to the contract, if a recipient or subrecipient is using federal funding to pay for the contract, the recipient or subrecipient must comply with applicable federal laws, including the federal procurement standards.

The [federal procurement standards](#) for recipients and subrecipients are described in Title 2 of the Code of Federal Regulations (C.F.R.), Part 200, sections 200.317- 200.327. [2 C.F.R. § 200.327](#) states that “recipient's or subrecipient's contracts *must contain the applicable provisions* described in [Appendix II of this part](#)” (emphasis added).

Prior to purchasing goods and services under a FEMA award, recipients and subrecipients must be mindful of the date the federal award is made or the disaster declared because this date determines the applicable federal procurement standards including the required contract provisions in 2 C.F.R. Part 200. This document applies to all FEMA awards made or disasters declared on or after October 1, 2024, and includes the Office of Management and Budget (OMB) Revisions to the federal procurement standards effective on October 1, 2024. For [FEMA financial assistance programs subject to BABAA](#), recipient and subrecipient contracts for infrastructure projects must include a BABAA provision. The BABAA provision is applicable to FEMA awards made on or after October 23, 2023.

For FEMA awards made or disasters declared between November 12, 2020, through September 30, 2024, please refer to the [Contract Provisions Guide](#) dated June 2021 for the required federal contract provisions. For FEMA awards made or disasters declared *before* November 12, 2020, please refer to the [Contract Provisions Template](#) for required federal contract provisions. For questions regarding applicable federal procurement standards including the required contract provisions, please contact the FEMA Procurement Under Grants Division.

This document is designed to help FEMA recipients and subrecipients navigate Appendix II to Part 200 —Contract Provisions for Non-Federal Entity Contracts Under Federal Awards. Additionally, this document also describes contract clauses where 2 C.F.R. Part 200 requires clauses to be included but does not mandate specific language. In those cases, FEMA has provided suggested language in this document. In addition to the contract clauses [required](#) by 2 C.F.R. Part 200, this document includes [recommended](#) contract clauses that are pursuant to FEMA's authorities. **FEMA does not recommend incorporating by reference.** FEMA recommends including the name of the recipient or subrecipient conducting the purchase under a FEMA award in the blank sections when using sample language from this Guide.

This document provides:

- Suggested language or references to find suggested language for some of the federally required clauses.
- Required language for clauses that require recipient and subrecipient contracts to include specific language.
- Sample language for some of the federally recommended clauses.

This document does *not* provide:

- Sample language for certain federally required or recommended clauses that must be drafted in accordance with the recipient's or subrecipient's applicable laws, rules, and procedures.
- Contract provisions required by applicable state, tribal, or local laws or rules separate from the federal procurement standards.

Many of the provisions described in this document only apply when certain circumstances are present, such as the type of work being procured, the dollar amount, or the date when it is procured. Each section will describe the applicable requirements. See [Table A](#) for applicability of required contract provisions and [Table B](#) for *recommended* contract provisions by FEMA.

NOTE: The recipient or subrecipient is solely responsible for ensuring that all language included in its contracts meets the requirements of 2 C.F.R. Part 200, including 2 C.F.R. § 200.327 and Appendix II. Additionally, the required language noted below is current as of the date of the publication of this document and it is the recipient's and subrecipient's responsibility to ensure the required language used in the contract is consistent with applicable statutes. While the Contract Provisions Guide provides general guidance, recipients or subrecipients should reach out to their applicable FEMA grant program representative(s) if they have specific questions on the applicability of the contract provisions to a particular FEMA grant program.

Contract Provisions Quick Reference Guide

[Table A](#) and [Table B](#) are designed to help FEMA recipients and subrecipients conduct a quick reference of the applicability of a specific contract provision and whether sample contract language is included within this Guide to incorporate within the recipient's or subrecipient's contract.

The Tables are divided between the [required](#) contract provisions set forth under 2 C.F.R. Part 200 Appendix II and those that FEMA [recommends](#) in addition to those required by 2 C.F.R. Part 200.

Table A: Required Contract Provisions

	Provision (Appendix II Section)	Applicability	Sample Contract Language Included	Grant Program Applicability
1	Legal/contractual /administrative remedies for breach of contract (A)	Contract is greater than the Federal simplified acquisition threshold (SAT), currently \$250,000.	No. Based on the recipient's or subrecipient's procedures.	All. NOTE: AFG must include a penalty clause in all contracts for any AFG-funded vehicle.
2	Termination for cause and convenience (B)	Contract is greater than \$10,000.	No. Based on the recipient's or subrecipient's procedures.	All
3	Equal Employment Opportunity (C)	Contracts and subcontracts for construction work; exact language from 41 C.F.R. § 60-1.4(b) required.	Yes. Exact language from 41 C.F.R. § 60-1.4(b) included.	All
4	Davis-Bacon Act (D)	Contracts and subcontracts for construction work over \$2,000; required language at 29 C.F.R. § 5.5(a).	Yes, via reference to required language at 29 C.F.R. § 5.5(a).	Required for EMPG , HSGP , NSGP , THSGP , PSGP , TSGP , IPR , and HHPD .
5	Copeland "Anti-Kickback" Act (D)	Contracts and subcontracts for construction work over \$2,000.	Yes	Required for EMPG , HSGP , NSGP , THSGP , PSGP , TSGP , IPR , and HHPD .

	Provision (Appendix II Section)	Applicability	Sample Contract Language Included	Grant Program Applicability
6	Contract Work Hours and Safety Standards Act (E)	Contracts and subcontracts over \$100,000 and if for mechanics or laborers; exact language required from 29 C.F.R. § 5.5(b).	Yes. Exact language required from 29 C.F.R. § 5.5(b).	All
7	Rights to inventions made under a contract or agreement (F)	Funding agreement.	Yes	This clause is not required under the PA , HMGP , FMA , BRIC , PDM , FMAG , HMGP Post Fire , CCP , DCM , IHP-ONA , or Safeguarding Tomorrow RLF programs, as FEMA Awards under these programs do not meet the definition of “ funding agreement ”.
8	Clean Air Act and federal Water Pollution Control Act (G)	Contracts and subcontracts greater than \$150,000.	Yes	All
9	Debarment and Suspension (H)	Contracts and subcontracts greater than \$25,000.	Yes	All
10	Byrd Anti-Lobbying Amendment (I)	Contracts and subcontracts greater than \$100,000. Clause and certification required.	Yes. Clause and certification.	All
11	Procurement of Recovered Materials (J)	Only applies if a recipient or subrecipient is a state or political subdivision of a state; work involves the use of materials, and the contract is for more than \$10,000. NOTE: Not applicable for Indian Tribal governments and nonprofit organizations.	Yes	All

	Provision (Appendix II Section)	Applicability	Sample Contract Language Included	Grant Program Applicability
12	Prohibition on Contracting for Covered Telecommunications Equipment or Services (K)	Contracts and subcontracts under FEMA declaration or grant award issued on or after November 12, 2020.	Yes	All
13	Domestic Preferences for Procurements (L)	Contracts under FEMA declaration or grant award issued on or after November 12, 2020.	Yes	All
14	Build America, Buy America Act (BABAA) (M)	Infrastructure projects under applicable grant awards issued on or after January 2, 2023.	Yes	FEMA financial assistance programs subject to BABBA.

Table B: Recommended Contract Provisions

	Provision	Applicability	Sample Contract Language Included
1	Access to Records	All	Yes
2	Contract Changes or Modifications	All	No. It depends on nature of contract and end-item procured.
3	DHS Seal, Logo, and Flags	All	Yes
4	Compliance with Federal Law, Regulations, and Executive Orders	All	Yes
5	No Obligation by Federal Government	All	Yes
6	Program Fraud and False or Fraudulent Statements or Related Acts	All	Yes
7	Socioeconomic Contracting	All	Yes
8	Copyright	All procurements that may involve creation of copyrightable material.	Yes
9	Build America, Buy America Act (BABAA) for Architectural and/or Engineering Contracts	FEMA financial assistance programs subject to BABAA.	Yes
10	Providing Good, Safe Jobs to Workers	All	Yes
11	Buy Clean	PA, BRIC, and HMGP	Yes

Required Contract Provisions

1. Remedies

Contracts must address administrative, contractual, or legal remedies in instances where contractors violate or breach contract terms and must provide for sanctions and penalties as appropriate.¹

1.1 Applicability

This contract provision is required for contracts over the SAT,² currently set at \$250,000 for procurements made on or after June 20, 2018.³ For all other contracts at or below the SAT under FEMA programs, FEMA suggests including a remedies provision, but this is not required.

1.2 Additional Considerations

For FEMA's Assistance to Firefighters Grant Program (AFG), recipients must include a penalty clause in all contracts for any AFG-funded vehicle, regardless of dollar amount.⁴ In that situation, the contract must include a clause addressing that non-delivery by the contract's specified date or other vendor nonperformance will require a penalty of no less than \$100 per day until such time that the vehicle, compliant with the terms of the contract, has been accepted by the recipient.⁵ This penalty clause should, however, account for *force majeure* or acts of God. AFG recipients should refer to the applicable year's Notice of Funding Opportunity (NOFO) for additional information.

2. Termination for Cause and Convenience

Contracts must address termination for cause and for convenience by the recipient or subrecipient, including the manner by which it will be carried out and the basis for settlement.⁶

¹ 2 C.F.R. Part 200, Appendix II, § A.

² FEMA Grant Programs Directorate Information Bulletin No. 434, Increases and Changes to the Micro-Purchase and Simplified Acquisition Thresholds (Aug. 28, 2018),

[https://www.fema.gov/sites/default/files/2020-](https://www.fema.gov/sites/default/files/2020-08/ib_434_changes_micro_purch_simp_acquisition_thresholds.pdf)

[08/ib_434_changes_micro_purch_simp_acquisition_thresholds.pdf](https://www.fema.gov/sites/default/files/2020-08/ib_434_changes_micro_purch_simp_acquisition_thresholds.pdf). For procurements subject to 2 C.F.R. Part 200 that were made before June 20, 2018, the SAT was \$150,000.

³ 2 C.F.R. Part 200, Appendix II, § A.

⁴ E.g., Fiscal Year 2023 Assistance to Firefighters Grant Program Notice of Funding Opportunity, available at <https://www.grants.gov/search-results-detail/351954>.

⁵ *Id.*

⁶ 2 C.F.R. Part 200, Appendix II, § B.

2.1 Applicability

This contract provision is required for contracts and purchase orders exceeding \$10,000.⁷ For contracts at or below \$10,000, FEMA suggests including a termination for cause provision, but this is not required.

2.2 Additional Considerations

FEMA recommends that termination clauses be actionable and specific. For example, a termination clause that allows for 60-day notice of termination for a contract with a 30-day duration may not be actionable. Additionally, if a contract allows for due oral or written notice of termination, it should specify what is considered due oral or written notice.

3. Equal Employment Opportunity

This contract provision promotes and ensures equal opportunity for all persons, without regard to race, color, religion, sex, sexual orientation, gender identity, or national origin under federally assisted construction contracts.⁸

3.1 Applicability

This contract provision is required for all procurements that meet the definition of a “federally assisted construction contract,” unless otherwise stated in 41 C.F.R. Part 60.⁹

3.2 Key Definitions

- **Federally Assisted Construction Contract:** The regulation at 41 C.F.R. § 60-1.3 defines a federally assisted construction contract as “any agreement or modification thereof between any applicant and a person for construction work which is paid for in whole or in part with funds obtained from the Government or borrowed on the credit of the Government pursuant to any federal program involving a grant, contract, loan, insurance, or guarantee, or undertaken pursuant to any federal program involving such grant, contract, loan, insurance, or guarantee, or any application or modification thereof approved by the Government for a grant, contract, loan, insurance, or guarantee under which the applicant itself participates in the construction work.”
- **Construction Work:** The regulation at 41 C.F.R. § 60-1.3 defines construction work as “the construction, rehabilitation, alteration, conversion, extension, demolition or repair of buildings, highways, or other changes or improvements to real property, including facilities providing utility

⁷ *Id.*

⁸ [Executive Order 11246](#), “Equal Employment Opportunity” (30 FR 12319, 12935, 3 C.F.R. Part, 1964-1965 Comp., p. 339), as amended by [Executive Order 11375](#), “Amending [Executive Order 11246](#) Relating to Equal Employment Opportunity.”

⁹ 2 C.F.R. Part 200, Appendix II, § C.

services. The term also includes the supervision, inspection, and other onsite functions incidental to the actual construction.”

- **Contract:** The regulation at 41 C.F.R. § 60-1.3 defines contract as “any Government contract or subcontract or any federally assisted construction contract or subcontract.”

NOTE: Additional definitions pertaining to this contract provision can be found at 41 C.F.R. § 60-1.3.

3.3 Required Language

The regulation at 41 C.F.R. § 60-1.4(b) requires, except as otherwise provided or exempted in 41 C.F.R. Part 60, the insertion of the following contract clause:

“During the performance of this contract, the Contractor agrees as follows:

(1) The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, gender identity, or national origin. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, sexual orientation, gender identity, or national origin. Such action shall include, but not be limited to the following:

Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.

(2) The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, or national origin.

(3) The Contractor will not discharge or in any other manner discriminate against any employee or applicant for employment because such employee or applicant has inquired about, discussed, or disclosed the compensation of the employee or applicant or another employee or applicant. This provision shall not apply to instances in which an employee who has access to the compensation information of other employees or applicants as a part of such employee's essential job functions discloses the compensation of such other employees or applicants to individuals who do not otherwise have access to such information, unless such disclosure is in response to a formal complaint or charge, in furtherance of an investigation, proceeding, hearing, or action, including an investigation conducted by the employer, or is consistent with the contractor's legal duty to furnish information.

(4) The Contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided

advising the said labor union or workers' representatives of the Contractor's commitments under this section and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(5) The Contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

(6) The Contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(7) In the event of the Contractor's noncompliance with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts or federally assisted construction contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

(8) The Contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (8) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The Contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance:

Provided, however, that in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency, the Contractor may request the United States to enter such litigation to protect the interests of the United States.

The Applicant further agrees that it will be bound by the above equal opportunity clause with respect to its own employment practices when it participates in federally assisted construction work: *Provided*, that if the applicant so participating is a State or local government, the above equal opportunity clause is not applicable to any agency, instrumentality or subdivision of such government which does not participate in work on or under the contract.

The Applicant agrees that it will assist and cooperate actively with the administering agency and the Secretary of Labor in obtaining the compliance of contractors and subcontractors with the equal opportunity clause and the rules, regulations, and relevant orders of the Secretary of

Labor, that it will furnish the administering agency and the Secretary of Labor such information as they may require for the supervision of such compliance, and that it will otherwise assist the administering agency in the discharge of the agency's primary responsibility for securing compliance.

The Applicant further agrees that it will refrain from entering into any contract or contract modification subject to Executive Order 11246 of September 24, 1965, with a contractor debarred from, or who has not demonstrated eligibility for, Government contracts and federally assisted construction contracts pursuant to the Executive Order and will carry out such sanctions and penalties for violation of the equal opportunity clause as may be imposed upon contractors and subcontractors by the administering agency or the Secretary of Labor pursuant to Part II, Subpart D of the Executive Order. In addition, the Applicant agrees that if it fails or refuses to comply with these undertakings, the administering agency may take any or all of the following actions: Cancel, terminate, or suspend in whole or in part this grant (contract, loan, insurance, guarantee); refrain from extending any further assistance to the applicant under the program with respect to which the failure or refund occurred until satisfactory assurance of future compliance has been received from such applicant; and refer the case to the Department of Justice for appropriate legal proceedings.”

4. Davis-Bacon Act

This statute requires that contractors must pay wages to laborers and mechanics at a rate not less than the prevailing wages specified in the Secretary of Labor’s wage determination. Additionally, contractors are required to pay wages at least once per week.¹⁰ Additional requirements are listed below, and relevant definitions are at 29 C.F.R. § 5.2. Recipients and subrecipients should refer to the applicable NOFO or other program guidance or contact their applicable FEMA grant representative for additional information on how to implement this requirement.

4.1 Applicability

When required by the federal program legislation, all prime construction contracts over \$2,000 awarded by recipients or subrecipients must include a provision for compliance with the Davis-Bacon Act.¹¹

The Davis-Bacon Act does not apply to all FEMA financial assistance programs. Recipients and subrecipients should refer to applicable NOFO or other program guidance or contact their applicable FEMA grant representative to determine if this provision is required for the procurement. However, the Davis-Bacon Act clause is not federally required for procurements under FEMA’s Public Assistance (PA) or Hazard Mitigation Assistance (HMA) Programs.

¹⁰ 40 U.S.C. §§ 3141-3144 and 3146-3148. The Davis-Bacon Act is supplemented by Department of Labor regulations at 29 C.F.R. Part 5 (Labor Standards Provisions Applicable to Contracts Covering Federally Financed and Assisted Construction).

¹¹ 2 C.F.R. Part 200, Appendix II, § D.

4.2 Additional Requirements

If applicable, in addition to the requirements mentioned in the beginning of this section, the recipient or subrecipient must do the following:

- The recipient or subrecipient must place a copy of the Department of Labor’s current prevailing wage determination in each solicitation. Contracts or subcontracts must be awarded on the condition that the prevailing wage determination is accepted. The recipient or subrecipient must report all suspected or reported violations to the federal agency.¹²
- Contracts subject to the Davis-Bacon Act, must also include a provision for compliance with the Copeland “Anti-Kickback” Act.¹³ See Required Contract Provisions, Section 5. Copeland Anti-Kickback Act in this document for additional information. According to 29 C.F.R. § 5.5(a)(5), the regulatory requirements for the Copeland “Anti-Kickback” Act are incorporated by reference into the required contract provision, so a separate contract provision is not necessary. However, the recipient or subrecipient may include a separate contract provision specific to the Copeland “Anti-Kickback” Act.
- Per Department of Labor’s implementing regulations for the Davis-Bacon Act, the recipient’s or subrecipient’s contractor and any subcontractors are required to insert, or incorporate by reference, the clauses contained at 29 C.F.R. § 5.5(a)(1)-(11)¹⁴ into any subcontracts.
- Follow the other requirements of the Davis-Bacon Act and implementing regulations.¹⁵

4.3 Required Language¹⁶

If applicable per the standard described above, the recipient or subrecipient must include the provisions at 29 C.F.R. § 5.5(a)(1)-(11) in full into all applicable contracts, and all applicable contractors must include these provisions in full in any subcontracts.¹⁷

5. Copeland “Anti-Kickback” Act

The Copeland “Anti-Kickback” Act prohibits workers on construction contracts from giving up wages that they are owed.¹⁸ Additional requirements are listed below, and relevant definitions are at 29 C.F.R. § 3.2. The applicable implementing regulations are intended to assist with enforcement of the

¹² 29 C.F.R. Part 200, Appendix II, § D.

¹³ *Id.*

¹⁴ 29 C.F.R. § 5.5(a)(6).

¹⁵ 40 U.S.C. §§ 3141-3144, 3146-3148; 29 C.F.R. § Part 5.

¹⁶ 29 C.F.R. § 5.5(a).

¹⁷ 29 C.F.R. § 5.5(a)(6).

¹⁸ 40 U.S.C. § 3145. The Copeland “Anti-Kickback” Act is supplemented by Department of Labor regulations at 29 C.F.R. Part 3 (Contractors and Subcontractors on Public Building or Public Work Financed in Whole or in Part by Loans or Grants from the United States).

Davis-Bacon Act's minimum wage provisions as well as various statutes with similar minimum wage provisions for federally assisted construction.¹⁹

5.1 Applicability

For all prime construction contracts above \$2,000, when the Davis-Bacon Act also applies,²⁰ recipients or subrecipients must include a provision in contracts and subcontracts for compliance with the Copeland "Anti-Kickback" Act.²¹ The Copeland "Anti-Kickback" Act does not apply to all FEMA financial assistance programs. Recipients or subrecipients should refer to applicable NOFO or other program guidance or contact their applicable FEMA grant representative to determine if this provision is required for the procurement. However, the Copeland "Anti-Kickback" Act clause is not federally required for procurements under FEMA's PA or HMA Programs.

5.2 Additional Requirements

If applicable, the recipient or subrecipient must do the following:

- Include a provision for compliance with the Copeland "Anti-Kickback" Act.²² According to the implementing regulations for the Davis-Bacon Act, the regulatory requirements for the Copeland "Anti-Kickback" Act are incorporated by reference into the required contract provision for the Davis-Bacon Act. Therefore, a separate contract provision is not necessary. However, the recipient or subrecipient may include a separate contract provision specific to the Copeland "Anti-Kickback" Act with language suggested below.
- The Copeland "Anti-Kickback Act" prohibits each contractor or subcontractor from any form of persuading a person employed in construction, completion, or repair of public work to give up any part of their rightful compensation. The recipient or subrecipient must report all suspected or reported violations of the Copeland "Anti-Kickback Act" to FEMA.²³
- Each contractor and subcontractor must provide weekly reports of the wages paid during the prior week's payroll period to each employee covered by the "Copeland Anti-Kickback" Act and the Davis-Bacon Act.²⁴ The reports must be delivered to a representative of a federal or state agency in charge at the building or work site by the contractor or subcontractor within seven days of the payroll period's payment date.²⁵
- Follow the other requirements of the Copeland "Anti-Kickback" Act and implementing regulations.²⁶

¹⁹ 29 C.F.R. § 3.1.

²⁰ 2 C.F.R. Part 200, Appendix II, § D; 29 C.F.R. §§ 3.1, 3.3(c).

²¹ 2 C.F.R. Part 200, Appendix II, § D.

²² *Id.*

²³ *Id.*

²⁴ 29 C.F.R. § 3.3(b).

²⁵ 29 C.F.R. § 3.4(a).

²⁶ 40 U.S.C. § 3145; 29 C.F.R. Part 3.

5.3 Suggested Language

The following provides a sample contract clause:

“Compliance with the Copeland “Anti-Kickback” Act.

Contractor. The Contractor shall comply with 18 U.S.C. § 874, 40 U.S.C. § 3145, and the requirements of 29 C.F.R. Part 3 as may be applicable, which are incorporated by reference into this contract.

Subcontracts. The Contractor or Subcontractor shall insert in any subcontracts the clause above and such other clauses as FEMA may by appropriate instructions require, and a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The Prime Contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all these contract clauses.

Breach. A breach of the contract clauses above may be grounds for termination of the contract, and for debarment as a contractor and subcontractor as provided in 29 C.F.R. § 5.12.”

6. Contract Work Hours and Safety Standards Act

Where applicable,²⁷ contracts must include a provision for compliance with statutory requirements on work hours and safety standards.²⁸ Under 40 U.S.C. § 3702, each contractor must base wages for every mechanic and laborer on a standard 40-hour work week. Work over 40 hours is allowed, so long as the worker is paid at least one and a half times the base pay rate for all hours worked over 40 in the work week. Additionally, for construction work, under 40 U.S.C. § 3704, work surroundings and conditions for laborers and mechanics must not be unsanitary or unsafe. Relevant definitions are at 40 U.S.C. § 3701 and 29 C.F.R. § 5.2.

6.1 Applicability

This required contract provision applies to all procurements over \$100,000 that involve the employment of mechanics, laborers, and construction work.²⁹ These requirements do not apply to the purchase of supplies, materials, or articles ordinarily available on the open market, contracts for transportation or transmission of intelligence.³⁰

²⁷ 40 U.S.C. §§ 3701-3708.

²⁸ 40 U.S.C. §§ 3702, 3704. The Contract Work Hours and Safety Standards Act is supplemented by Department of Labor regulations at 29 C.F.R. Part 5, 2 C.F.R. Part 200, Appendix II, §E.

²⁹ 2 C.F.R. Part 200, Appendix II, § E.

³⁰ *Id.*

6.2 Additional Requirements

If applicable per the standard described above, the recipient or subrecipient must include the provisions at 29 C.F.R. § 5.5(b)(1)-(5), verbatim, into all applicable contracts, and all applicable contractors must include these provisions, in full, into any subcontracts.³¹

In addition to the required language from 29 C.F.R. § 5.5(b)(1)-(5), in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any other statutes cited in 29 C.F.R. § 5.1, the recipient or subrecipient must also insert a clause meeting the requirements of 29 C.F.R. § 5.5(c). Specific language is not required, but FEMA has provided suggested language below.

6.3 Required Language

For the required contract provision, the language from 29 C.F.R. § 5.5(b)(1)-(5) is provided below for ease of reference. The language provided is current as of the date of publication of the Contract Provisions Guide. However, 29 C.F.R. § 5 may be updated periodically, such that recipients and subrecipients are encouraged to reference the regulations for the most current language.

“Compliance with the Contract Work Hours and Safety Standards Act.

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

(2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (b)(1) of this section the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages and interest from the date of the underpayment. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchpersons and guards, employed in violation of the clause set forth in paragraph (b)(1) of this section, in the sum of \$32 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (b)(1).

(3) Withholding for unpaid wages and liquidated damages—

(i) Withholding Process. The **(insert name of recipient or subrecipient)** may, upon its own action, or must, upon written request of an authorized representative of the Department of

³¹ 29 C.F.R. § 5.5(b)(1), (4).

Labor, withhold or cause to be withheld from the contractor so much of the accrued payments or advances as may be considered necessary to satisfy the liabilities of the prime contractor or any subcontractor for any unpaid wages; monetary relief, including interest; and liquidated damages required by the clauses set forth in this paragraph (b) on this contract, any other federal contract with the same prime contractor, or any other federally assisted contract subject to the Contract Work Hours and Safety Standards Act that is held by the same prime contractor (as defined in § 5.2). The necessary funds may be withheld from the contractor under this contract, any other federal contract with the same prime contractor, or any other federally assisted contract that is subject to the Contract Work Hours and Safety Standards Act and is held by the same prime contractor, regardless of whether the other contract was awarded or assisted by the same agency, and such funds may be used to satisfy the contractor liability for which the funds were withheld.

(ii) Priority to withheld funds. The Department has priority to funds withheld or to be withheld in accordance with paragraph (a)(2)(i) or (b)(3)(i) of this section, or both, over claims to those funds by:

- (A)** A contractor's surety(ies), including without limitation performance bond sureties and payment bond sureties;
- (B)** A contracting agency for its procurement costs;
- (C)** A trustee(s) (either a court-appointed trustee or a U.S. trustee, or both) in bankruptcy of a contractor, or a contractor's bankruptcy estate;
- (D)** A contractor's assignee(s);
- (E)** A contractor's successor(s); or
- (F)** A claim asserted under the Prompt Payment Act, 31 U.S.C. 3901-3907.

(4) Subcontracts. The contractor or subcontractor must insert in any subcontracts the clauses set forth in paragraphs (b)(1) through (5) of this section and a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor is responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (b)(1) through (5). In the event of any violations of these clauses, the prime contractor, and any subcontractor(s) responsible will be liable for any unpaid wages and monetary relief, including interest from the date of the underpayment or loss, due to any workers of lower-tier subcontractors, and associated liquidated damages and may be subject to debarment, as appropriate.

(5) Anti-retaliation. It is unlawful for any person to discharge, demote, intimidate, threaten, restrain, coerce, blacklist, harass, or in any other manner discriminate against, or to cause any person to discharge, demote, intimidate, threaten, restrain, coerce, blacklist, harass, or in any other manner discriminate against, any worker or job applicant for:

- (i) Notifying any contractor of any conduct which the worker reasonably believes constitutes a violation of the Contract Work Hours and Safety Standards Act (CWHSSA) or its implementing regulations in this part;
- (ii) Filing any complaint, initiating, or causing to be initiated any proceeding, or otherwise asserting or seeking to assert on behalf of themselves or others any right or protection under CWHSSA or this part;
- (iii) Cooperating in any investigation or other compliance action, or testifying in any proceeding under CWHSSA or this part; or
- (iv) Informing any other person about their rights under CWHSSA or this part.”

6.4 Suggested Language

For contracts that are subject only to the Contract Work Hours and Safety Standards Act and are not subject to the other laws referenced by 29 C.F.R. § 5.1 where an additional contract provision is required, FEMA suggests including the following language:

“Further Compliance with the Contract Work Hours and Safety Standards Act.

(1) The contractor or subcontractor must maintain regular payrolls and other basic records during the course of the work and must preserve them for a period of three years after all the work on the prime contract is completed for all laborers and mechanics, including guards and watchpersons, working on the contract. Such records must contain the name; last known address, telephone number, and email address; and social security number of each such worker; each worker’s correct classification(s) of work performed; hourly rates of wages paid; daily and weekly number of hours actually worked; deductions made; and actual wages paid.

(2) Records to be maintained under this provision must be made available by the contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the Department of Homeland Security, the Federal Emergency Management Agency, and the Department of Labor, and the contractor or subcontractor will permit such representatives to interview workers during working hours on the job.”

7. Rights to Inventions Made Under a Contract or Agreement

This contract provision outlines the rules governing the ownership of inventions created using federal funds. If the FEMA award meets the definition of funding agreement³² and the recipient or subrecipient enters any contract involving substitution of parties, assignment, or performance of

³² Funding agreement definition found under 37 C.F.R. § 401.2(a).

experimental, developmental, or research work under that funding agreement, then the recipient or subrecipient must comply with the requirements of 37 C.F.R. Part 401 and any implementing regulations issued by FEMA.

7.1 Applicability

This provision does not apply to all FEMA financial assistance programs. Recipients and subrecipients should refer to applicable NOFO or other program guidance or contact their applicable FEMA grant representative to determine if this provision is required for the procurement. However, the Rights to Inventions Made Under a Contract or Agreement clause is not required for procurements under FEMA's PA Program.

7.2 Key Definitions

Funding Agreements: The regulation at 37 C.F.R. § 401.2(a) defines funding agreement as “any contract, grant, or cooperative agreement entered into between any federal agency, other than the Tennessee Valley Authority, and any contractor for the performance of experimental, developmental, or research work funded in whole or in part by the Federal Government. This term also includes any assignment, substitution of parties, or subcontract of any type entered into for the performance of experimental, developmental, or research work under a funding agreement as defined in the first sentence of this paragraph.”

8. Clean Air Act and Federal Water Pollution Control Act

Contracts must contain a provision requiring contractors to comply with the Clean Air Act³³ and the Federal Water Pollution Control Act.³⁴ Violations must be reported to FEMA and the Regional Office of the Environmental Protection Agency.³⁵

8.1 Applicability

This contract provision is required for all procurements over \$150,000.

8.2 Suggested Language

The following provides a sample contract clause:

“Clean Air Act.

The contractor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act, as amended, 42 U.S.C. § 7401 *et seq.*

³³ 42 U.S.C. §§ 7401-7671q. This also includes all applicable standards, orders, or regulations issued pursuant to the Clean Air Act.

³⁴ 33 U.S.C. §§ 1251-1387, as amended.

³⁵ 2 C.F.R. Part 200, Appendix II, § G.

The contractor agrees to report each violation to the (name of recipient or subrecipient entering the contract) and understands and agrees that the (name of the recipient or subrecipient entering the contract) will, in turn, report each violation as required to assure notification to the Federal Emergency Management Agency, and the appropriate Environmental Protection Agency Regional Office.

The contractor agrees to include these requirements in each subcontract exceeding \$150,000 financed in whole or in part with federal assistance provided by FEMA.

Federal Water Pollution Control Act

The contractor agrees to comply with all applicable standards, orders, or regulations issued pursuant to the Federal Water Pollution Control Act, as amended, 33 U.S.C. § 1251 *et seq.*

The contractor agrees to report each violation to the (name of the recipient or subrecipient entering the contract) and understands and agrees that the (name of the recipient or subrecipient entering into the contract) will, in turn, report each violation as required to assure notification to the (name of the pass-through entity, if applicable), Federal Emergency Management Agency, and the appropriate Environmental Protection Agency Regional Office.

The contractor agrees to include these requirements in each subcontract exceeding \$150,000 financed in whole or in part with federal assistance provided by FEMA.”

9. Suspension and Debarment

Recipients, subrecipients, contractors, and subcontractors are subject to suspension and debarment regulations.³⁶ Applicable contracts and subcontracts must include a provision requiring compliance with suspension and debarment regulations.³⁷

9.1 Applicability

The suspension and debarment clause is required for all contracts and subcontracts for \$25,000 or more, all contracts that require the consent of an official of a federal agency, and all contracts for federally required audit services.³⁸

³⁶ 2 C.F.R. Part 180 (implementing Executive Order 12549, Debarment and Suspension (1986) and Executive Order 12689, Debarment and Suspension (1989)); 2 C.F.R. Part 3000 (Department of Homeland Security regulations for Nonprocurement Debarment and Suspension, implementing 2 C.F.R. Part 180).

³⁷ 2 C.F.R. § 180; 2 C.F.R. Part 200, Appendix II, § H; 2 C.F.R. § 3000.332.

³⁸ 2 C.F.R. § 180.220(b); 2 C.F.R. § 3000.220.

Local governments and nonprofits, even for procurements under \$25,000, must also comply with the regulation requiring local governments and nonprofits to only award contracts to responsible vendors.³⁹

9.2 Additional Requirements

The suspension and debarment regulations restrict awards, subawards, contracts, and subcontracts with parties that are suspended, debarred, or otherwise excluded, or declared ineligible for participation in federal assistance programs and activities.⁴⁰

If applicable, a contract or subcontract must not be made to parties listed on the governmentwide exclusions in the System for Award Management (SAM). SAM Exclusions is the list maintained by the General Services Administration that contains the names of parties that are suspended, debarred, or otherwise excluded, or declared ineligible under statutory or regulatory authority other than Executive Order 12549.⁴¹ SAM Exclusions can be accessed at www.SAM.gov.⁴²

In general, an “excluded” party cannot receive a federal grant award or a contract considered to be a “covered transaction,” which includes parties that receive federal funding indirectly such as subawards and subcontracts. The key to the exclusion is whether there is a covered transaction. A covered transaction is a non-procurement transaction at either a primary or secondary tier.⁴³

Specifically, a covered transaction includes the following contracts for goods or services under FEMA financial assistance programs:

- The contract is at least \$25,000;
- The contract requires the approval of FEMA, regardless of amount;
- The contract is for federally required audit services; or,
- It is a subcontract for \$25,000 or more.⁴⁴

³⁹ 2 C.F.R. § 200.318(h). For contracts and subcontracts under \$25,000, a contract provision is only required if those contracts or subcontracts are for federally required audit services or require the consent of a federal agency. However, even where a contract provision is not required, local governments and nonprofits must still ensure they are only awarding contracts to responsible vendors.

⁴⁰ 2 C.F.R. Part 200, Appendix II, § H; 2 C.F.R. § 200.213; 2 C.F.R. Parts 180, 3000.

⁴¹ 2 C.F.R. Part 200, Appendix II, § H.

⁴² 2 C.F.R. § 180.530.

⁴³ The regulations at 2 C.F.R. Parts 180 and 3000 are titled “nonprocurement” because they do not apply to procurements by the Federal Government but rather to federal financial assistance. There are separate debarment and suspension regulations covering procurements by the Federal Government. However, although the term “covered transactions” under 2 C.F.R. Parts 180 and 3000 does not include contracts awarded by the Federal Government, it does include some contracts awarded by recipients and subrecipients.

⁴⁴ 2 C.F.R. §§ 180.220, 3000.220.

9.3 Suggested Language

The following provides a suspension and debarment clause. It also incorporates an optional method of verifying that contractors are not excluded or disqualified:⁴⁵

“Suspension and Debarment

This contract is a covered transaction for purposes of 2 C.F.R. Part 180 and 2 C.F.R. Part 3000. As such, the contractor is required to verify that none of the contractor’s principals (defined at 2 C.F.R. § 180.995) or its affiliates (defined at 2 C.F.R. § 180.905) are excluded (defined at 2 C.F.R. § 180.940) or disqualified (defined at 2 C.F.R. § 180.935).

The contractor must comply with 2 C.F.R. Part 180, subpart C and 2 C.F.R. Part 3000, subpart C, and must include a requirement to comply with these regulations in any lower tier covered transaction it enters.

This certification is a material representation of fact relied upon by (insert name of recipient/subrecipient). If it is later determined that the contractor did not comply with 2 C.F.R. Part 180, subpart C and 2 C.F.R. Part 3000, subpart C, in addition to remedies available to (insert name of recipient/subrecipient), the Federal Government may pursue available remedies, including but not limited to suspension and/or debarment.

The bidder or proposer agrees to comply with the requirements of 2 C.F.R. Part 180, subpart C and 2 C.F.R. Part 3000, subpart C while this offer is valid and throughout the period of any contract that may arise from this offer. The bidder or proposer further agrees to include a provision requiring such compliance in its lower tier covered transactions.”

10. Byrd Anti-Lobbying Amendment

Recipients or subrecipients who intend to award contracts of more than \$100,000, and their contractors who intend to award subcontracts of more than \$100,000, must include a contract provision prohibiting the use of federal appropriated funds to influence officers or employees of the Federal Government.⁴⁶ Contractors that apply or bid for a contract for more than \$100,000 must also file the required certification regarding lobbying.⁴⁷

Each tier certifies to the tier above that it will not and has not used federal appropriated funds to pay any person or organization for influencing or attempting to influence an employee of a federal

⁴⁵ Per 2 C.F.R. § 180.300, a recipient or subrecipient about to enter an applicable contract, or a contractor about to enter into an applicable subcontract, must verify that the contractor or subcontractor is not excluded or disqualified by doing one of three things: 1) check SAM Exclusions; 2) collect a certification from the contractor or subcontractor; or 3) add a clause or condition to the contract or subcontract. The additional suggested language in this sample clause is for purposes of this requirement.

⁴⁶ 31 U.S.C. §1352(a), (b), (d)(1)(c)(2).

⁴⁷ 2 C.F.R. Part 200, Appendix II, § I (citing 31 U.S.C. § 1352); 44 C.F.R. § 18.110.

agency, a Member of Congress, an employee of Congress, or an employee of a Member of Congress in connection with receiving any federal contract, grant, or other award covered by 31 U.S.C. § 1352.

The required certification form is found in FEMA regulations.⁴⁸ Each tier must also disclose any lobbying with non-federal funds that takes place in connection with obtaining any federal funding. These disclosures are forwarded from tier to tier, all the way up to the federal agency.⁴⁹

10.1 Applicability

The Byrd Anti-Lobbying Amendment clause and certification are required for contracts and subcontracts of more than \$100,000.

10.2 Suggested Language

The following provides a sample contract clause:

“Byrd Anti-Lobbying Amendment, as amended, 31 U.S.C. § 1352.

Contractors who apply or bid for an award of more than \$100,000 shall file the required certification. Each tier certifies to the tier above that it will not and has not used federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, officer or employee of Congress, or an employee of a Member of Congress in connection with obtaining any federal contract, grant, or any other award covered by 31 U.S.C. § 1352. Each tier shall also disclose any lobbying with non-federal funds that takes place in connection with obtaining any federal award. Such disclosures are forwarded from tier to tier up to the recipient who in turn will forward the certification(s) to the federal agency.”

10.3 Required Certification

10.3.1 REQUIRED CERTIFICATION LANGUAGE

If applicable, contractors must sign and submit the following certification to the recipient or subrecipient with each bid or offer exceeding \$100,000:

“APPENDIX A, 44 C.F.R. PART 18 – CERTIFICATION REGARDING LOBBYING.

Certification for Contracts, Grants, Loans, and Cooperative Agreements

⁴⁸ 44 C.F.R. §§ 18.100, 18.110; 44 C.F.R. Part 18, Appendix A. FEMA’s regulations at 44 C.F.R. Part 18 implement the requirements of 31 U.S.C. § 1352 and provides, in Appendix A to Part 18, a copy of the certification that is required to be completed by each entity as described in 31 U.S.C. § 1352.

⁴⁹ 44 C.F.R. §§ 18.100, 18.110; 44 C.F.R. Part 18, Appendix B. The specific form for disclosures is referenced in Appendix B to 44 C.F.R. Part 18 and is SF-LLL, also available at https://apply07.grants.gov/apply/forms/readonly/SFLLL_2_0-V2.0.pdf.

The undersigned certifies, to the best of his or her knowledge and belief, that:

No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any federal grant, the making of any federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any federal contract, grant, loan, or cooperative agreement.

If any funds other than federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure."

10.4 Recommended Signature Line:

At the end of the certification language, FEMA recommends including the following signature line:

"The Contractor, _____, certifies or affirms the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, the Contractor understands and agrees that the provisions of 31 U.S.C. Chap. 38, Administrative Remedies for False Claims and Statements, apply to this certification and disclosure, if any."

Signature of Contractor's Authorized Official

Name and Title of Contractor's Authorized Official

Date

11. Procurement of Recovered Materials

Applicable recipients or subrecipients must comply with Section 6002 of the Solid Waste Disposal Act⁵⁰ and include a contract provision requiring compliance with this requirement.⁵¹ Additional requirements are listed below.

11.1 Applicability

This required contract provision applies to all procurements made by a state agency or political subdivision of a state and its contractors for certain items, as designated by the Environmental Protection Agency, with a purchase price greater than \$10,000.⁵²

11.2 Additional Requirements

The requirements include:

- Procuring only items designated in EPA guidelines⁵³ that contain the highest practical percentage of recovered materials consistent with maintaining competition, where the purchase price of the item is greater than \$10,000, or the value of the amount of items purchased in the preceding fiscal year was greater than \$10,000;
- Procuring solid waste management services in a way that maximizes energy and resource recovery; and
- Establishing an affirmative procurement program for procurement of recovered materials identified in the EPA guidelines.⁵⁴

In addition, recipients and subrecipients should, to the greatest extent practicable, purchase, acquire, or use products and services that can be reused, refurbished, or recycled; contain recycled content, are biobased, or are energy and water efficient; and are sustainable.⁵⁵

⁵⁰ Pub. L. No. 89-272 (1965) (codified as amended by the Resource Conservation and Recovery Act at 42 U.S.C. § 6962). 2 C.F.R. § 200.323.

⁵¹ 2 C.F.R. Part 200, Appendix II, § J (citing 2 C.F.R. § 200.323).

⁵² 2 C.F.R. Part 200, Appendix II, § J; 2 C.F.R. § 200.323; 40 C.F.R. Part 147.

⁵³ 40 C.F.R. Part 247.

⁵⁴ 42 U.S.C. § 6962; 2 C.F.R. § 200.323.

⁵⁵ 2 C.F.R. § 200.323(b); Executive Order 14057, Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability (2021).

11.3 Suggested Language

The following provides a sample contract clause:

“In the performance of this contract, the Contractor shall make maximum use of products containing recovered materials that are EPA-designated items unless the product cannot be acquired—

- a) Competitively within a timeframe providing for compliance with the contract performance schedule;
- b) Meeting contract performance requirements; or
- c) At a reasonable price.

Information about this requirement, along with the list of EPA-designated items, is available at [Comprehensive Procurement Guideline \(CPG\) Program | US EPA](#). The Contractor also agrees to comply with all other applicable requirements of Section 6002 of the Solid Waste Disposal Act.

The Contractor should, to the greatest extent practicable and consistent with the law, purchase, acquire, or use products and services that can be reused, refurbished, or recycled; contain recycled content, are biobased, or are energy and water efficient; and are sustainable.”

12. Prohibition on Contracting for Covered Telecommunications Equipment or Services

Section 889(b)(1) of the [John S. McCain National Defense Authorization Act for Fiscal Year 2019 \(FY 2019 NDAA\)](#) and [2 C.F.R. § 200.216](#), as implemented by [FEMA Policy 405-143-1, Prohibitions on Expending FEMA Award Funds for Covered Telecommunications Equipment or Services](#), prohibit the obligation or expending of federal award funds on certain telecommunication products or from certain entities for national security reasons. Effective August 13, 2020, FEMA recipients and subrecipients, as well as their contractors and subcontractors, may not obligate or expend any FEMA award funds to:

- a. Procure or obtain any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology of any system;
- b. Enter, extend, or renew a contract to procure or obtain any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology of any system; or
- c. Enter, extend, or renew contracts with entities that use covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system.

12.1 Applicability

As of November 12, 2020, all FEMA recipients and subrecipients, and their contractors and subcontractors, are required to include this contract provision in all FEMA-funded contracts and subcontracts, including any purchase orders.⁵⁶

12.2 Suggested Language

The following provides a sample contract clause:

“Prohibition on Contracting for Covered Telecommunications Equipment or Services.

- (a) *Definitions.* As used in this clause, the terms backhaul; covered foreign country; covered telecommunications equipment or services; interconnection arrangements; roaming; substantial or essential component; and telecommunications equipment or services have the meaning as defined in FEMA Policy 405-143-1, Prohibitions on Expending FEMA Award Funds for Covered Telecommunications Equipment or Services, as used in this clause—
- (b) *Prohibitions.*
- 1) Section 889(b) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019, Pub. L. No. 115-232, and 2 C.F.R. § 200.216 prohibit the head of an executive agency on or after Aug.13, 2020, from obligating or expending grant, cooperative agreement, loan, or loan guarantee funds on certain telecommunications products or from certain entities for national security reasons.
 - 2) Unless an exception in paragraph (c) of this clause applies, the contractor and its subcontractors may not use grant, cooperative agreement, loan, or loan guarantee funds from the Federal Emergency Management Agency to:
 - i. Procure or obtain any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology of any system;
 - ii. Enter, extend, or renew a contract to procure or obtain any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology of any system;
 - iii. Enter, extend, or renew contracts with entities that use covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system; or

⁵⁶ 2 C.F.R. Part 200, Appendix II, § K (citing 2 C.F.R. § 200.216).

- iv. Provide, as part of its performance of this contract, subcontract, or other contractual instrument, any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system.

(c) Exceptions.

- 1) This clause does not prohibit contractors from providing—
 - i. A service that connects to the facilities of a third-party, such as backhaul, roaming, or interconnection arrangements; or
 - ii. Telecommunications equipment that cannot route or redirect user data traffic or permit visibility into any user data or packets that such equipment transmits or otherwise handles.
- 2) By necessary implication and regulation, the prohibitions also do not apply to:
 - i. Covered telecommunications equipment or services that:
 - a. Are not used as a substantial or essential component of any system; and
 - b. Are not used as critical technology of any system.
 - ii. Other telecommunications equipment or services that are not considered covered telecommunications equipment or services.
- 3) *Reporting requirement.*
 - 1) In the event the contractor identifies covered telecommunications equipment or services used as a substantial or essential component of any system, or as critical technology as part of any system, during contract performance, or the contractor is notified of such by a subcontractor at any tier or by any other source, the contractor shall report the information in paragraph (d)(2) of this clause to the recipient or subrecipient, unless elsewhere in this contract are established procedures for reporting the information.
 - 2) The Contractor shall report the following information pursuant to paragraph (d)(1) of this clause:
 - i. Within one business day from the date of such identification or notification: The contract number; the order number(s), if applicable; supplier name; supplier unique entity identifier (if known); supplier Commercial and Government Entity (CAGE) code (if known); brand; model number (original equipment manufacturer number, manufacturer part number, or wholesaler number); item description; and any readily available information about mitigation actions undertaken or recommended.

- ii. Within 10 business days of submitting the information in paragraph (d)(2)(i) of this clause: Any further available information about mitigation actions undertaken or recommended. In addition, the contractor shall describe the efforts it undertook to prevent use or submission of covered telecommunications equipment or services, and any additional efforts that will be incorporated to prevent future use or submission of covered telecommunications equipment or services.
- (e) *Subcontracts.* The Contractor shall insert the substance of this clause, including this paragraph (e), in all subcontracts and other contractual instruments.”

13. Domestic Preferences for Procurements

The recipient or subrecipient should, to the greatest extent practicable and consistent with law, provide a preference for the purchase, acquisition, or use of goods, products, or materials produced in the United States. This includes, but is not limited to, iron, aluminum, steel, cement, and other manufactured products.⁵⁷

13.1 Applicability

For procurements made under grant awards or declarations issued on or after November 12, 2020, all FEMA recipients and subrecipients are required to include in all contracts and purchase orders for work or products a contract provision encouraging domestic preference for procurements.⁵⁸ Programs receiving federal financial assistance for infrastructure projects may also be subject to the Build America, Buy America Act preferences set forth in 2 C.F.R. Part 184.

13.2 Suggested Language

The following provides a sample contract clause:

“Domestic Preference for Procurements.

The Contractor should, to the greatest extent practicable and consistent with law, provide a preference for the purchase, acquisition, or use of goods, products, or materials produced in the United States. This includes, but is not limited to, iron, aluminum, steel, cement, and other manufactured products.

For purposes of this clause:

Produced in the United States means, for iron and steel products, that all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States.”

⁵⁷ 2 C.F.R. § 200.322.

⁵⁸ 2 C.F.R. Part 200, Appendix II, § L (citing 2 C.F.R. § 200.322). The requirements of 2 C.F.R. § 200.322 must also be included in all subawards.

14. Build America, Buy America Act

The Build America, Buy America Act (BABAA) requires all federal agencies, including FEMA, to ensure that no federal financial assistance for “infrastructure” projects is provided unless all the iron, steel, manufactured products, and construction materials used in the project are produced in the United States.⁵⁹

14.1 Applicability

The BABAA domestic preference requirements are applicable to infrastructure projects funded under subject FEMA financial assistance program awards issued on or after Jan. 2, 2023, as well as new funding FEMA obligates to existing awards or through renewal awards where the new funding is obligated on or after Jan. 2, 2023.⁶⁰

The BABAA contract provision and self-certification are required for contracts and subcontracts for infrastructure projects that are subject to the BABAA requirements unless the requirement is waived.⁶¹ For additional information on types of BABAA waivers, please refer to FEMA’s website at ["Buy America" Preference in FEMA Financial Assistance Programs for Infrastructure | FEMA.gov](https://www.fema.gov/buy-america-preference-in-fema-financial-assistance-programs-for-infrastructure).

14.2 Suggested Language

The following provides a sample contract clause:

“Build America, Buy America Act (BABAA).

Contractors and their subcontractors who apply or bid for an award for an infrastructure project subject to the domestic preference requirement in the Build America, Buy America Act shall file the required certification to **(insert name of recipient/subrecipient)** with each bid or offer for an infrastructure project, unless a domestic preference requirement is waived by FEMA. Contractors and subcontractors certify that no federal financial assistance funding for infrastructure projects will be provided unless all the iron, steel, manufactured projects, and construction materials used in the project are produced in the United States. BABAA, Pub. L. No. 117-58, §§ 70901-52. Contractors and subcontractors shall also disclose any use of federal financial assistance for infrastructure projects that does not ensure compliance with BABAA domestic preference requirements. Such disclosures shall be forwarded to the recipient who, in turn, will forward the disclosures to FEMA, the federal agency; subrecipients will forward disclosures to the pass-through entity, who will, in turn, forward the disclosures to FEMA.”

⁵⁹ 2 C.F.R. § 184.1(b).

⁶⁰ FEMA Policy: *Buy America Preference in FEMA Financial Assistance Programs for Infrastructure*, April 25, 2024.

⁶¹ 2 C.F.R. § 184.4(b).

14.3 Required Self-Certification

For FEMA financial assistance programs subject to BABAA, contractors and subcontractors must sign and submit the following certification to the next tier (e.g., subcontractors submit to the contractor; contractors submit to the recipient or subrecipient) each bid or offer for an infrastructure project that has not been waived by a BABAA waiver:⁶²

“The undersigned certifies, to the best of their knowledge and belief, that:

The Build America, Buy America Act (BABAA) requires that no federal financial assistance for “infrastructure” projects is provided “unless all of the iron, steel, manufactured products, and construction materials used in the project are produced in the United States.” Section 70914 of Public Law No. 117-58, §§ 70901-52.

The undersigned certifies that for the **(insert name of project)** that the iron, steel, manufactured products, and construction materials used in this contract are in full compliance with the BABAA requirements including:

1. All iron and steel used in the project are produced in the United States. This means all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States.
2. All manufactured products purchased with FEMA financial assistance must be produced in the United States. For a manufactured product to be considered produced in the United States, the cost of the components of the manufactured product that are mined, produced, or manufactured in the United States is greater than 55% of the total cost of all components of the manufactured product, unless another standard for determining the minimum amount of domestic content of the manufactured product has been established under applicable law or regulation.
3. All construction materials are manufactured in the United States. This means that all manufacturing processes for the construction material occurred in the United States.

The **(insert name of contractor or subcontractor)**, certifies or affirms the truthfulness and accuracy of each statement of its certification and disclosure, if any. In addition, the **(insert name of contractor or subcontractor)** understands and agrees that the provisions of 31 U.S.C. Chap. 38, Administrative Remedies for False Claims and Statements, apply to this certification and disclosure, if any.”

Signature of **(insert name of contractor or subcontractor)** Authorized Official

Name and Title of **(insert name of contractor or subcontractor)** Authorized Official

⁶² *Id.*

Date

FEMA Recommended Contract Provisions

The federal procurement standards authorize FEMA to require or recommend additional provisions for recipient and subrecipient contracts. Therefore, FEMA recommends the following:

1. Access to Records

A recipient or subrecipient and its contractors and subcontractors must give the Department of Homeland Security and FEMA access to records associated with their awards during the required record retention period and as long as the records are retained.⁶³ All parties agree to comply with DHS provisions about accessing people, places, and things related to the federal financial award as necessary or as required by DHS regulations or other applicable laws and policies.⁶⁴ Additionally, for contracts entered into after August 1, 2017, under a major disaster or emergency declaration under Titles IV or V of the Robert T. Stafford Disaster Relief Act, FEMA is prohibited from funding any contracts that prevent audits or internal reviews by the FEMA Administrator or Comptroller General.⁶⁵

1.1 Suggested Language for All Procurements

The following provides a sample contract clause:

“The Contractor agrees to provide (**insert recipient or subrecipient**), (**insert name of pass-through entity, if applicable**), the FEMA Administrator, the Comptroller General of the United States, or any of their authorized representatives access to any books, documents, papers, and records of the Contractor which are directly pertinent to this contract for the purposes of making audits, examinations, excerpts, and transcriptions.

The Contractor agrees to permit any of the foregoing parties to reproduce by any means whatsoever or to copy excerpts and transcriptions as reasonably needed.

The Contractor agrees to provide the FEMA Administrator or his authorized representatives access to construction or other work sites pertaining to the work being completed under the contract.”

⁶³ 2 C.F.R. §§ 200.334, 200.337.

⁶⁴ DHS Standard Terms and Conditions, available at <https://www.dhs.gov/publication/dhs-standard-terms-and-conditions>.

⁶⁵ Sections 1202 and 1225 of the Disaster Recovery Reform Act of 2018, Pub. L. No. 115-254.

1.2 Additional Suggested Language Applicable to Contracts Entered into After August 1, 2017, Under a Major Disaster or Emergency Declaration

The following provides a sample contract clause:

“In compliance with section 1225 of the Disaster Recovery Reform Act of 2018, the **(insert name of the recipient or subrecipient)** and the Contractor acknowledge and agree that no language in this contract is intended to prohibit audits or internal reviews by the FEMA Administrator or the Comptroller General of the United States.”

2. Changes

To be allowable under a FEMA grant or cooperative agreement award, the cost of any contract change, modification, amendment, addendum, change order, or constructive change must be necessary, allocable, within the scope of the grant or cooperative agreement, reasonable for the scope of work, and otherwise allowable.⁶⁶ FEMA recommends that all contracts include a changes clause that describes how, if at all, changes can be made by either party to alter the method, price, or schedule of the work without breaching the contract. The language of the clause may depend on the nature of the contract and the procured item(s) or service(s). The recipient or subrecipient should also consult their servicing legal counsel to determine whether and how contract changes are permissible under applicable state, local, or tribal laws or regulations.

3. DHS Seal, Logo, and Flags

All recipients and subrecipients and their contractors and subcontractors must obtain permission before using the DHS seal(s), logos, crests, reproductions of flags, or likenesses of DHS agency officials.⁶⁷

3.1 Suggested Language

The following provides a sample contract clause:

“**(Insert name of the recipient or subrecipient)** must obtain written permission from DHS prior to using the DHS seals, logos, crests, or reproductions of flags, or likenesses of DHS agency officials. This includes use of DHS component (e.g., FEMA, CISA, etc.) seals, logos, crests, or reproductions of flags, or likenesses of component officials.”

⁶⁶ 2 C.F.R. § 200.403.

⁶⁷ DHS Standard Terms and Conditions, available at <https://www.dhs.gov/publication/dhs-standard-terms-and-conditions>.

4. Compliance with Federal Law, Regulations, and Executive Orders and Acknowledgement of Federal Funding

The recipient or subrecipient and its contractors are required to comply with all applicable federal laws, regulations, and executive orders. Additionally, recipients and subrecipients must acknowledge their use of federal funding when issuing statements, press releases, requests for proposal, bid invitations, and other documents describing projects or programs funded in whole or in part with federal funds.⁶⁸ FEMA recommends that all recipients and subrecipients include a statement acknowledging that FEMA funding will be used in the contract, as well as a requirement that contractors will comply with all applicable federal law, regulations, executive orders, and FEMA policies, procedures, and directives.

4.1 Suggested Language

The following provides a sample contract clause:

“This is an acknowledgement that FEMA financial assistance will be used to fund all or a portion of the contract. The contractor will comply with all applicable federal law, regulations, executive orders, FEMA policies, procedures, and directives.”

5. No Obligation by Federal Government

FEMA is not a party to any transaction between a recipient or subrecipient and its contractor. Therefore, FEMA is not subject to any obligations or liable to any party for any matter relating to the contract between a recipient or subrecipient and its contractor.⁶⁹ FEMA recommends that the recipient or subrecipient include a statement in its contract that the Federal Government is not a party to the contract and, thus, is not subject to any obligations or liabilities to any party resulting from the contract.

5.1 Suggested Language

The following provides a sample contract clause:

“The Federal Government is not a party to this contract and is not subject to any obligations or liabilities to the recipient or subrecipient, contractor, or any other party pertaining to any matter resulting from the contract.”

⁶⁸ DHS Standard Terms and Conditions, available at <https://www.dhs.gov/publication/dhs-standard-terms-and-conditions>.

⁶⁹ E.g., 2 C.F.R. § 200.318(k) (stating that the recipient or subrecipient alone is responsible for the settlement of all contractual and administrative issues arising out of procurements).

6. Program Fraud and False or Fraudulent Statements or Related Acts

Recipients and subrecipients must comply with the requirements of the False Claims Act, which prohibits submitting false or fraudulent claims for payment to the Federal Government.⁷⁰ As part of the contract with a recipient or subrecipient, contractors must acknowledge that 31 U.S.C. Chap. 38, regarding administrative remedies for false claims and statements, applies to their actions under their contract.⁷¹ FEMA recommends that contracts include a provision prohibiting making false or fraudulent claims to the Federal Government.

6.1 Suggested Language

The following provides a sample contract clause:

“The Contractor acknowledges that 31 U.S.C. Chap. 38 (Administrative Remedies for False Claims and Statements) applies to the contractor’s actions pertaining to this contract.”

7. Socioeconomic Contracting

When possible, recipients and subrecipients are encouraged to take the six socioeconomic contracting steps listed in [2 C.F.R. § 200.321](#) to ensure small businesses, minority businesses, women’s business enterprises, veteran-owned businesses, and labor surplus area firms are considered. One of the six steps is to ensure a contractor under a federal award applies the five other socioeconomic steps to subcontracts.⁷² FEMA recommends that contracts include a statement encouraging contractors to apply the socioeconomic steps to subcontracts.

7.1 Suggested Language

The following provides a sample contract clause:

“The Contractor is encouraged to take all necessary steps identified in 2 C.F.R. § 200.321(b)(1)-(5) to ensure small businesses, minority businesses, women’s business enterprises, veteran-owned businesses, and labor surplus area firms are considered when possible.”

8. Copyright

Regarding intangible property, [2 C.F.R. § 200.315](#) requires that a recipient or subrecipient provide certain licenses with respect to copyright to the federal agency. 2 C.F.R. § 200.315(b) provides to the federal agency “a royalty-free, nonexclusive, and irrevocable right to reproduce, publish, or

⁷⁰ 31 U.S.C. §§ 3729-3733.

⁷¹ DHS Standard Terms and Conditions, available at <https://www.dhs.gov/publication/fy15-dhs-standard-terms-and-conditions>.

⁷² 2 C.F.R. § 200.321; compare 2 C.F.R. § 200.317 (2019), with 2 C.F.R. § 200.317 in Office of Management and Budget, Guidance for Grants and Agreements, 85 Fed. Reg. 49,506, 49,552 (Aug. 13, 2020).

otherwise use (any work that is subject to copyright) for federal purposes and to authorize others to do so.” This includes the right to require recipients and subrecipients to make such works available through agency-designated public access repositories. 2 C.F.R. § 200.315(d) provides to the Federal Government the rights to “obtain, reproduce, publish, or otherwise use” data produced under a federal award and to authorize others to do the same.

8.1 Applicability

When a recipient or subrecipient enters a contract requiring a contractor or subcontractor to produce copyrightable subject matter for the recipient or subrecipient under the award, the recipient or subrecipient should include appropriate copyright licenses to meet its obligations under 2 C.F.R. § 200.315(b) and (d). Work that is subject to copyright, or copyrightable subject matter, includes any written reports or literary works, software and/or source code, music, choreography, pictures or images, graphics, sculptures, videos, motion pictures or other audiovisual works, sound and/or video recordings, and architectural works.⁷³

8.2 Suggested Language

The following provides a sample contract clause:

“License and Delivery of Works Subject to Copyright.

The Contractor grants to the **(insert name of the recipient or subrecipient)**, a paid-up, royalty-free, nonexclusive, irrevocable, worldwide license in data first produced in the performance of this contract to reproduce, publish, or otherwise use, including prepare derivative works, distribute copies to the public, and perform publicly and display publicly such data. For data required by the contract but not first produced in the performance of this contract, the Contractor will identify such data and grant to the **(insert name of the recipient or subrecipient)** or acquires on its behalf a license of the same scope as for data first produced in the performance of this contract. Data, as used herein, shall include any work subject to copyright under 17 U.S.C. § 102, for example, any written reports or literary works, software and/or source code, music, choreography, pictures or images, graphics, sculptures, videos, motion pictures or other audiovisual works, sound and/or video recordings, and architectural works. Upon or before the completion of this contract, the Contractor will deliver to the **(insert name of the recipient or subrecipient)** data first produced in the performance of this contract and data required by the contract but not first produced in the performance of this contract in formats acceptable by the **(insert name of the recipient or subrecipient)**.”

⁷³ 17 U.S.C. § 102.

9. Build America, Buy America Act (BABAA) for Architectural and/or Engineering Contracts

In accordance with the Build America, Buy America Act (BABAA), FEMA must ensure that no federal financial assistance for infrastructure projects is awarded unless all of the iron, steel, manufactured products, and construction materials used in the project are produced in the United States.⁷⁴

Although architectural and/or engineering (A/E) professional services are not considered infrastructure, FEMA recommends that A/E contracts under FEMA grants that are subject to BABAA include a statement requiring contractors and subcontractors to implement a Buy America Preference in their planning and design of an infrastructure project.

9.1 Applicability

For [FEMA grants subject to BABAA](#), FEMA recommends that recipients and subrecipients include a Buy America Preference clause in A/E contracts.

9.2 Suggested Language

The following provides a sample contract clause:

"Build America, Buy America Act Preference.

Contractors and subcontractors agree to incorporate the Buy America Preference into planning and design when providing architectural and/or engineering professional services for infrastructure projects. Consistent with the Build America, Buy America Act (BABAA) Pub. L. 117-58 §§ 70901-52, no federal financial assistance funding for infrastructure projects will be used unless all the iron, steel, manufactured projects, and construction materials used in the project are produced in the United States."

10. Providing Good, Safe Jobs to Workers

Recipients and subrecipients should pursue additional steps that improve the quality of jobs on FEMA-funded projects and encourage fair labor practices and a highly skilled workforce in FEMA-funded projects by ensuring that contractors comply with applicable worker protection laws. By encouraging these practices, contractors can create high-quality, good-paying jobs, attract and retain skilled workers, increase productivity, and produce high-quality outcomes for federal projects. FEMA strongly encourages all recipients and subrecipients using FEMA financial assistance to include in their contracts a statement that contractors will comply with all applicable worker protection laws.

⁷⁴ Section 70914 of Pub. L. 117-58 §§ 70901-52; 2 C.F.R. § 200.322(c); 2 C.F.R. Part 184.1(b).

10.1 Suggested Language

The following provides a sample contract clause:

“Creating Good Jobs.

Pursuant to [FEMA Information Bulletin No. 520](#), the contractor will comply with all applicable federal labor and employment laws. To maximize cost efficiency and quality of work, the contractor commits to strong labor standards and protections for the project workforce by creating an effective plan for ensuring high-quality jobs and complying with federal labor and employment laws. The contractor acknowledges applicable minimum wage, overtime, prevailing wage, and health and safety requirements, and will incorporate [Good Jobs Principles](#) wherever appropriate and to the greatest extent practicable.”

11. Buy Clean

On August 16, 2022, the President signed the Inflation Reduction Act (IRA) into law. The IRA is applicable for disasters declared, or Notice of Funding Opportunities published, on or after August 16, 2022, and the authority expires on September 30, 2026. FEMA is authorized by Section 70006 to provide financial assistance through its Public Assistance (PA), Building Resilient Infrastructure and Communities (BRIC), Hazard Mitigation Grant Program (HMGP), HMGP Post Fire, and Congressionally Directed Pre-Disaster Mitigation (PDM) for: "(1) costs associated with low-carbon materials; and (2) incentives that encourage low-carbon and net-zero energy projects." For low carbon materials, this assistance is applicable even if those costs are higher than that of conventional materials.

The use of low carbon materials may be eligible under other FEMA grant programs provided the recipient or subrecipient follows all applicable legal and programmatic requirements.

For more information about the IRA's authorization of the use of clean, climate resilient materials see [Building Clean, Climate-Resilient Communities through FEMA's Grant Programs | FEMA.gov](#).

11.1 Applicability

For PA, HMGP, HMGP Post Fire, BRIC and PDM grants, FEMA recommends that recipients and subrecipients include a provision encouraging the consideration of low-carbon materials. Recipients and subrecipients for other FEMA grant programs may also use this provision if they wish to encourage environmentally friendly construction practices.

11.2 Suggested Language

The following provides a sample contract clause:

“(Insert name of the recipient or subrecipient) encourages the use of environmentally friendly construction practices in the performance of this Agreement. In particular, (Insert name of the recipient or subrecipient) encourages that the performance of this agreement include considering the use of low-carbon materials which have substantially lower levels of embodied greenhouse-gas emissions associated with all relevant stages of production, use, and disposal, as compared to estimated industry averages of similar materials or products as demonstrated by their environmental product declaration.”

Acronyms

AFG: Assistance to Firefighter Grants

BABAA: Build America Buy America Act

BRIC: Building Resilient Infrastructure and Communities

CAGE: Commercial and Government Entity

CCP: Crisis Counseling Assistance & Training Program

CFR: Code of Federal Regulations

DCM: Disaster Case Management

DHS: U.S. Department of Homeland Security

DRRA: Disaster Recovery and Reform Act of 2018

EMPG: Emergency Management Performance Grant

EPA: U.S. Environmental Protection Agency

FAR: Federal Acquisition Regulation

FEMA: Federal Emergency Management Agency

FMAG: Fire Management Assistance Grant Program

HHPD: High Hazard Potential Dam Grant Program

HMA: Hazard Mitigation Assistance

HMGP: Hazard Mitigation Grant Program

HSGP: Homeland Security Grant Program

IHE: Institution of Higher Education

IHP-ONA: Individuals and Households Program – Other Needs Assistance

IPR: Intercity Passenger Rail Program

IRA: Inflation Reduction Act

JFO: Joint Field Office

NDAA: National Defense Authorization Act

NOFO: Notice of Funding Opportunity

NSGP: Nonprofit Security Grant Program

OMB: Office of Management and Budget

PA: Public Assistance Program

PSGP: Port Security Grant Program

RLF: Revolving Loan Fund

SAM: System for Award Management

SAT: Simplified Acquisition Threshold

THSGP: Tribal Homeland Security Grant Program

TSGP: Transit Security Grant Program

USC: United States Code

Definitions

- **Contract:** A legal instrument by which a FEMA award recipient or subrecipient purchases property or services needed to carry out the project or program under a federal award.⁷⁵ A contract, for the purposes of this Guide, does not mean a federal award or subaward.
- **Contractor:** An entity that receives a contract.⁷⁶
- **Cooperative agreement:** A legal instrument of financial assistance between a federal agency and a recipient or between a pass-through entity and subrecipient, consistent with 31 U.S.C. 6302-6305:
 - Is used to enter into a relationship the principal purpose of which is to transfer anything of value to carry out a public purpose authorized by a law of the United States (see 31 U.S.C. 6101(3)); and not to acquire property or services for the federal government or pass-through entity's direct benefit or use;
 - Is distinguished from a grant in that it provides for substantial involvement of the federal agency or pass-through entity in carrying out the activity contemplated by the federal award.

The term does not include:

- A cooperative research and development agreement as defined in 15 U.S.C. 3710a; or

An agreement that provides only:

- Direct United States Government cash assistance to an individual;
 - A subsidy;
 - A loan;
 - A loan guarantee; or Insurance.⁷⁷
- **Federal agency:** An “agency” as defined at 5 U.S.C. 551(1) and further clarified by 5 U.S.C. 552(f). The term generally refers to the agency that provides a federal award directly to a recipient unless the context indicates otherwise. See also definitions of federal award and recipient.⁷⁸ The federal agency discussed in this Guide is FEMA.

⁷⁵ 2 C.F.R. § 200.1 *Contract*.

⁷⁶ 2 C.F.R. § 200.1 *Contractor*.

⁷⁷ 2 C.F.R. § 200.1 *Cooperative agreement*.

⁷⁸ 2 C.F.R. § 200.1 *Federal agency*.

- **Federal award:** In this Guide, the term is used interchangeably with “FEMA Award” and means the federal financial assistance that a recipient receives directly from a federal agency or indirectly from a pass-through entity, as described in 2 C.F.R. § 200.101. The financial assistance that a recipient or subrecipient receives either directly from a federal agency or indirectly from a pass-through entity.⁷⁹
- **Federal Emergency Management Agency (FEMA):** FEMA’s statutory mission is to reduce the loss of life and property and protect the Nation from all hazards, including natural disasters, acts of terrorism, and other man-made disasters, by leading and supporting the Nation in a risk-based, comprehensive emergency management system of preparedness, protection, response, recovery, and mitigation.⁸⁰ Among other things:
 - FEMA administers its programs and carries out its activities through its headquarters offices in Washington, D.C.; 10 Regional Offices; Area Offices for the Pacific, Caribbean, and Alaska; various Recovery Offices; and temporary Joint Field Offices (JFO).
 - FEMA administers numerous assistance programs annually on a regular basis to increase the Nation’s preparedness, readiness, and resilience to all hazards. These assistance programs are typically available to recipients or subrecipients, including, but not limited to, states, local governments, Indian Tribes, universities, hospitals, and certain private nonprofit organizations.
 - Each program is governed by the applicable federal law, regulations, executive orders, and FEMA program-specific policies. As the federal agency for these programs, FEMA is responsible for the proper management and administration of these programs as otherwise required by law and enforcing the terms of the agreements it enters with recipients or subrecipients that receive FEMA financial assistance, consistent with the requirements at 2 C.F.R. Part 200.
- **Grant agreement or grant:** A legal instrument of financial assistance between a federal agency and a recipient or between a pass-through entity and a subrecipient, consistent with 31 U.S.C. § 6302, 6304: Is used to transfer anything of value from the federal agency or pass-through entity to the recipient or subrecipient to carry out a public purpose authorized by a law of the United States (see 31 U.S.C. § 6101(3)); and does not include an agreement that provides only:
 - Direct United States government cash assistance to an individual;
 - A loan;
 - A loan guarantee; or
 - A subsidy;
 - Insurance.⁸¹

⁷⁹ 2 C.F.R. § 200.1 *Federal award*.

⁸⁰ Homeland Security Act of 2002, Pub. L. No. 107-296, § 503 (2002) (codified as amended at 6 U.S.C. § 313).

⁸¹ 2 C.F.R. § 200.1 *Grant agreement or grant*.

- **Indian Tribe (or “federally recognized Indian tribe”):** Any Indian Tribe, band, nation, or other organized group or community, including any Alaska Native village or regional or village corporation as defined in or established pursuant to the Alaska Native Claims Settlement Act (43 U.S.C. Chapter 33), which is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians. See 25 U.S.C. 5304(e). This includes any Indian Tribe identified in the annually published Bureau of Indian Affairs list of [“Indian Entities Recognized and Eligible to Receive Services”](#) and other entities that qualify as an Alaska Native village or regional village corporation as defined in or established pursuant to the Alaska Native Claims Settlement Act.⁸²

- **Local government:**⁸³ Any unit of government within a state, including a:
 - County
 - Borough
 - Municipality
 - City
 - Town
 - Township
 - Parish
 - Special district
 - School District
 - Intrastate district
 - Council of governments, whether incorporated or not as a nonprofit corporation under state law
 - Local public authority, including any public housing agency under the United States Housing Act of 1937
 - Any other agency or instrumentality of a multi-regional, or intra-state or local government.

- **Nonprofit organization:** Any organization that:

⁸² 2 C.F.R. § 200.1 *Indian Tribe*.

⁸³ 2 C.F.R. § 200.1 *Local government*.

- Is operated primarily for scientific, educational, service, charitable, or similar purposes in the public interest;
 - Is not organized primarily for profit;
 - Uses net proceeds to maintain, improve, or expand the organization's operations; and
 - Is not an IHE.⁸⁴
- **Pass-through entity:** A recipient or subrecipient that provides a subaward to a subrecipient (including lower tier subrecipients) to carry out part of a federal program. The authority of the pass-through entity under this part flows through the subaward agreement between the pass-through entity and subrecipient.⁸⁵ Pass-through entities are responsible for processing subawards to subrecipients and ensuring subrecipient compliance with the terms and conditions of the FEMA award agreement.
 - **Political Subdivision:** The unit of government that the State determines to have met the State's legislative definition of a political subdivision.⁸⁶
 - **Recipient:** An entity that receives a federal award directly from a federal agency to carry out an activity under a federal program. The term recipient does not include subrecipients or individuals that are participants or beneficiaries of the award.⁸⁷ A recipient is responsible for administering the federal award in accordance with applicable federal laws. Examples of recipients include state, local, Indian tribal, and territorial governments.
 - **Simplified Acquisition Threshold (SAT):** The dollar amount below which a recipient or subrecipient may purchase property or services using small purchase methods (see 2 C.F.R. § 200.320). Recipients and subrecipients adopt small purchase procedures to expedite the purchase of items at or below the simplified acquisition threshold. The simplified acquisition threshold set in the FAR at 48 C.F.R. part 2, subpart 2.1 is used in this part as the simplified acquisition threshold for secondary procurement activities administered under Federal awards. The recipient or subrecipient is responsible for determining an appropriate simplified acquisition threshold, which is less than or equal to the dollar value established in the FAR, based on internal controls, an evaluation of risk, and its documented procurement procedures. Recipients and subrecipients should also determine if local government purchasing laws apply.⁸⁸ This threshold must never exceed the dollar value established in the FAR. Presently and as of June 2018, the federal SAT is \$250,000,⁸⁹ but is periodically adjusted for inflation.

⁸⁴ 2 C.F.R. § 200.1 *Nonprofit organization*.

⁸⁵ 2 C.F.R. § 200.1 *Pass-through entity*.

⁸⁶ 40 C.F.R. § 35.6015(a) *Political subdivision*

⁸⁷ 2 C.F.R. § 200.1 *Recipient*.

⁸⁸ Section 805 codified at 41 U.S.C. § 134; OMB Memo (M-18-18), available at <https://www.whitehouse.gov/wp-content/uploads/2018/06/M-18-18.pdf>.

⁸⁹ 2 C.F.R. § 200.1 *Simplified acquisition threshold*.

- **State:** Any state of the United States, the District of Columbia, the Commonwealth of Puerto Rico, U.S. Virgin Islands, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, and any agency or instrumentality thereof exclusive of local governments.⁹⁰ In this Guide, state is used interchangeably with “state entity”.
- **Subaward:** An award provided by a pass-through entity to a subrecipient for the subrecipient to contribute to the goals and objectives of the project by carrying out part of a federal award received by the pass-through entity. It does not include payments to a contractor, beneficiary, or participant. A subaward may be provided through any legal agreement consistent with criteria in 2 C.F.R. § 200.331, including an agreement the pass-through entity considers a contract.⁹¹ In this Guide, the term is used interchangeably with “subgrant.”
- **Subrecipient:** An entity that receives a subaward from a pass-through entity to carry out part of a federal award. The term subrecipient does not include a beneficiary or participant. A subrecipient may also be a recipient of other federal awards directly from a federal agency.⁹²

⁹⁰ 2 C.F.R. § 200.1 *State*. Some hospitals and IHEs as defined by 2 C.F.R. § 200.1 *Hospitals* and 2 C.F.R. § 200.1 *Institutions of Higher Education* respectively, may meet the definition of a State.

⁹¹ 2 C.F.R. § 200.1 *Subaward*.

⁹² 2 C.F.R. § 200.1 *Subrecipient*.

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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.

PERFORMANCE BOND

Prepared By



Endorsed By



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GUIDELINES FOR USE OF EJCDC® C-610, PERFORMANCE BOND

1.0 PURPOSE AND INTENDED USE OF THE DOCUMENT

The Performance Bond is the document in which the Contractor and Surety provide assurances to the Owner regarding the performance and completion of the Contractor's obligations under the construction contract. The Performance Bond establishes the responsibilities of the Surety with regard to a default in performance by the Contractor.

The Owner typically provides the Performance Bond form to prospective Bidders or Contractors, sometimes with some of the Project-specific information (for example, Owner's correct legal entity name) inserted in the form. After a Contractor has been selected, the Contractor's Surety issues the actual executed Performance Bond, based on the form, and the Contractor submits the executed Performance Bond to Owner at the time the Contract is signed.

For additional information regarding C-610, see EJCDC® C-001, Commentary on the 2018 EJCDC Construction Documents (2018).

2.0 ORGANIZATION OF INFORMATION

All parties involved in a construction project benefit significantly from a standardized approach in the location of subject matter throughout the documents. Experience confirms the danger of addressing the same subject matter in more than one location; doing so frequently leads to confusion and unanticipated legal consequences. Careful attention should be given to the guidance provided in EJCDC® N-122/AIA® A521, Uniform Location of Subject Matter (2012 Edition) when preparing documents. EJCDC® N-122/AIA® A521 is available at no charge from the EJCDC website, www.ejcdc.org, and from the websites of EJCDC's sponsoring organizations.

If CSI MasterFormat™ is used for organizing the Project Manual, consult CSI MasterFormat™ for the appropriate document number (e.g., under 00 11 00, Advertisements and Invitations), and accordingly number the document and its pages.

3.0 EDITING THIS DOCUMENT

3.1 It is intended that this document be edited before being furnished as a form to prospective Bidders or Contractors, and for each actual issuance of a Performance Bond. Guidelines for editing include:

- A. Remove the cover pages which consist of the title pages and these Guidelines for Use.
- B. Type in required information as indicated by brackets ([]). Bracketed text will usually provide instructions for what is to be inserted in place of the brackets. Delete brackets and change formatting to match existing text after project specific text has been added, e.g. change "[Project Name]" to "Peach Street Renovation" (without brackets or bold, or quotation marks).
- C. Fill in blanks, if any. It will be more common for information to be inserted by user to be indicated by a prompt in brackets, as described in Paragraph B above, rather than by an underline-style blank.

D. Modify check-boxes as required by clicking in the box.

4.0 LICENSE AGREEMENT

This document is subject to the terms and conditions of the **License Agreement, 2018 EJCDC® Construction Series Documents**. A copy of the License Agreement was furnished at the time of purchase of this document, and is available for review at www.ejcdc.org and the websites of EJCDC's sponsoring organizations.

PERFORMANCE BOND

Contractor Name: [Full formal name of Contractor] Address <i>(principal place of business)</i> : [Address of Contractor's principal place of business]	Surety Name: [Full formal name of Surety] Address <i>(principal place of business)</i> : [Address of Surety's principal place of business]
Owner Name: Dunes Community Development District Mailing address <i>(principal place of business)</i> : 101 Jungle Hut Road, Palm Coast, FL	Contract Description <i>(name and location)</i> : Reverse Osmosis Membrane Feed Pump Replacement Contract Price: [Amount from Contract] Effective Date of Contract: [Date from Contract]
Bond Bond Amount: [Amount] Date of Bond: [Date] <i>(Date of Bond cannot be earlier than Effective Date of Contract)</i> Modifications to this Bond form: ☐ None ☐ See Paragraph 16	
Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Performance Bond, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.	
Contractor as Principal	Surety
<i>(Full formal name of Contractor)</i>	<i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <i>(Signature)</i>	By: _____ <i>(Signature)(Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <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 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: **None**

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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.

PAYMENT BOND



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GUIDELINES FOR USE OF EJCDC® C-615, PAYMENT BOND

1.0 PURPOSE AND INTENDED USE OF THE DOCUMENT

The Payment Bond is the document in which the Contractor and its Surety commit to making payment to Subcontractors and Suppliers for labor, materials, and equipment provided to Contractor for the benefit of the Project and Owner. This bond form sets forth the obligations of the Surety to the Owner in the event Contractor fails to pay a Subcontractor or Supplier.

For additional information regarding EJCDC® C-615, see EJCDC® C-001, Commentary on the 2018 EJCDC Construction Documents (2018).

2.0 ORGANIZATION OF INFORMATION

All parties involved in a construction project benefit significantly from a standardized approach in the location of subject matter throughout the documents. Experience confirms the danger of addressing the same subject matter in more than one location; doing so frequently leads to confusion and unanticipated legal consequences. Careful attention should be given to the guidance provided in EJCDC® N-122/AIA® A521, Uniform Location of Subject Matter (2012 Edition) when preparing documents. EJCDC® N-122/AIA® A521 is available at no charge from the EJCDC website, www.ejcdc.org, and from the websites of EJCDC's sponsoring organizations.

If CSI MasterFormat™ is used for organizing the Project Manual, consult CSI MasterFormat™ for the appropriate document number (e.g., under 00 11 00, Advertisements and Invitations), and accordingly number the document and its pages.

3.0 EDITING THIS DOCUMENT

3.1 It is intended that this document be edited before being furnished as a form to prospective Bidders or Contractors, and for each actual issuance of a Payment Bond. Guidelines for editing include:

- A. Remove the cover pages which consist of the title pages and these Guidelines for Use.
- B. Type in required information as indicated by brackets ([]). Bracketed text will usually provide instructions for what is to be inserted in place of the brackets. Delete brackets and change formatting to match existing text after project specific text has been added, e.g. change “[Project Name]” to “Peach Street Renovation” (without brackets or bold, or quotation marks).
- C. Fill in blanks, if any. It will be more common for information to be inserted by user to be indicated by a prompt in brackets, as described in Paragraph B above, rather than by an underline-style blank.
- D. Modify check-boxes as required by clicking in the box.

4.0 LICENSE AGREEMENT

This document is subject to the terms and conditions of the **License Agreement, 2018 EJCDC® Construction Series Documents**. A copy of the License Agreement was furnished at the time of purchase of this document, and is available for review at www.ejcdc.org and the websites of EJCDC's sponsoring organizations.

PAYMENT BOND

Contractor Name: [Full formal name of Contractor] Address <i>(principal place of business)</i> : [Address of Contractor's principal place of business]	Surety Name: [Full formal name of Surety] Address <i>(principal place of business)</i> : [Address of Surety's principal place of business]
Owner Name: Dunes Community Development District Mailing address <i>(principal place of business)</i> : 101 Jungle Hut Road, Palm Coast, FL 32137	Contract Description <i>(name and location)</i> : Reverse Osmosis Membrane Feed Pump Replacement Contract Price: [Amount, from Contract] Effective Date of Contract: [Date, from Contract]
Bond Bond Amount: [Amount] Date of Bond: [Date] <i>(Date of Bond cannot be earlier than Effective Date of Contract)</i> Modifications to this Bond form: ☐ None ☐ 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
<i>(Full formal name of Contractor)</i>	<i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <i>(Signature)</i>	By: _____ <i>(Signature)(Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <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: **None**

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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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GUIDELINES FOR USE OF EJCDC® C-700, STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

1.0 PURPOSE AND INTENDED USE OF THE DOCUMENT

EJCDC® C-700, Standard General Conditions of the Construction Contract (2018), is the foundation document for the EJCDC Construction Series. The General Conditions define the basic rights, responsibilities, risk allocations, and contractual relationship of the Owner and Contractor, and establish how the Contract is to be administered.

2.0 OTHER DOCUMENTS

EJCDC documents are intended to be used as a system and changes in one EJCDC document may require a corresponding change in other documents. Other EJCDC documents may also serve as a reference to provide insight or guidance for the preparation of this document.

These General Conditions have been prepared for use with either EJCDC® C-520, Agreement Between Owner and Contractor for Construction Contract (Stipulated Price), or EJCDC® C-525, Agreement Between Owner and Contractor for Construction Contract (Cost-Plus-Fee) (2018 Editions). The provisions of the General Conditions and the Agreement are interrelated, and a change in one may necessitate a change in the other.

To prepare supplementary conditions that are coordinated with the General Conditions, use EJCDC® C-800, Supplementary Conditions of the Construction Contract (2018).

The full EJCDC Construction series of documents is discussed in the EJCDC® C-001, Commentary on the 2018 EJCDC Construction Documents (2018).

3.0 ORGANIZATION OF INFORMATION

All parties involved in a construction project benefit significantly from a standardized approach in the location of subject matter throughout the documents. Experience confirms the danger of addressing the same subject matter in more than one location; doing so frequently leads to confusion and unanticipated legal consequences. Careful attention should be given to the guidance provided in EJCDC® N-122/AIA® A521, Uniform Location of Subject Matter (2012 Edition) when preparing documents. EJCDC® N-122/AIA® A521 is available at no charge from the EJCDC website, www.ejcdc.org, and from the websites of EJCDC's sponsoring organizations.

If CSI MasterFormat™ is used for organizing the Project Manual, consult CSI MasterFormat™ for the appropriate document number (e.g., under 00 11 00, Advertisements and Invitations), and accordingly number the document and its pages.

4.0 EDITING THIS DOCUMENT

Remove these Guidelines for Use. Some users may also prefer to remove the two cover pages.

Although it is permissible to revise the Standard EJCDC Text of C-700 (the content beginning at page 1 and continuing to the end), it is common practice to leave the Standard EJCDC Text of C-700 intact and unaltered, with modifications and supplementation of C-700's provisions set forth in EJCDC® C-800, Supplementary Conditions of the Construction Contract (2018). If the Standard Text itself is revised, the

user must comply with the terms of the License Agreement, Paragraph 4.0, Document-Specific Provisions, concerning the tracking or highlighting of revisions. The following is a summary of the relevant License Agreement provisions:

1. The term “Standard EJCDC Text” for C-700 refers to all text prepared by EJCDC in the main body of the document. Document covers, logos, footers, instructions, or copyright notices are not Standard EJCDC Text for this purpose.
2. During the drafting or negotiating process for C-700, it is important that the two contracting parties are both aware of any changes that have been made to the Standard EJCDC Text. Thus, if a draft or version of C-700 purports to be or appears to be an EJCDC document, the user must plainly show all changes to the Standard EJCDC Text, using “Track Changes” (redline/strikeout), highlighting, or other means of clearly indicating additions and deletions.
3. If C-700 has been revised or altered and is subsequently presented to third parties (such as potential bidders, grant agencies, lenders, or sureties) as an EJCDC document, then the changes to the Standard EJCDC Text must be shown, or the third parties must receive access to a version that shows the changes.
4. Once the document is ready to be finalized (and if applicable executed by the contracting parties), it is no longer necessary to continue to show changes to the Standard EJCDC Text. The user may produce a final version of the document in a format in which all changes are accepted, and the document at that point does not need to include any “Track Changes,” redline/strikeout, highlighting, or other indication of additions and deletions to the Standard EJCDC Text.

5.0 LICENSE AGREEMENT

This document is subject to the terms and conditions of the **License Agreement, 2018 EJCDC® Construction Series Documents**. A copy of the License Agreement was furnished at the time of purchase of this document, and is available for review at www.ejcdc.org and the websites of EJCDC’s sponsoring organizations.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

TABLE OF CONTENTS

	Page
Article 1—Definitions and Terminology.....	1
1.01 Defined Terms.....	1
1.02 Terminology	6
Article 2—Preliminary Matters	7
2.01 Delivery of Performance and Payment Bonds; Evidence of Insurance.....	7
2.02 Copies of Documents	7
2.03 Before Starting Construction	7
2.04 Preconstruction Conference; Designation of Authorized Representatives	8
2.05 Acceptance of Schedules	8
2.06 Electronic Transmittals	8
Article 3—Contract Documents: Intent, Requirements, Reuse.....	9
3.01 Intent.....	9
3.02 Reference Standards.....	9
3.03 Reporting and Resolving Discrepancies	10
3.04 Requirements of the Contract Documents.....	10
3.05 Reuse of Documents	11
Article 4—Commencement and Progress of the Work	11
4.01 Commencement of Contract Times; Notice to Proceed.....	11
4.02 Starting the Work.....	11
4.03 Reference Points	11
4.04 Progress Schedule	12
4.05 Delays in Contractor’s Progress	12
Article 5—Site; Subsurface and Physical Conditions; Hazardous Environmental Conditions	13
5.01 Availability of Lands	13
5.02 Use of Site and Other Areas.....	14
5.03 Subsurface and Physical Conditions.....	15
5.04 Differing Subsurface or Physical Conditions	16

5.05	Underground Facilities	17
5.06	Hazardous Environmental Conditions at Site	19
Article 6—Bonds and Insurance.....		21
6.01	Performance, Payment, and Other Bonds	21
6.02	Insurance—General Provisions	22
6.03	Contractor’s Insurance.....	24
6.04	Builder’s Risk and Other Property Insurance	25
6.05	Property Losses; Subrogation	25
6.06	Receipt and Application of Property Insurance Proceeds	27
Article 7—Contractor’s Responsibilities		27
7.01	Contractor’s Means and Methods of Construction	27
7.02	Supervision and Superintendence	27
7.03	Labor; Working Hours	27
7.04	Services, Materials, and Equipment	28
7.05	“Or Equals”	28
7.06	Substitutes	29
7.07	Concerning Subcontractors and Suppliers.....	31
7.08	Patent Fees and Royalties.....	32
7.09	Permits	33
7.10	Taxes	33
7.11	Laws and Regulations.....	33
7.12	Record Documents.....	33
7.13	Safety and Protection	34
7.14	Hazard Communication Programs	35
7.15	Emergencies	35
7.16	Submittals	35
7.17	Contractor’s General Warranty and Guarantee	38
7.18	Indemnification	39
7.19	Delegation of Professional Design Services	39
Article 8—Other Work at the Site.....		40
8.01	Other Work	40
8.02	Coordination	41
8.03	Legal Relationships.....	41

Article 9—Owner’s Responsibilities	42
9.01 Communications to Contractor	42
9.02 Replacement of Engineer	42
9.03 Furnish Data	42
9.04 Pay When Due.....	42
9.05 Lands and Easements; Reports, Tests, and Drawings	43
9.06 Insurance.....	43
9.07 Change Orders	43
9.08 Inspections, Tests, and Approvals.....	43
9.09 Limitations on Owner’s Responsibilities	43
9.10 Undisclosed Hazardous Environmental Condition.....	43
9.11 Evidence of Financial Arrangements.....	43
9.12 Safety Programs	43
Article 10—Engineer’s Status During Construction	44
10.01 Owner’s Representative.....	44
10.02 Visits to Site.....	44
10.03 Resident Project Representative.....	44
10.04 Engineer’s Authority	44
10.05 Determinations for Unit Price Work	45
10.06 Decisions on Requirements of Contract Documents and Acceptability of Work	45
10.07 Limitations on Engineer’s Authority and Responsibilities	45
10.08 Compliance with Safety Program.....	45
Article 11—Changes to the Contract	46
11.01 Amending and Supplementing the Contract	46
11.02 Change Orders	46
11.03 Work Change Directives.....	46
11.04 Field Orders.....	47
11.05 Owner-Authorized Changes in the Work	47
11.06 Unauthorized Changes in the Work.....	47
11.07 Change of Contract Price	47
11.08 Change of Contract Times.....	49
11.09 Change Proposals.....	49
11.10 Notification to Surety.....	50

Article 12—Claims.....	50
12.01 Claims.....	50
Article 13—Cost of the Work; Allowances; Unit Price Work	51
13.01 Cost of the Work	51
13.02 Allowances	55
13.03 Unit Price Work.....	55
Article 14—Tests and Inspections; Correction, Removal, or Acceptance of Defective Work	56
14.01 Access to Work.....	56
14.02 Tests, Inspections, and Approvals.....	56
14.03 Defective Work	57
14.04 Acceptance of Defective Work.....	58
14.05 Uncovering Work	58
14.06 Owner May Stop the Work	58
14.07 Owner May Correct Defective Work.....	59
Article 15—Payments to Contractor; Set-Offs; Completion; Correction Period	59
15.01 Progress Payments.....	59
15.02 Contractor’s Warranty of Title	62
15.03 Substantial Completion.....	62
15.04 Partial Use or Occupancy	63
15.05 Final Inspection	64
15.06 Final Payment.....	64
15.07 Waiver of Claims	65
15.08 Correction Period	66
Article 16—Suspension of Work and Termination	67
16.01 Owner May Suspend Work	67
16.02 Owner May Terminate for Cause.....	67
16.03 Owner May Terminate for Convenience.....	68
16.04 Contractor May Stop Work or Terminate	68
Article 17—Final Resolution of Disputes	69
17.01 Methods and Procedures.....	69
Article 18—Miscellaneous	69
18.01 Giving Notice	69
18.02 Computation of Times.....	69

18.03	Cumulative Remedies	70
18.04	Limitation of Damages	70
18.05	No Waiver	70
18.06	Survival of Obligations	70
18.07	Controlling Law	70
18.08	Assignment of Contract.....	70
18.09	Successors and Assigns	70
18.10	Headings.....	70

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.

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SECTION 007300.16 - SUPPLEMENTARY CONDITIONS

TABLE OF CONTENTS

PART I - AMENDMENTS TO GENERAL CONDITIONS

Article Number	Title
1	DEFINITIONS AND TERMINOLOGY
2	PRELIMINARY MATTERS
3	DOCUMENTS; INTENT, REQUIREMENTS, REUSE
4	COMMENCEMENT AND PROGRESS OF THE WORK
5	SITE; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS
6	BONDS AND INSURANCE
7	CONTRACTOR'S RESPONSIBILITIES
8	OTHER WORK AT THE SITE
9	OWNER'S RESPONSIBILITIES
10	ENGINEER'S STATUS DURING CONSTRUCTION
11	AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK
13	COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK
14	TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK
15	PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD
16	SUSPENSION OF WORK AND TERMINATION
17	FINAL RESOLUTION OF DISPUTES
18	MISCELLANEOUS

SECTION 007300.16 - SUPPLEMENTARY CONDITIONS

PART 1 - AMENDMENTS TO GENERAL CONDITIONS

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract (EJCDC Document No. C-700, 2018 edition) and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY

SC-1.01A.39.

Delete paragraph 1.01A.39. of the General Conditions in its entirety and replace with the following:

39. Specifications - Sections included under Division 01 through Division 43 of the Project Manual.

42. Add the following sentence to the definition of Substantial Completion:

Including as further defined for this project in Section 017700 Closeout Procedures.

ARTICLE 2 - PRELIMINARY MATTERS

SC-2.01C.

Delete Paragraph 2.01C of the General Conditions in its entirety.

SC-2.02A.

Delete "four" in the first line and replace with "one."

ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

SC-3.01G.

Add the following new paragraph immediately after Paragraph 3.01G. of the General Conditions which is to read as follows:

H. Each and every provision of law and clause required by law to be inserted in these Contract Documents shall be deemed to be inserted herein, and they shall be read and enforced as though they were included herein, and if through mistake or otherwise, any such provision is not inserted, or if not correctly inserted, then upon the application of either party, the Contract Documents shall forthwith be physically amended to make such insertion.

ARTICLE 4 - COMMENCEMENT AND PROGRESS OF THE WORK

SC-4.01A.

Delete Paragraph 4.01A of the General Conditions in its entirety and replace with the following:

A. The Contract Time will commence to run on following the Effective Date of the Agreement.

SC-4.03A.

Add the following new paragraph immediately after Paragraph 4.03A of the General Conditions which is to read as follows:

B. Engineer may check the lines, elevations, reference marks, batter boards, etc., set by Contractor, and Contractor shall correct any errors disclosed by such check. Such a check shall not be considered approval of Contractor's work and shall not relieve Contractor of the responsibility for accurate construction of the entire Work. Contractor shall furnish personnel to assist Engineer in checking lines and grades.

ARTICLE 5 - SITE; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

SC-5.01A.

Add the following new paragraph immediately after Paragraph 5.01A. of the General Conditions which is to read as follows:

1. If all lands and rights-of-way are not obtained as herein contemplated before construction begins, Contractor shall begin the Work upon such land and rights-of-way as Owner has previously acquired.

SC-5.03

Delete Paragraph 5.03 A.2 of the General Conditions in its entirety and replace it with the following:

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 used in preparing the Contract Documents. In the preparation of Drawings and Specifications, the Engineer has relied upon the following site record drawings:

- a. Dunes Community Development District Reverse Osmosis Water Treatment Plant Phase I & Phase II, Volume 4 of 4, dated September 2007, prepared by CH2MHILL, under CH2MHILL Project No. 323491.62.
- b. Dunes Community Development District Water Treatment Plant Expansion, dated April 2014, prepared by McKim&Creed, under McKim&Creed Project No. 01012-0002

Copies of these record drawings may be examined by appointment at the Engineer's office during regular business hours or digital copies requested for electronic delivery. Such record drawings are not part of the Contract Documents.

SC-5.06

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

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

ARTICLE 6 - BONDS AND INSURANCE

SC-6.01B.

Add the following paragraph immediately after Paragraph 6.01B of the General Conditions:

1. Contractor shall furnish Efficiency Guarantee Bonds in accordance with and executed on forms approved by the Owner.

SC-6.02D

Add the following paragraphs immediately after Paragraph 6.02D of the General Conditions which are to read as follows:

1. Contractor shall provide evidence of its insurance coverage on the ACORD certificate of insurance form and shall include the following statement in its entirety in the section of the form entitled "Description of Operations/Locations/Vehicles/Special Items".

2. Dunes Community Development District, Dunes Board of Supervisors, and CDM Smith Inc., and their subsidiaries, officers, directors, partners, employees and other consultants and subcontractors are named as additional insureds with respect to the insured's Commercial General Liability, Automobile Liability and Pollution Liability Insurance Policies. All insurers waive all rights of subrogation against Dunes Community Development District and CDM Smith Inc., their subsidiaries, officers, directors, partners, employees and other consultants and subcontractors. All insurance is primary for all claims covered thereby. Commercial General Liability Insurance includes contractual liability coverage.

SC-6.02.G.

Replace the existing Paragraph 6.02.G with the following:

G. Contractor shall purchase and maintain a separate Owner's Protective Liability policy, issued to Owner at the expense of Contractor, including Owner and Engineer as named insured. This insurance shall provide coverage for not less than the following amounts:

1. Bodily Injury	\$1,000,000	Each Occurrence
2. Property Damage	\$1,000,000	Each Occurrence
	\$1,000,000	Annual Aggregate

SC-6.03

Add new Subparagraph 6.03.A.1 as follows:

1. Contractor's Insurance

- a. Workers' Compensation: Contractor shall purchase and maintain workers' compensation and employer's liability insurance for:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts.
2. United States Longshoreman and Harbor Workers' Compensation Act and Jones Act coverage (if applicable).
3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees (by stop-gap endorsement in monopolist worker's compensation states).
4. Foreign voluntary worker compensation (if applicable)
5. Stop Gap Employer Liability for work in ND, OH, WA, WY & Puerto Rico
6. The limits of liability for the workers compensation insurance required by Paragraph 6.03 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by law.

(1)	Worker's Compensation	Statutory
(2)	Employer's Liability	\$1,000,000 Each Occurrence \$1,000,000 Disease per employee
(3)	U.S. Longshoremen's and Harbor Workers' Compensation Act	\$1,000,000
(4)	Admiralty Jurisdiction, Coverage/Program II	\$1,000,000

- b. 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:

1. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees.
2. claims for damages insured by reasonably available personal injury liability coverage.
3. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.
4. Contractor's commercial liability policy shall be written on a 1996 (or later) ISO commercial general liability form (occurrence form) and include the following coverages and endorsements:
5. Products and completed operations coverage:
 - 1) Such insurance shall be maintained for three years after final payment.
 - 2) 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.
6. Blanket contractual liability coverage, to the extent permitted by law, including but not limited to tort liability and coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.

7. Severability of interest.
8. Underground, explosion, and collapse coverage.
9. Personal injury coverage.
10. 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 CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.
11. For design professional additional insureds, ISO Endorsement CG 20 32 07 04, “Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured” or its equivalent.
12. There shall be no specific exclusions associated with scope or work or any cross-suit exclusions for Additional Insureds.
13. Commercial General Liability Insurance shall not be less than the following amounts.

Bodily Injury:	\$2,000,000	Each Occurrence
	\$4,000,000	Annual Aggregate
Property Damage:	\$2,000,000	Each Occurrence
	\$4,000,000	Annual Aggregate
Personal Injury:	\$4,000,000	Annual Aggregate

- c. Comprehensive Automobile Liability including all owned (private and others), hired and non-owned vehicles, including contractual liability coverage and MCS-90 endorsement if Contractor is hauling goods:

Bodily Injury	\$1,000,000	
Personal Injury	\$1,000,000	Each Accident
Property Damage:	\$1,000,000	Each Occurrence

- d. Umbrella or Excess Liability:

Per Occurrence	\$5,000,000
General Aggregate	\$5,000,000

- e. Contractor’s Pollution Liability:

Each Occurrence	\$2,000,000
General Aggregate	\$2,000,000

- f. Contractor’s Professional Liability:

Each Claim	\$1,000,000
Annual Aggregate	\$2,000,000

SC 6.03 B

Add a new subparagraph 6.03 B .6 as follows

6. All policies of insurance required to be provided by the Contractor shall contain provisions that the insurer(s) waive all rights of subrogation against the Owner, Engineer, and their officers, directors, partners and other consultants and subcontractors of each and any of them and other parties identified in the Supplementary Conditions.

SC 6.03 C.1 Additional Insureds

Add the following two sentences to subparagraph 6.03.C.1 of the General Conditions:

Dunes Community Development District, Dunes Board of Supervisors, and CDM Smith Inc., and their subsidiaries officers, directors, partners, employees and other consultants and subcontractors are named as additional insureds. All insurers waive all rights of subrogation against Dunes Community Development District and CDM Smith Inc., their subsidiaries, officers, directors, partners, employees and other consultants and subcontractors.

SC 6.04 Builder's Risk and Other Property Insurance

SC-6.04.A.1

Add the following new subparagraph after subparagraph 6.04.A:

1. In addition to Owner, Contractor, and all Subcontractors, include as insureds the following: CDM Smith Inc., and their subsidiaries, officers, directors, partners, employees and other consultants and subcontractors.
2. include for the benefit of Owner loss of profits and soft cost coverage including, without limitation, fixed expenses and debt service for a minimum of 12 months with a maximum deductible of 30 days, plus attorneys' fees and engineering or other consultants' fees, if not otherwise covered;

SC-6.04F

Add Paragraph 6.04.F after Paragraph 6.04E of the General Conditions.

F. All policies required by this Paragraph shall contain provisions to the effect that the insurer(s) waive all rights of subrogation against the Owner, Engineer and their officers, directors, partners, employees and other consultants and subcontractors of each and any of them.

G. 7 - CONTRACTOR'S RESPONSIBILITIES

SC-7.02

Add the following new paragraphs, C through J, immediately after Paragraph 7.02B. of the General Conditions which are to read as follows:

C. Regular working hours are defined as 8 hours per day, Monday through Friday, excluding holidays, between the hours of 7:00 AM and 3:30 PM. Requests to work other than regular working hours shall be

submitted to Owner and Engineer not less than 48 hours prior to any proposed weekend work or scheduled extended work weeks. Occasional unscheduled overtime on weekdays may be permitted provided two hours' notice is given to Owner and Engineer.

D. Contractor shall reimburse the Owner for additional engineering and/or inspection costs incurred as a result of overtime work in excess of the regular working hours stipulated in Paragraph SC-7.02C. At Owner's option, overtime costs may either be deducted from the Contractor's monthly payment request or deducted from the Contractor's retention prior to release of final payment. Overtime costs for the Owner's personnel shall be based on the individual's current overtime wage rate. Overtime costs for personnel employed by the Engineer or Owner's independent testing laboratory shall be calculated in accordance with the terms of their respective contracts with the Owner.

E. This Agreement is subject to the applicable provisions of the Contract Work Hours and Safety Standards Act, Public Law 87-581, 87th Congress. No Contractor or Subcontractor contracting for any part of the Work shall require or permit any laborer or mechanic to be employed on the Work in excess of forty hours in any work week unless such laborer or mechanic receives compensation at a rate not less than one and one-half times that person's basic rate of pay for all hours worked in excess of forty hours in such work week.

F. Contractor shall employ only competent persons to do the work and whenever Owner shall notify Contractor, in writing, that any person on the Work appears to be incompetent, disorderly, or otherwise unsatisfactory, such person shall be removed from the Project and shall not again be employed on it except with the consent of Owner.

G. Contractor and Subcontractors shall, insofar as practicable, give preference in the hiring of workers for the Project to qualified local residents with first preference being given to citizens of the United States who have served in the armed forces of the United States and have been honorably discharged therefrom or released from active duty therein.

H. Contractor and all Subcontractors shall pay to all laborers and mechanics employed for the construction covered by this Contract the minimum rates of pay as determined by the Secretary of Labor in accordance with the Act of March 3, 1931, as amended, known as the Davis-Bacon Act (40 U.S.C. 276a through 276a-7). Furthermore, Contractor and Subcontractors shall adhere to the stipulations and provisions published by the Secretary of Health, Education, and Welfare in "Labor Standards (Federal Water Pollution Control Act)." The Wage Rate Schedule as prepared by the Secretary of Labor and the "Labor Standards" are part of this Contract and are included in PART II of these Supplementary Conditions.

I. Except as may be otherwise required by law, all claims and disputes pertaining to the classification of labor employed on the project under this Contract shall be decided by the governing body having jurisdiction.

J. Contractor and all Subcontractors shall comply with the Regulations of the Secretary of Labor made pursuant to the Anti-Kickback Act of June 30, 1940 (40 U.S.C. 276c) and all amendments or modifications thereto. Contractor and all Subcontractors shall furnish Owner with weekly Statements of Compliance. In case of Subcontracts, Contractor shall cause appropriate provision to be inserted in all subcontracts for the Work which Contractor may let to ensure compliance with said Anti-Kickback Act by all Subcontractors subject thereto, and Contractor shall be responsible for the submission of all Statements of Compliance required of Subcontractors by said Anti-Kickback Act except as the Secretary of Labor may specifically provide for reasonable limitations, variations, and exemptions from the

requirements thereof. These Regulations are part of this Contract and are included in PART II of these Supplementary Conditions.

SC-7.10A

Add the following new Paragraph 7.10B to the General Conditions to read as follows:

B. Certain materials and supplies to be used in the Work of this Contract may be exempt from the Sales and Use Tax of the State of Florida. Contractor shall obtain the proper certificates, maintain the necessary records and otherwise comply with the requirements of Florida and any amendments thereto.

SC-7.15A.

Delete the last sentence in Paragraph 7.15A. of the General Conditions in its entirety and replace with the following:

If Engineer determines that the incident giving rise to the emergency action was not the responsibility of the Contractor and that a change in the Contract Document is required because of the action taken by the Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

SC-7.16D.1.

Add the following new sentence at the end of paragraph 7.16.D.1 of the General Conditions to read as follows:

Approval of Shop Drawings for equipment requiring Efficiency Guarantee Bonds will be withheld until the receipt of such Bonds.

SC-7.17A.

Add the following new paragraph immediately after Paragraph 7.17A. of the General Conditions which is to read as follow:

1. The Contractor guarantees that the Work and Services to be performed under the Contract, and all workmanship, materials and equipment performed, furnished, used or installed in the construction of the same shall be free from defects and flaws, and shall be performed and furnished in strict accordance with the Drawings, Specifications, and other Contract Documents, that the strength of all parts of all manufactured equipment shall be adequate and as specified and that the performance test requirements of the Contract shall be fulfilled. This guarantee shall be for a period of one year from and after the date of substantial completion. If part of the Work is accepted in accordance with Paragraph 15.04 of the General Conditions, the guarantee for that part of the Work shall be for a period of one year from the date fixed for such acceptance.

2. If at any time within the said period of guarantee any part of the Work requires repairing, correction or replacement, the Owner may notify the Contractor in writing to make the required repairs, correction or replacements. If the Contractor neglects to commence making such repairs, corrections or replacements to the satisfaction of the Owner within seven (7) days from the date of receipt of such notice, or having commenced fails to prosecute such Work with diligence, the Owner may employ other persons to make said repairs, correction or replacements, and charge the costs, including compensation for additional professional services, to the Contractor.

3. The Contractor's guarantee under Paragraph 7.17A, is in addition to the Contractor's express or implied warranties under this Contract and State law and in no way diminish any other rights that the Owner may have against the Contractor.

SC-7.17E.

Add the following new paragraph immediately after Paragraph 7.17E. of the General Conditions which is to read as follows:

F. Manufacturer's Guaranty/Warranty

1. The Contractor shall obtain the following guaranty/warranty from the manufacturer of all major pieces of equipment furnished and installed on this Project. Such guaranty/warranty shall be for the benefit of Owner and be furnished in writing by the manufacturer. The Contractor's and manufacturer's obligations under this provision are in addition to other express or implied warranties under the Contract Documents and under the law and in no way diminish any other right that the Owner may have against the Contractor or manufacturer for faulty material, equipment or work. The warranty period shall not be interpreted as a limitation on the time in which the Owner can enforce such other duties, obligations, rights, or remedies.

2. The manufacturer warrants and guarantees for a period of one year from the date of Substantial Completion, or such longer period that may be specified in the Contract Documents, that all materials and equipment furnished and installed shall be free from flaws, defects in material and workmanship and shall be in conformance with the Contract Documents.

SC-7.18A.

Delete Paragraph 7.18A of the General Conditions in its entirety and replace with the following:

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 defend, indemnify and hold harmless Owner, Engineer and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses and damages (including but not limited to all reasonable fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost or loss or damage:

1. is attributable to bodily injury, sickness, disease or death or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom; and
2. is caused in whole or in part by any act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable, regardless of whether or not caused in part by any negligence or omission of an individual or entity indemnified hereunder or whether liability is imposed upon such indemnified party by Laws and Regulations regardless of the negligence of any such indemnified party unless caused by the sole negligence of a party indemnified hereunder. If through the omissions or acts of neglect on the part of Contractor, any other contractor or any Subcontractor shall suffer loss or damage on the Work, Contractor shall settle with such other contractor or Subcontractor by agreement or arbitration if such other contractor or Subcontractor will so settle. If such other contractor or Subcontractor shall assert any claim against Owner and/or Engineer, or the officers, directors, members, partners, employees, agents, consultants and

subcontractors of each on account of any damage alleged to have been sustained, Owner shall notify Contractor, who shall defend, indemnify and save harmless Owner, Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each against any such claims.

H. 8. OTHER WORK AT THE SITE

SC-8.03 A

Delete paragraph 8.03 A of the General Conditions in its entirety and replace with the following.

A. If, in the course of performing other work at or adjacent to the Site for Owner, the Owner's employees, any other contractor working for Owner, or any utility owner for whom the Owner is responsible 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 not institute any action, legal or equitable, against Owner, Engineer, Engineer's Consultants or the Construction Coordinator or permit any action against any of them to be maintained and continued in its name or for its benefit in any court or before any arbiter which seeks to impose liability on or to recover damages from Owner, Engineer, Engineer's Consultants or the Construction Coordinator on account of any such damage or claim. If Contractor is delayed at any time in performing or furnishing Work by any act or neglect of a separate contractor and Owner and Contractor are unable to agree as to the extent of any adjustment in Contract Times attributable thereto, Contractor may make a claim for an extension of times in accordance with Article 12. An extension of the Contract Times shall be Contractor's exclusive remedy with respect to Owner, Engineer, Engineer's Consultants and Construction Coordinator for any delay, disruption, interference or hindrance caused by any separate contractor. This paragraph does not prevent recovery from Owner, Engineer, Engineer's Consultant or Construction Coordinator for activities that are their respective responsibilities.

SC-8.03C.

Delete Paragraph 8.03C of the General Conditions in its entirety and replace with the following.

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, Engineer's Consultants, the Construction Coordinator or any person then Contractor shall 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, Contractor shall, to the fullest extent permitted by Laws and Regulations defend, indemnify and hold Owner, Engineer, Engineer's Consultants and the Construction Coordinator harmless from and against all claims, damages, losses and expenses (including, but not limited to, fees of engineers, architects, attorneys and other professionals, and court and arbitration or mediation costs) arising directly, indirectly or consequentially out of any action, legal or equitable, brought by any separate contractor against Owner, Engineer, Engineer's Consultants or the Construction Coordinator to the extent based on a claim arising out of Contractor's performance of the Work.

I. 9. OWNER'S RESPONSIBILITIES

SC-9.11A.

Add the following new paragraph immediately after Paragraph 9.11A of the General Conditions which is to read as follows:

B. Upon request of Contractor prior to the execution of any Change Order involving a significant percent increase in the Contract Price, Owner shall furnish to Contractor responsible evidence that adequate financial arrangements have been made by Owner to enable Owner to fulfill the increased financial obligations to be undertaken by Owner as a result of such Change Order.

SC-9.13

Add the following new paragraph immediately after Paragraph 9.12 of the General Conditions which is to read as follows:

9.13 Owner's Site Representative

A. Owner will furnish an "Owner's Site Representative" to represent Owner at the Site and assist Owner in observing the progress and quality of the Work. The Owner's Site Representative is not Engineer's consultant, agent, or employee.

J. 10 - ENGINEER'S STATUS DURING CONSTRUCTION

SC-10.03C

Add the following new paragraph immediately after Paragraph 10.03B of the General Conditions which is to read as follows:

C. On this Project, by agreement with the Owner, Engineer will not furnish a Resident Project Representative to represent Engineer at the Site or assist Engineer in observing the progress and quality of the Work.

K. 11 - CHANGES TO THE CONTRACT

If the Contract is EPA or by other agency funded that does not allow "agreed upon sums" include the following change:

SC-11.07B.2

Delete paragraph 11.07B.2. of the General Conditions in its entirety.

If the Contract is funded by the State Revolving Fund (SRF) or other state funds the following changes to Article 11.07C apply:

SC-11.07C.1.

Delete paragraph 11.07C.1 of the General Conditions in its entirety.

SC-11.07C.2.

Delete "15 percent" in the second line of paragraph 11.07C.2.a of the General Conditions and replace with "20 percent".

SC-11.07C.2.b.

In paragraph 11.07C.2.b, before the semicolon add the following words "based on subcontractor's Cost of the Work";

Delete "5 percent" in paragraph 11.07C.2.b of the General Conditions and replace with "7-1/2 percent."

Delete "15 percent" in the third line of paragraph 11.07C.2.c, of the General Conditions and replace with "20 percent" and delete "5 percent" in the seventh line and replace with "7-1/2 percent."

L. 13 - COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

SC-13.01B.1.

Delete the second sentence in paragraph 13.01B.1. of the General Conditions in its entirety and replace with the following:

Such employees shall include foremen at the site.

If the Contract is funded by the State Revolving Fund (SRF) or other state funds the following changes to Article 13.01 and 13.02 apply:

SC-13.01B.1.

Add the following new paragraph immediately after paragraph 13.01B.1. of the General Conditions which is to read as follows:

a. Following award and prior to execution of a construction contract Contractor shall establish, in the Agreement, the Direct Labor Cost percentage. This percentage, where approved by Owner, will be used in the determination of the Direct Labor Cost listed in the Change Order Form included in PART II of the Supplementary Conditions. The Direct Labor Costs are defined to include social security contributions, unemployment, excise and payroll taxes, workers' and workmen's compensation, health and retirement benefits, sick leave, vacation and holiday pay, and cost of premiums for all additional insurance required because of changes in the Work.

SC-13.02.

Delete Paragraph 13.02 of the General Conditions in its entirety.

SC-13.03E.

Delete Paragraph 13.03E. of the General Conditions in its entirety and replace with the following:

E. The unit price of an item of Unit Price Work shall be subject to re-evaluation and adjustment under the following conditions:

1. If the total cost of a particular item of Unit Price Work amounts to 10 percent or more of the Contract Price and the variation in the quantity of that particular item of Unit Price Work performed by Contractor differs by more than 25 percent from the estimated quantity of such item indicated in the Agreement; and
2. If there is no corresponding adjustment with respect to any other item of Work; and
3. If Contractor believes that Contractor has incurred additional expense as a result thereof; or if Owner believes that the quantity variation entitles Owner to an adjustment in the unit price, either Owner or Contractor may make a claim for an adjustment in the Unit Price for that quantity by which the actual quantity exceeds 115% of the estimated quantity in accordance with Article 12 if the parties are unable to agree as to the effect of any such variations in the quantity of Unit Price Work performed.

M. 14 - TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

SC-14.06A.

Add the following new paragraph immediately after Paragraph 14.06A. of the General Conditions to read as follows:

B. If Owner stops Work under Paragraph 14.06A. Contractor shall not be entitled to any extension of Contract Time or increase in Contract Price.

N. 15 - PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

SC-15.01B.1.

In the first sentence of paragraph 15.01.B.1 of the General Conditions delete the number "20" and replace with the number "5".

Add the following new paragraph under 15.01.B.1 of the General Conditions.

- a. Acceptable Record Drawings shall be submitted with Payment Applications or Payment will be withheld. Acceptable shall be solely defined by the OWNER.

SC-15.01B.4.

Add the following new paragraph immediately after paragraph 15.01B.4 of the General Conditions which is to read as follows:

5. Contractor shall furnish evidence that payment received on the basis of materials and equipment not incorporated and suitably stored, has in fact been paid to the respective supplier(s) within sixty (60) days of payment by Owner. Failure to provide such evidence of payment may result in the withdrawal of previous approval(s) and removal of the cost of related materials and equipment from the next submitted Application for Payment.

SC-15.01D.1.

Add the following new paragraphs immediately after paragraph 15.01D.1. of the General Conditions which are to read as follows:

2. Should Contractor neglect to pay any undisputed claims, made in writing to Owner within thirty days after completion of the Work, but continuing unsatisfied for a period of ninety days, Owner may pay such claim and deduct the amount thereof from the balance due Contractor. Owner may also, with the written consent of Contractor, use any monies retained, due, or to become due under this Contract for the purpose of paying for both labor and materials for the Work, for which claims have not been filed.
3. Security is provided both by the Payment Bond and the power of Owner to retain any monies for claims, but payment by one shall in no way impair or discharge the liability of the other.
4. All monies paid by Owner in settlement of liens, with the costs and expenses incurred by Owner in connection therewith, shall be charged to Contractor, shall bear interest at the rate of three percentage points above the rediscount rate then charged by the Federal Reserve Bank, and shall be deducted from the next payment due Contractor under the terms of this Contract.

SC-15.02

Add the following new paragraphs immediately after Paragraph 15.02A of the General Conditions which are to read as follows:

- B. No materials or supplies for the Work shall be purchased by Contractor or Subcontractor subject to any chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller. Contractor warrants that Contractor has good title to all materials and supplies used by Contractor in the Work, free from all liens, claims or encumbrances.
- C. Contractor shall defend, indemnify and save Owner and Engineer harmless from all claims growing out of the lawful demands of Subcontractors, laborers, workmen, mechanics, materialmen, and furnishers of machinery and parts thereof, equipment, power tools, and all supplies, including commissary, incurred in the furtherance of the performance of this Contract. Contractor shall at Owner's request, furnish satisfactory evidence that all obligations of the nature hereinabove designated have been paid, discharged, or waived. If Contractor fails to do so, then Owner may, after having served written notice on the said Contractor either pay unpaid bills, of which Owner has written notice, direct, or withhold from the Contractor's unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged whereupon payment to Contractor shall be resumed, in accordance with the terms of this Contract, but in no event shall the provisions of this sentence be construed to impose any obligations upon Owner to either Contractor or Contractor's Surety. In paying any unpaid bills of the Contractor, Owner shall be deemed the agent of Contractor and any payment so made by Owner shall be considered as payment made under the Contract by Owner to Contractor and Owner shall not be liable to Contractor for any such payment made in good faith.

SC-15.06B.

Delete paragraph 15.06B of the General Conditions in its entirety and replace with the following:

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 - all as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will indicate in writing Engineer's recommendation of payment and present the Application to Owner for payment. Thereupon Engineer will give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of paragraph 15.07. Otherwise, Engineer will return the Application to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application. If the Application and accompanying documentation are appropriate as to form and substance, Owner shall in accordance with the applicable laws and regulations, pay Contractor the amount recommended by Engineer.

SC-15.06E.

Add the following new paragraph immediately after Paragraph 15.06E. of the General Conditions which is to read as follows:

F. Final payment will be reduced by the amount of excessive costs of plant inspection of pipe. Excessive costs are defined as the inspection costs incurred by Owner for that amount of pipe which exceeds 125 percent of the aggregate length of each type installed.

O. 16 - SUSPENSION OF WORK AND TERMINATION

SC-16.02A.4.

Add the following new paragraph immediately after paragraph 16.02.A.4 of the General Conditions which is to read as follows:

5. If Contractor abandons the Work, or sublets this Contract or any part thereof, without the previous written consent of Owner, or if the Contract or any claim thereunder shall be assigned by Contractor otherwise than as herein specified.

P. 17 - FINAL RESOLUTION OF DISPUTES

SC-17.01A

Insert new paragraph 17.01A.3 of the General Conditions as follows:

3. Either Owner or Contractor may request mediation of any Claim. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of this Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract.

SC-17.01B.

Add a new paragraph immediately after paragraph 17.01B. of the General Conditions which is to read as follows:

C. Contractor shall carry on the Work and maintain the progress schedule during the dispute resolution proceedings, unless otherwise agreed by Contractor and Owner in writing.

Q. 18 - MISCELLANEOUS

SC-18.10

Add the following new paragraphs immediately after Paragraph 18.10 of the General Conditions which are to read as follows:

18.11 Addresses

A. Both the address given in the Bid Form upon which this Agreement is founded, and Contractor's office at or near the site of the Work are hereby designated as places to either of which notices, letters, and other communications to Contractor shall be certified, mailed, or delivered. The delivering at the above-named place, or depositing in a postpaid wrapper directed to the first-named place, in any post office box regularly maintained by the post office department, of any notice, letter or other communication to Contractor shall be deemed sufficient service thereof upon Contractor; and the date of said service shall be the date of such delivery or mailing. The first-named address may be changed at any time by an instrument in writing, executed and acknowledged by Contractor, and delivered to Owner and Engineer. Nothing herein contained shall be deemed to preclude or render inoperative the service of any notice, letter, or other communication upon Contractor personally.

18.12 Wage Rates

A. The requirements and provisions of all applicable laws and any amendments thereof or additions thereto as to the employment of labor, and to the schedule of minimum wage rates established in compliance with laws shall be a part of these Contract Documents. Copies of the wage schedules are included in PART II of these Supplementary Conditions. If, after the Notice of Award, it becomes necessary to employ any person in a trade or occupation not classified in the wage determinations, such person shall be paid at not less than such rates as shall be determined by the officials administering the laws mentioned above. Such approved minimum rate shall be retroactive to the time of the initial employment of such person in such trade or occupation. Contractor shall notify Owner of Contractor's intention to employ persons in trades or occupations not classified in sufficient time for Owner to obtain approved rates for such trades or occupations.

B. The schedules of wages referred to above are minimum rates only, and Owner will not consider any claims for additional compensation made by Contractor because of payment by Contractor of any wage rate in excess of the applicable rate contained in these Contract Documents. All disputes between Contractor and employees of Contractor in regard to the payment of wages in excess of these specified in the schedules shall be resolved by Contractor.

C. The said schedules of wages shall continue to be the minimum rates to be paid during the life of this Agreement and a legible copy of said schedules shall be kept posted in a conspicuous place at the site of the work.

D. Both Federal and State schedules of minimum wage rates are included in PART II of these Supplementary Conditions. Where rates differ, the higher rates shall apply as a minimum for that trade.

PART 2 - FEDERAL AND STATE GOVERNMENT PROVISIONS

Federal, State and Local Government Provisions included herein, have been selected from those to which specific references have been made elsewhere in the Contract Documents. Each and every other provision of law or clause required by law to be inserted in this Contract shall be deemed to be also inserted herein in accordance with Paragraph 3.01H of the Supplementary Conditions.

1.0. FEDERAL GOVERNMENT PROVISIONS

1.1. Davis Bacon Act Requirements

1.2. Federal Wage Rates

1.3. American Iron and Steel Requirements of P. L. 113-76, the Consolidated Appropriations Act of 2014.

1.4. Build America, Buy America Act Requirements

This project is subject to American Iron and Steel and the Build America, Buy America Act (BABA). The amendments to the Clean Water Act, as part of WRRDA, apply the American Iron and Steel (AIS) requirements to all treatment works projects. Furthermore, Bipartisan Infrastructure Law (BIL) extends this procurement requirement to all State Revolving Fund (SRF) construction projects going forward with the inclusion of the Build America, Buy America Act (BABA). Starting on May 14, 2022, all steel, iron, manufactured products, non-ferrous metals, plastic and polymer-based products (including polyvinylchloride, composite building materials, and polymers used in fiber optic cables), glass (including optic glass), lumber, and drywall used in infrastructure projects for federal financial assistance programs must be produced in the United States. MassDEP ensures that the required procurement language is included in contracts and conducts field verifications of project compliance.

2.0. STATE GOVERNMENT PROVISIONS

2.1. Owner and Contractor agree that the following State Government Provisions apply to the work to be performed under this Contract and that these provisions supersede any conflicting provisions of this Contract.

END OF SECTION 007300.16

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Contractor's use of site and premises.
5. Coordination with occupants.
6. Work restrictions.
7. Specification and Drawing conventions.

- B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 017300 "Execution" for coordination of Owner-installed products.

1.3 PROJECT INFORMATION

- A. Project Identification: Dunes Community Development District (DCDD) Water Treatment Plant (WTP) Reverse Osmosis (RO) Membrane Feed Pump Replacement for RO Skids 1 through 4.

1. Project Location: Administrative Building at the DCDD WTP located at 101 Jungle Hut Road, Palm Coast, Florida 32137.

- B. Owner: Dunes Community Development District.

- C. Engineer: CDM Smith Inc.

- D. Contractor: To be determined (TBD) has been engaged as Contractor for this Project.

1. Contractor Representative: To be determined (TBD)

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

1. This project includes the following Work at the DCDD WTP and other Work indicated in the Contract Documents:
 - a. Administration and Process Building Maintenance Room Modifications: Demolish existing overhead ventilation duct work that will conflict with the installation of the Modular In-Plant Office/Control Room. Maintain the existing ventilation supply fan. Relocate any wall-mounted lights, outlets, switches, and accessories or equipment that will conflict with installation of the new Modular In-Plant Office/Control Room along the South wall of the Maintenance Room adjacent to the existing Electric Room.
 - b. Modular In-Plant Office/Control Room: Supply and install a new 10' x 14' heated and cooled in-plant modular office inside the existing maintenance room to serve as a process control room and office for the operators and to make necessary electrical and communication connections to the existing electric room and process control system. Provide delegated design submittals for the modular building and anchorage or connection to existing.
 - 1) New Modular In-Plant Office/Control Room HVAC: Supply and install a ductless mini-split "in-ceiling cassette style" HVAC system suitable for heating and cooling the new modular in-plant office/control room; including condensate lines to a new external dry well. Provide delegated design submittals for equipment sizing.
 - c. Relocate Operators: Coordinate and assist the Owner to relocate furniture and accessories from the existing electric room to the new modular in-plant office and process control room.
 - d. Administration and Process Building Electric Room Modifications: Prepare the electric room, motor control center (MCC), and power panels for four new variable frequency drives (VFDs), four new pump connections, new modular in-plant office/control room, and to demolish and replace the existing HVAC system including four new concrete VFD equipment pads. Demolish, supply, and install all associated conduit and wiring. After all pumps are installed and operational, demolish the four existing MCC-mounted reduced-voltage solid-state starters (RVSS) powering the four existing pumps.
 - 1) New VFDs: Supply and install four new VFDs in the existing electric room and four new bucket breakers in the existing MCC. Supply and install all associated wiring and conduit connections from the VFD to the new buckets in the existing MCC. Provide delegated design for equipment supports and anchorage.
 - 2) HVAC Modifications: Demolish the existing electrical room HVAC system. Supply and install a new electrical room HVAC system. Power to the new HVAC equipment will be supplied from existing 480V power panel 20-DP-1 or 208/120V panel 20-LP-1 or 20-LP-2 in the administration and process building electrical room. Provide delegated design for duct supports, connections to existing, and equipment anchorage.

- 3) PLC Panel Modifications: Maintain the existing PLC panel and hardware. The PLC hardware will remain in service without modification other than repurposing the valve control and position I/O points to be utilized as new VFD speed control and feedback I/O points. RO Train Feed flow control, is currently based on modulating valve and will be revised to utilize the new VFD pumps. A new network switch and cables will be supplied and installed to provide connectivity from the existing control panel to the new modular in-plant office/operator control room and operator's control stations.
 - 4) Post Pump Installation MCC Modifications: The four existing RO feed pumps are powered from MCC-1 through MCC-mounted RVSS. The existing RVSS for each pump will be demolished. Supply and install the associated equipment to restore the MCC after demolition.
 - 5) Other Panel Modifications: Supply and install wire and conduit from an existing 208V/120V panel in the electrical room to power the new modular in-plant office/control room electrical panel supplied with the modular office.
- e. RO Process Room Ventilation Modifications: Demolish, supply, and install four ventilation fans (two supply and two exhaust) in the existing RO Process Room.
 - f. Pump Pads: Install four new concrete pump pads adjacent to each RO Train for mounting and installing the four new membrane feed pumps and motors. Provide delegated design for equipment support and anchorages.
 - g. RO Feed Pumps: Demolish, supply, and install four new RO membrane feed pumps and motors including associated pump base and supports, piping, valves and instrumentation from the cartridge filter discharge flange to the RO membrane inlet flange. Each RO pump will need to be replaced separately to allow the Owner to keep operating the RO water treatment process. All subgrade wires from the MCC to each RO Train will reuse existing underground conduit and so will require demolition and replacement of existing wires. All aboveground conduit and wires, associated with pump replacement, will be demolished and supplied as new. Provide delegated design for equipment support and anchorages.
 - h. RO Feed Pump Bypass: Install new RO membrane feed pump bypass piping, isolating ball valves, a modulating valve, and supports on each RO skid.
 - i. All Controls and SCADA work associated with the foregoing changes.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.5 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- B. Limits on Use of Site: Limit use of Project site to the RO process operations area, the electric room, and maintenance shop located inside the Administrative Building indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.6 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy Project site and existing building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
 2. Notify Owner not less than 72hours in advance of activities that will affect Owner's operations.
- B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
 1. Engineer will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
 3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
 4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.7 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work to between 7:00 a.m. to 3:30 P.M. Monday through Friday, excluding holidays observed by the Owner, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than 7 days in advance of proposed utility interruptions.
 - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify Owner not less than 3 days in advance of proposed disruptive operations.
 - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Owner's property is not permitted.
- F. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times while on the Owner's premises.
- G. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
 - 1. Maintain list of approved screened personnel with Owner's representative.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.

3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
 4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.
- C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 011000

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section.

Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of Engineers and owners if requested.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
2. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Engineer will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Forms of Acceptance: Change Order, Construction Change Directive, or Engineer's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Engineer does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.7 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
1. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:
- a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Engineer will consider requests for substitution if received within 60 days after Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Engineer.
1. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:
- a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Engineer for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with Contract Documents and will produce indicated results.
 - d. Substitution request is fully documented and properly submitted.
 - e. Requested substitution will not adversely affect Contractor's construction schedule.
 - f. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - g. Requested substitution is compatible with other portions of the Work.
 - h. Requested substitution has been coordinated with other portions of the Work.
 - i. Requested substitution provides specified warranty.

- j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012500

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
 - 2. Section 013100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.3 MINOR CHANGES IN THE WORK

- A. Engineer will issue Field Orders authorizing minor changes in the Work, not involving adjustment to the Contract Price or the Contract Time, on EJCDC Form C-942 or other form acceptable to Owner.

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Price or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Requests For Proposal (RFP) issued by Engineer are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of RFP, submit a quotation estimating adjustments to the Contract Price and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.

- d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Engineer.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Engineer.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Price and the Contract Time.
 - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include costs of labor and supervision directly attributable to the change.
 - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - 6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 - 7. Proposal Request Form: Use form acceptable to Engineer.

1.5 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Price to reflect actual costs of allowances.
- B. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.6 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Change Order Request, Engineer will issue a Change Order for signatures of Owner and Contractor on EJCDC Form C-941 or other form acceptable to Owner.

1.7 WORK CHANGE DIRECTIVE

- A. Work Change Directive: Engineer may issue a Work Change Directive on EJCDC Document C-940 or other form acceptable to Owner. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Work Change Directive contains a complete description of change in the Work. It also

designates method to be followed to determine change in Contract Price or the Contract Time.

- B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.
 - 1. After completion of change, submit itemized account and supporting data necessary to substantiate cost and time adjustments to Contract.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012600

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SECTION 012900 – PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Engineer at earliest possible date, but no later than ten days before the date scheduled for submittal of initial Applications for Payment. Schedule of Values must be approved prior to the first payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Owner's name.
 - c. Owner's Project number.
 - d. Name of Engineer.
 - e. Engineer's Project number.

- f. Contractor's name and address.
 - g. Date of submittal.
- 2. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
- 3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of **five** percent of the Contract Sum.
- 4. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
- 5. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
- 6. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
- 7. Overhead Costs, Separate Line Items: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
- 8. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
- 9. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.
- 10. Only the Owner's representatives can approve the schedule of values. If review comments are provided by the Owner or Owner's Representative, these comments shall be incorporated. Once approved by the Owner's Representative, the Contractor shall not revise nor modify the schedule of values.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Engineer and paid for by Owner.

- B. Payment Application Times: Submit Application for Payment to Engineer by the 25th day of the month. The period of construction work covered by each Application for Payment is one month, ending on the last day of the month.
 - 1. Submit draft copy of Application for Payment twenty days prior to due date for review by Engineer.
- C. Application for Payment Forms: Use EJCDC Document C-620 as form for Applications for Payment.
 - 1. Other Application for Payment forms proposed by the Contractor may be acceptable to Engineer and Owner. Submit forms for approval with initial submittal of schedule of values.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Engineer will return incomplete applications without action.
 - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 - 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed.
 - 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment.
 - 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 - 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit one signed and notarized original copies of each Application for Payment to Engineer by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- H. Maintain an updated set of drawings to be used as record drawings in accordance with Section 017839 "Project Record Documents." As a prerequisite for monthly progress payments, exhibit the updated record drawings for review by Owner and Engineer for completeness and accuracy.
- I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule.
 4. Products list (preliminary if not final).
 5. Schedule of unit prices.
 6. Submittal schedule.
 7. List of Contractor's staff assignments.
 8. List of Contractor's principal consultants.
 9. Copies of building permits.
 10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 11. Initial progress report.
 12. Report of preconstruction conference.
- J. Application for Payment at Substantial Completion: After Engineer issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - a. Complete administrative actions, submittals, and Work proceeding this application, as described in Section 017700 "Closeout Procedures."
 2. Include initial submittal of closeout record drawings in accordance with Section 017839 "Project Record Documents."
 3. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

- K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Certification of completion of final punch list items.
 3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 4. Final submittal of closeout record drawings in accordance with Section 017839 "Project Record Documents."
 5. Updated final statement, accounting for final changes to the Contract Sum.
 6. AIA Document G706.
 7. AIA Document G706A.
 8. AIA Document G707.
 9. Evidence that claims have been settled.
 10. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 11. Final liquidated damages settlement statement.
 12. Proof that taxes, fees, and similar obligations are paid.
 13. Waivers and releases.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012900

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SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Digital project management procedures.
 - 5. Web-based Project management software package.
 - 6. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. RFI: Request for Information. Request from Owner, Engineer, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.

3. Drawing number and detail references, as appropriate, covered by subcontract.

- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities, list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and scheduled activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.

1.6 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Engineer will return without response those RFIs submitted to Engineer by other entities controlled by Contractor.

2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
 2. Owner name.
 3. Owner's Project number.
 4. Name of Engineer.
 5. Engineer's Project number.
 6. Date.
 7. Name of Contractor.
 8. RFI number, numbered sequentially.
 9. RFI subject.
 10. Specification Section number and title and related paragraphs, as appropriate.
 11. Drawing number and detail references, as appropriate.
 12. Field dimensions and conditions, as appropriate.
 13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 14. Contractor's signature.
 15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716 or similar.
1. Attachments shall be electronic files in PDF format.
- D. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow seven days for Engineer's response for each RFI. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Engineer's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt by Engineer of additional information.

3. Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer in writing within 5 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:
 1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Engineer.
 4. RFI description.
 5. Date the RFI was submitted.
 6. Date Engineer's response was received.
 7. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 8. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Engineer's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Engineer within seven days if Contractor disagrees with response.

1.7 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Use of Engineer's Digital Data Files: Digital data files of Engineer's CAD drawings will be provided by Engineer for Contractor's use during construction.
 1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
 2. Engineer makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.

1.8 PROJECT MEETINGS

- A. General: Engineer will schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Engineer of scheduled meeting dates and times a minimum of 10 working days prior to meeting.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Engineer, within three days of the meeting.

- B. Preconstruction Conference: Engineer will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Engineer, but no later than 15 days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Use of web-based Project software.
 - h. Procedures for processing field decisions and Change Orders.
 - i. Procedures for RFIs.
 - j. Procedures for testing and inspecting.
 - k. Procedures for processing Applications for Payment.
 - l. Distribution of the Contract Documents.
 - m. Submittal procedures.
 - n. Preparation of Record Documents.
 - o. Use of the premises.
 - p. Work restrictions.
 - q. Working hours.
 - r. Owner's occupancy requirements.
 - s. Responsibility for temporary facilities and controls.
 - t. Procedures for moisture and mold control.
 - u. Procedures for disruptions and shutdowns.
 - v. Construction waste management and recycling.
 - w. Parking availability.
 - x. Office, work, and storage areas.
 - y. Equipment deliveries and priorities.
 - z. First aid.
 - aa. Security.
 - bb. Progress cleaning.
 - cc. List of major subcontractors and suppliers.
 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Engineer of scheduled meeting dates.

2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Sustainable design requirements.
 - i. Review of mockups.
 - j. Possible conflicts.
 - k. Compatibility requirements.
 - l. Time schedules.
 - m. Weather limitations.
 - n. Manufacturer's written instructions.
 - o. Warranty requirements.
 - p. Compatibility of materials.
 - q. Acceptability of substrates.
 - r. Temporary facilities and controls.
 - s. Space and access limitations.
 - t. Regulations of authorities having jurisdiction.
 - u. Testing and inspecting requirements.
 - v. Installation procedures.
 - w. Coordination with other work.
 - x. Required performance results.
 - y. Protection of adjacent work.
 - z. Protection of construction and personnel.
 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Engineer, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of Record Documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Procedures for completing and archiving web-based Project software site data files.
 - d. Submittal of written warranties.
 - e. Requirements for completing sustainable design documentation.
 - f. Requirements for preparing operations and maintenance data.
 - g. Requirements for delivery of material samples, attic stock, and spare parts.
 - h. Requirements for demonstration and training.
 - i. Preparation of Contractor's punch list.
 - j. Procedures for processing Applications for Payment at Substantial Completion and for final payment including final change order.
 - k. Submittal procedures.
 - l. Coordination of separate contracts.
 - m. Owner's partial occupancy requirements including certificate of occupancy and closeout of permits.
 - n. Installation of Owner's furniture, fixtures, and equipment.
 - o. Responsibility for removing temporary facilities and controls.
 - p. Final cleaning.
 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at regular intervals.
1. Revise "Attendees" Subparagraph below if attendance by other known entities is necessary.
 2. Attendees: In addition to representatives of Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.

- 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site use.
 - 8) Temporary facilities and controls.
 - 9) Progress cleaning.
 - 10) Quality and work standards.
 - 11) Status of correction of deficient items.
 - 12) Field observations.
 - 13) Status of RFIs.
 - 14) Status of Proposal Requests.
 - 15) Pending changes.
 - 16) Status of Change Orders.
 - 17) Pending claims and disputes.
 - 18) Documentation of information for payment requests.
 4. Minutes: Entity responsible for conducting the meeting will record and distribute meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- F. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.

- c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site use.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of RFIs.
 - 14) Proposal Requests.
 - 15) Change Orders.
 - 16) Pending changes.
- 3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013100

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SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily construction reports.
 - 5. Material location reports.
 - 6. Site condition reports.
 - 7. Unusual event reports.
- B. Related Requirements:
 - 1. Section 014000 "Quality Requirements" for schedule of tests and inspections.
 - 2. Section 012900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.
 - 3. Section 013513.24 "Special Procedures for Maintenance of Plant Operations and Construction Schedule" for construction sequencing and schedule requirements.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.

- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time belongs to Owner.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file.
 - 2. PDF file.
- B. Startup construction schedule.
 - 1. Submittal of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.
- E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, latest allowable start date, latest allowable finish date, status (where critical) and total float and free float in calendar days.
 - 1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
 - 3. Total Float Report: List of activities sorted in ascending order of total float.

- 4. Earnings Report: Compilation of Contractor's total earnings from the Notice to Proceed until most recent Application for Payment.
- F. Construction Schedule Updating Reports: Submit with Applications for Payment.
- G. Daily Construction Reports: Submit at weekly intervals.
- H. Material Location Reports: Submit at monthly intervals.
- I. Site Condition Reports: Submit at time of discovery of differing conditions.
- J. Unusual Event Reports: Submit at time of unusual event.
- K. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Engineer's request.
- B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013512.24 "Special Procedures for Maintenance of Plant Operations (MOPO) and Construction Schedule." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:
 - 1. Review software limitations and content and format for reports.
 - 2. Verify availability of qualified personnel needed to develop and update schedule.
 - 3. Discuss constraints, including work stages, area separations, interim milestones, and partial Owner occupancy.
 - 4. Review delivery dates for Owner-furnished products.
 - 5. Review submittal requirements and procedures.
 - 6. Review time required for review of submittals and resubmittals.
 - 7. Review requirements for tests and inspections by independent testing and inspecting agencies.
 - 8. Review time required for Project closeout and Owner startup procedures; including commissioning activities.
 - 9. Review and finalize list of construction activities to be included in schedule.
 - 10. Review procedures for updating schedule.
 - 11. Submit at this conference a preliminary network defining the planned operation during the first 60 calendar days after the Notice to Proceed.

1.6 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.

2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
 1. Use Microsoft Project or Primavera for current Windows operating system.
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Final Completion.
 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Engineer.
 2. Activities to facilitate the Work: Indicate start and completion dates for the following as applicable:
 - a. Securing of approvals and permits required for performance of the Work.
 - b. Temporary facilities.
 - c. Construction of mock-ups, prototypes and samples.
 - d. Owner interfaces and furnishing of items.
 - e. Interfaces with Separate Contracts.
 - f. Regulatory agency approvals.
 - g. Punch list.
 3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - a. Modular In-Plant Office System
 - b. Electric Room HVAC System
 - c. Eaton Motor Control Center (MCC) Electrical Buckets and Breakers
 - d. Process Room Ventilation Fans
 - e. Variable Frequency Drives
 - f. Reverse Osmosis Membrane Feed Pumps and Motors
 4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 5. Startup and Testing Time: Include f startup and testing for each Reverse Osmosis Train separately.

6. Commissioning Time: Include commissioning for each Reverse Osmosis Train separately.
 7. Substantial Completion: Is defined in 007200.16 EJCDC-700 General Conditions, 007300.16 Supplementary Conditions, and Section 017700 Closeout Procedures. Indicate completion in advance of date established for Substantial Completion and allow time for Engineer's administrative procedures necessary for certification of Substantial Completion.
 8. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
 2. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use-of-premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
 3. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Startup and placement into final use and operation.
 - m. Commissioning.
 4. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.

- e. Completion of electrical installation.
 - f. Substantial Completion.
- 5. Other Constraints:
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, Final Completion\, and the following interim milestones:]
 - 1. Modular In-Plan Office (Control Room) Ready for Occupancy and Operational Control
 - 2. Electrical and Process Room Modifications Completed (HVAC system installed, new VFD pads and equipment installed, new pump pedestals installed, and ventilation fans installed).
 - 3. Reverse Osmosis Train 1 New Feed Pump Startup and Commissioning.
 - 4. Reverse Osmosis Train 2 New Feed Pump Startup and Commissioning.
 - 5. Reverse Osmosis Train 3 New Feed Pump Startup and Commissioning.
 - 6. Reverse Osmosis Train 4 New Feed Pump Startup and Commissioning.
- F. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
 - 1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.
- G. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
 - 1. Unresolved issues.
 - 2. Unanswered Requests for Information.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
 - 5. Pending modifications affecting the Work and the Contract Time.
- H. Acceptability
 - 1. Submit the CPM schedule submittals, as specified, and resubmit as needed, until they are in compliance with Contract requirements.
 - 2. The Engineer's review of the Contractor's construction schedule submittals will only be for conformance with the Contract requirements – including but not limited to contract time and work sequences specified in the contract documents. The Engineer's review of the schedule shall not include the Contractor's means and methods of construction or safety. The Engineer's concurrence, acceptance, or approval of the Contractor's schedule submittals will not relieve the Contractor from responsibility for complying with the Contract Scope, Contract Time or any other contract requirement. Any indication of concurrence, acceptance, or approval of the Contractor's schedule will only indicate a general conformance with the Contract Requirements.
 - 3. Engineer's review of the Contractor's construction schedule submittals shall not relieve the Contractor from responsibility for any deviations from the Contract Documents unless the Contractor has in writing called Engineer's attention to such deviations at the time of submission and Engineer has given written concurrence to the specific deviations, nor shall any concurrence by the Engineer relieve Contractor from responsibility for

- errors and omissions in the submittals. Concurrence of the CPM Activity Network by the Engineer is advisory only and shall not relieve the Contractor of responsibility for accomplishing the Work within the Contract completion date(s).
4. Concurrence, acceptance, or approval of the Contractor's CPM schedule by the Engineer in no way makes the Engineer an insurer of the CPM schedule's success, nor liable for time or cost overruns resulting therefrom.
 5. Failure to include any element of work required for the performance of this Contract will not excuse the Contractor from completing all Work required within the Contract completion date(s), notwithstanding the review of the network by the Engineer.
 6. CPM schedules that contain activities with negative float, or which extend beyond the contract completion date, will not be acceptable.
 7. Except where earlier completions are specified, CPM schedules which show completion of all work prior to the contract completion date may be indicated; however, in no event shall they constitute a basis for claim for delay by the Contractor.
- I. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate Final Completion percentage for each activity. Activities shall not be considered to be complete until they are in fact 100 percent complete.
 4. Submit a narrative report based on the CPM schedule evaluation, in a format agreed upon by the Contractor and the Engineer. The report shall include a description of the progress during the previous period in terms of completed activities, an explanation of each activity which is showing a delay, a description of problem areas, current and anticipated delaying factors and their estimated impact on performance of other activities and completion dates and an explanation of corrective action taken or proposed.
- J. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- K. The contract completion time will be adjusted only for causes specified in this Contract. In the event the Contractor requests an extension of any contract completion date, the Contractor shall furnish such justification and supporting evidence as the Engineer may deem necessary to determine whether the Contractor is entitled to an extension of time under the provisions of this Contract. The Engineer will, after receipt of such justification and supporting evidence, make findings of fact and will advise the Contractor in writing thereof. If the Engineer finds that the Contractor is entitled to any extension of any contract completion date, the Engineer's determination as to the total number of days extension shall be based upon the currently approved CPM schedule and on all data relevant to the extension. Such data shall be included in the next updating of the schedule. Actual delays in activities which, according to the CPM

schedule, do not affect any contract completion date shown by the critical path in the network will not be the basis for a change therein.

- L. Distribution: Distribute copies of approved schedule to Engineer Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.8 GANTT-CHART SCHEDULE REQUIREMENTS

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice to Proceed.
 - 1. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 - 1. For construction activities that require three months or longer to complete indicate an estimated completion percentage in 10 percent increments within time bar.

1.9 CPM SCHEDULE REQUIREMENTS

1.10 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 - 1. List of subcontractors at Project site.
 - 2. List of separate contractors at Project site.
 - 3. Approximate count of personnel at Project site.
 - 4. Equipment at Project site.
 - 5. Material deliveries.
 - 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 - 7. Testing and inspection.
 - 8. Accidents.
 - 9. Meetings and significant decisions.
 - 10. Unusual events.
 - 11. Stoppages, delays, shortages, and losses.
 - 12. Meter readings and similar recordings.
 - 13. Emergency procedures.
 - 14. Orders and requests of authorities having jurisdiction.

15. Change Orders received and implemented.
16. Construction Change Directives received and implemented.
17. Services connected and disconnected.
18. Equipment or system tests and startups.
19. Partial completions and occupancies.
20. Substantial Completions authorized.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013200

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SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Concealed Work photographs.
 - 3. Periodic construction photographs.
 - 4. Final Completion construction photographs.
- B. Related Requirements:
 - 1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
 - 2. Section 013513.24 "Special Procedure for Maintenance of Plant Operations" for Final Completion Photographs at each Partial Substantial Completion stage of the project.

1.3 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within 7 days of taking photographs.
 - 1. Submit photos by uploading them to web-based Project management software site. Include copy of key plan indicating each photograph's location and direction.
 - 2. Identification: Provide the following information with each image description in web-based Project management software site:
 - a. Name of Project.
 - b. Name and contact information for photographers.
 - c. Name of Engineer.
 - d. Name of Contractor.
 - e. Date photograph was taken.
 - f. Description of location, vantage point, and direction.
 - g. Unique sequential identifier keyed to accompanying key plan.

1.4 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera. Use flash in low light levels or backlit conditions.

1.5 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs with maximum depth of field and in focus.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- B. Preconstruction Photographs: Before commencement of the Work take photographs of Project site and surrounding properties, including existing items to remain during construction. Photographs must be taken from at least two different vantage points.
- C. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficiently in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:
 - 1. Underground utilities.
 - 2. Underslab services.
 - 3. Piping.
 - 4. Electrical conduit.
 - 5. Waterproofing and weather-resistant barriers.
 - 6. Concrete pad or pedestal base adjoining surface preparations, anchors, and embedment's prior to pouring.
- D. Periodic Construction Photographs: Take photographs coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- E. Final Completion Construction Photographs: Take photographs after date of each Partial Substantial Completion, as described in Section 013200 "Construction Progress Documentation" 1.7.C.7. for submission as Project Record Documents. Select vantage points to show substantial or final completion.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Submittal schedule requirements.
 - 2. Administrative and procedural requirements for submittals.

- B. Related Requirements:

- 1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 4. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
 - 5. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
 - 6. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
 - 7. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 8. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

- C. Mass Submittals: Six or more submittals or items in one day or 15 or more submittals or items in one week.

1.4 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.
 - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 - 2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 - 3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
 - 4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Engineer's final release or approval.

1.5 SUBMITTAL FORMATS

- A. Numbering System: Utilize the following example submittal identification numbering system to identify submittals and as file names for PDF submissions:
 - 1. First Identifier - Alphabet Character: D, S, M or I which represents Shop Drawing (including working drawings and product data), Sample, Manual (Operating & Maintenance) or Informational, respectively.
 - 2. Second Identifier - Next 6 or 8 Digits: Applicable Specification Section Number. Do not mix submittals from different specification sections into a single submittal.
 - 3. Third Identifier - Next Three Digits: Sequential number of each separate item or drawing submitted under each Specification Section, in chronological order submitted, starting at 001.
 - 4. Fourth Identifier - Last Alphabet Character: A to Z, indicating the submission (or resubmission) of the same submittal, i.e., "A" = 1st submission, "B" = 2nd submission, "C" = 3rd submission, etc.
 - 5. EXAMPLE: D-033000.13-008-B.

- a. D = Shop Drawing.
- b. 03 30 00.13 = Section; use only 6 digits for sections that do not include 8 digits.
- c. 008 = the eighth different submittal under this Section.
- d. B = the second submission (first resubmission) of that particular shop drawing.

B. Submittal Information: Include the following information in each submittal:

- 1. Project name.
- 2. Date.
- 3. Name of Engineer.
- 4. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
- 5. Category and type of submittal.
- 6. Submittal purpose and description.
- 7. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
- 8. Drawing number and detail references, as appropriate.
- 9. Indication of full or partial submittal.
- 10. Location(s) where product is to be installed, as appropriate.
- 11. Other necessary identification.
- 12. Remarks.
- 13. Signature of transmitter.

C. Options: Identify options requiring selection by Engineer.

D. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Engineer on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

E. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

F. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.6 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

- 1. Email: If access to web-based project software is not available, email is acceptable. Prepare submittals as PDF package and transmit to Engineer by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Engineer.
 - a. Engineer will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.

2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 30 days for initial review of each submittal (and 45 days for multi-discipline reviews). Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Engineer's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
 5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Engineer and to Engineer's consultants, allow 30 days for review of each submittal. Submittal will be returned to Engineer before being returned to Contractor.
 - a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Engineer.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Engineer's action stamp.
 4. Repetitive Reviews: Shop drawings, O&M manuals, and other submittals will be reviewed no more than twice at the Owner's expense. All subsequent reviews will be

performed at the Contractor's expense. Reimburse the Owner for all costs invoiced by Engineer for the third and subsequent reviews.

- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

1.7 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 - 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 - 5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Engineer's digital data drawing files is otherwise permitted.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.

- e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
 - 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 - 3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.
 - 4. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
 - 5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 - 6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer will return submittal with options selected.
 - 7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit two sets of Samples. Engineer will retain one Sample set; remainder will be returned.

- D. **Product Schedule:** As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
- E. **Qualification Data:** Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other specified information.
- F. **Design Data:** Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. **Certificates:**
1. **Certificates and Certifications Submittals:** Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 2. **Contractor's Certification:** Each shop drawing, working drawing, product data, and sample shall have affixed to it the following Certification Statement:
 - a. "Certification Statement: by this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements. "
 3. **Installer Certificates:** Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 4. **Manufacturer Certificates:** Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 5. **Material Certificates:** Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
 6. **Product Certificates:** Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
 7. **Welding Certificates:** Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.
- H. **Test and Research Reports:**
1. **Compatibility Test Reports:** Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests

- performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
 3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
 4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
 5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
 6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.8 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Engineer.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.9 PROPOSED PRODUCT LIST

- A. Within 15 days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, indicate manufacturer, trade name, model or catalog designation, and reference standards.

1.10 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.
- B. Contractor Responsible for:
 - 1. Determination and verification of materials including manufacturer's catalog numbers.
 - 2. Determination and verification of field measurements and field construction criteria.
 - 3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.
 - 4. Determination of accuracy and completeness of dimensions and quantities.
 - 5. Confirmation and coordination of dimensions and field conditions at Site.
 - 6. Construction means, techniques, sequences, and procedures.
 - 7. Safety precautions.
 - 8. Coordination and performance of Work of all trades.
 - 9. Other requirements enumerated in Contract Documents.
- C. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp or indication in web-based Project management software. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 - 1. Engineer will not review submittals received from Contractor that do not have Contractor's review and approval.

1.11 ENGINEER'S REVIEW

- A. Do not make mass submittals to Engineer. If mass submittals are received, Engineer's review time stated above will be extended as necessary to perform proper review. Engineer will review mass submittals based on priority determined by Engineer after consultation with Owner and [Contractor] [Construction Manager].
- B. Action Submittals: Engineer will review each submittal, indicate corrections or revisions required, and return.
 - 1. PDF Submittals: Engineer will indicate, via markup on each submittal, the appropriate action.

2. Submittals by Web-Based Project Management Software: Engineer will indicate, on Project management software website, the appropriate action.
- C. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.
- D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.
- E. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- F. Engineer will return without review submittals received from sources other than Contractor.
- G. Submittals not required by the Contract Documents will be returned by Engineer without action.
- H. Shop drawings will be returned to the Contractor with one of the following codes.
 1. "APPROVED" - This code is assigned when there are no notations or comments on the submittal. When returned under this code the Contractor may release the equipment and/or material for manufacture.
 2. "APPROVED AS NOTED" - This code is assigned when confirmation of the notations and comments IS NOT required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.
 3. "APPROVED AS NOTED/RESUBMIT" - This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the package. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. The resubmittal is to address all comments, omissions and non-conforming items that were noted. An additional box is checked to indicate whether the resubmission is for the complete package, or for parts of the package. If no box is checked, a complete resubmittal shall be provided. Review code may designate if a partial or full submittal is required. If full submittal is required, a complete resubmittal package addressing all comments shall be provided. If a partial submittal is designated, resubmittal shall only include information pertaining to those items noted in review comments requiring clarification and any portions of submittal impacted as a result of the response. Resubmittal is to be received by the Engineer within 30 calendar days of the date of the Engineer's transmittal requiring the resubmittal.
 4. "REJECTED" - This code is assigned when the submittal does not meet the intent of the Contract Documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the requirements of the Contract Documents.
 5. "RECEIPT ACKNOWLEDGED (Not subject to Engineer's Approval)" - This code is assigned to acknowledge receipt of a submittal that is not subject to the Engineer's approval. This code is generally used with submittals involving the Contractor's means and methods of construction work plans, and health and safety plans.

1.12 ELECTRONIC CAD FILES OF PROJECT DRAWINGS

- A. Electronic CAD Files of Project Drawings: May only be used to expedite production of Shop Drawings for the Project. Use for other Projects or purposes is not allowed.
- B. Electronic CAD Files of Project Drawings: Distributed only under the following conditions:
 - 1. Use of files is solely at receiver's risk. Engineer does not warrant accuracy of files. Receiving files in electronic form does not relieve receiver of responsibilities for measurements, dimensions, and quantities set forth in Contract Documents. In the event of ambiguity, discrepancy, or conflict between information on electronic media and that in Contract Documents, notify Engineer of discrepancy and use information in hard-copy Drawings and Specifications.
 - 2. CAD files do not necessarily represent the latest Contract Documents, existing conditions, and as-built conditions. Receiver is responsible for determining and complying with these conditions and for incorporating addenda and modifications.
 - 3. User is responsible for removing information not normally provided on Shop Drawings and removing references to Contract Documents. Shop Drawings submitted with information associated with other trades or with references to Contract Documents will not be reviewed and will be immediately returned.
 - 4. Receiver shall not hold Engineer responsible for data or file clean-up required to make files usable, nor for error or malfunction in translation, interpretation, or use of this electronic information.
 - 5. Receiver shall understand that even though Engineer has computer virus scanning software to detect presence of computer viruses, there is no guarantee that computer viruses are not present in files or in electronic media.
 - 6. Receiver shall not hold Engineer responsible for such viruses or their consequences and shall hold Engineer harmless against costs, losses, or damage caused by presence of computer virus in files or media.
- C. Costs: \$500 per file, plus administrative fee of \$500 per request paid in advance by certified check or money order payable to Engineer.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013300

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SECTION 013513.24 – SPECIAL PROCEDURES FOR MAINTENANCE OF PLANT OPERATION AND SEQUENCE OF CONSTRUCTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 to 43 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The Dunes Community Development District (DCDD) Reverse Osmosis (RO) Water Treatment Plant (WTP) is operated 24 hours a day, seven days a week. The existing facility will be maintained in continuous operation by the Owner at all times during the entire construction period, except for periods specifically delineated within this Section. The Contractor shall schedule and conduct his work such that it will not impede any part of the treatment process, create potential hazards to operating equipment and/or personnel, reduce the quality of the plant finished water, liquid residuals hauling operations or cause treatment process upsets. It shall be the Contractor's responsibility to ensure complete compatibility with the facility operations in his working schedules and sequenced construction activities.
- B. Detailed startup and testing activities for maintenance of plant operations (MOPO) affected equipment and facilities will be provided by the Contractor in the project Schedule. **Where shutdowns are required, they shall be coordinated with the Owner at least 7 days in advance. MCC-1 shutdowns are limited to 4-hours per an occurrence.**
- C. Critical Elements for Maintenance of Treatment Plant Operations (MOPO):
 - 1. Connection to the raw water main
 - 2. Maintain at least two RO treatment skids in operation.
 - 3. Maintain at least three RO treatment skids available to operate.
 - 4. Maintain high service pumping capability.
 - 5. Critical electrical components from Sheet E-3 and E-4.
 - a. 1200 Amp Main Power Supply to MCC-1. **Any required shutdown must be limited to 4-hours per an occurrence, outside of administrative office hours, and based on treated water storage tank capacity. The preferred time for shutdown is between the hours of 11:00 pm and 7:00 am. The treated water storage tank must be full before shutdown. The existing emergency diesel high service pump must remain operational during the shutdown and a 100 kW, 480V generator must be provided for operation of one high service pump and VFD. Additionally, 120V generator power must be provided for two PLC panels and the administration office internet server equipment. Existing RO feed pumps shall remain operational after VFD installation and replaced one at a time.**

- b. Reverse osmosis water treatment skid operation. **Sequential shutdown required to be coordinated with the Owner**
- 6. Supervisory Control and Data Acquisition (SCADA) system must be continuously in operation.

1.3 SEQUENCE OF CONSTRUCTION - GENERAL

- A. In order to maintain continuous plant operations during construction, a phased construction sequence shall be required. Specific constraints and steps are outlined and intended to suggest a sequence for specific activities. This sequence shall be coordinated with the Owner and the Engineer and submitted for approval in accordance with the requirements of Section 013300 Submittal Procedures. Work shall not commence unless the sequence has been approved.
- B. The detailed sequence of construction shall be based upon the schedule submitted by the Contractor and approved by the Owner and Engineer as specified above. However, as a guide for bidders in the preparation of their bid and for the Contractor and the preparation of his schedule, a suggested sequence of construction is described below for specific portions of the work. The Contractor may alter the sequence as approved by the Owner and Engineer, providing plant operations are maintained.
- C. The order of construction shall be subject to the approval of the Owner and Engineer; such approval or direction, however, shall in no way relieve the Contractors' responsibility to perform the work in strict accordance with the Contract Documents. The construction plans and specifications have been developed to minimize the construction impacts on the operation of the DCDD RO WTP. The Contractor shall note the requirements of this Section with regard to the operation of the facility and the phasing of construction when developing a work sequence. The Contractor's work sequence must be specifically detailed in the required Project Schedule.
- D. The following work sequence provides for completing the construction of the project within the requirements of the Owner's plant operation and schedule limitations. It does not purport to cover any sequences necessitated by the actual construction methods. This is a partial outline only. Portions of the work not specifically itemized must be scheduled by the Contractor in accordance with the requirements of the approved construction sequence. The Contractor is required to account for all details in formulating his own complete plan for implementation of the project.
- E. Some of the tasks below may overlap one another with the performance of the work. Numerical and alphabetical identification of the tasks does not necessarily conform with actual order of construction.

1.4 SEQUENCE OF CONSTRUCTION – SPECIFIC AREAS

- A. The following work can proceed in parallel:
 - 1. Existing electric room HVAC demolition and new electric room HVAC installation
 - 2. New VFD concrete pad installation in the electric room.
 - 3. New Pump concrete pedestal installation in the RO process room.
 - 4. Existing ventilation fan demolition and new ventilation fan installation in the RO process room.

B. Order and Receive Equipment:

Following the pre-construction meeting work with suppliers to prepare submittals for all specified components. Start first on all expected long lead items and major equipment such as the VFDs, pumps, and modular in-plant office. Assume an average of 14 consecutive days for single discipline review and up to 21 consecutive days for multi-discipline reviews. The following components are expected to be delegate engineering design and shall require a Florida Engineer (or a Florida licensed professional for heating ventilation and air conditioning systems) to provide certified drawings and calculations:

1. Modular In-Plant Office System and anchorage to existing.
2. Modular In-Plant Office heating and air conditioning system.
3. Equipment supports and anchorage.
4. Duct supports, connections, and anchorage.

All equipment for the Modular In-Plant Office System shall be received prior to demolition and installation activities associated with the in-plant modular office system.

All equipment for the HVAC system, Ventilation, and VFDs shall be received prior to demolition and installation activities associated with the electrical room modifications.

All equipment for each Pump replacement shall be received prior to demolition and installation.

C. Construct Modular In-Plant Operator Control Room.

1. Prepare a staging and storage area for received components. Inspect and inventory all received materials and equipment.
2. Prepare and clear the area established for the Modular In-Plant Office Area. Verify sufficient ingress and egress to transport components from the staging area to the construction area.
3. Construct and position the Modular In-Plant Office System in accordance with supplier instructions. It is recommended to request a manufacturer representative to provide support during installation.
4. Complete all electrical, building mechanical, and instrumentation modifications and tie-ins including grounding.
5. Clean up and prepare to ensure safe occupation, including all safety systems are installed (fire extinguishers, smoke detectors, etc.). Schedule a pre-occupancy inspection. Complete pre-occupancy punch list items.
6. Relocate the Operators and verify that process control is functional and as desired prior to any RO process modifications.

D. Electric Room and Process Room Modifications:

1. Prior to shipping the new VFD equipment, coordinate with the Engineer and Owner to attend the FAT. Following the FAT coordinate with the supplier to address all punch list items.
2. Prepare a clean dry weather-protected staging and storage area for the new electrical and VFD equipment and materials. Inspect and inventory all received materials and equipment.
3. Prepare the electric room to protect the existing equipment from construction activities including dust as necessary. Relocate any panels and or equipment that will be in the way of the new VFDs.

4. Form and pour the new concrete VFD mounting pads and new concrete pump pads.
5. After VFD mounting pads have sufficiently cured, set the new VFD units on the VFD mounting pads per manufacturer instructions.
6. Run all necessary conduit and wire from the new VFD units to the connecting MCC bucket, but do not make final connection. Leave sufficient wire to make necessary connections.
7. Plan MCC-1 power outage(s) to minimize shutdown time and frequency. **Limit shutdown(s) to 4-hours per an occurrence and outside of administration office hours. Treated water storage tank must be full. The existing emergency diesel high service pump must be verified as operational and a 100 kW generator must be provided to ensure high service pump operation throughout the duration of the shut down. Additionally, 120V generator power must be provided for two PLC panels and the administration office internet server equipment. Coordinate with Owner for written approval of shutdown plan.**
8. Demolish the existing HVAC system.
9. Install the new HVAC system.
10. During the planned power outage(s) to make HVAC electrical connections and modifications; also make any necessary MCC bucket breaker replacements for the new pump power supply. Maintain VFDs as isolated from power until pumps can be installed in 1.4.E
11. Demolish and replace the four ventilation fans in the process room.

E. Reverse Osmosis Skids 1 through 4 Modifications

After all VFDs and the new electric room HVAC system is installed, the RO skid modifications will be completed **one skid at a time** to ensure that there are always at least two skids available to operate with one on stand-by for emergency or maintenance. This step will be repeated for each skid. For each skid it is anticipated that it will take a minimum of 3 weeks but should not exceed 4 weeks or will require that the RO membranes are placed into long term storage prior to completing all modifications. **RO skids cannot remain drained of fluid for more than 8-hours.**

1. Conduct a pre-shutdown meeting with the Owner and provide a detailed plan and schedule to complete all work necessary to modify the selected RO skid within 3 weeks. During RO skid shutdown, means must be provided – including temporary plumbing or hoses (NSF 61 approved or FDA approved, consistent with F.A.C. 62-555.320(3)(b)) - to enable the train to be flushed with raw water every 48 hours. Include a contingency plan for placing the skid into long-term storage (requires a pickling procedure for the RO membranes as recommended by the manufacturer) if the shutdown will exceed 4 weeks. Once the plan is approved, coordinate with the Owner to shut the selected RO skid down.
2. Prior to demolition, the new concrete pump pads must be pre-installed as indicated in Step 1.4.D.4. of this part.
3. Demolish the existing pump, motor, valves, piping, platforms, electrical wire and conduit per contract documents.
4. Mechanically mount the new pump and motor per manufacturer instructions on the new Concrete pump pad previously installed in Step 1.4.D.4. Anchor the new pump per manufacturer and delegate engineer design.
5. Install new valve and pipe connections and pipe supports, including the pump bypass piping and valves, per contract documents. Flush new process pipe and fittings with water to clear any debris from construction prior to connection. RO Skids No.3 and No. 4 will require the existing 2-inch RO membrane inlet flange to be demolished, and a new 4-

- inch flange connection installed. It is anticipated that it will be necessary to drain the skid prior to conducting this piping demolition and replacement. This activity must be limited to 8 hours for each skid.
6. Complete all cabinet, wire and conduit runs, from the MCC breaker to the new VFD, to the RO skid control cabinet, and to the new pump motor per contract documents. It is recommended to pre-run all conduit and wire prior to the RO skid shutdown to any extent possible to minimize RO skid down time. This may be minimal since the contract calls for reuse of existing buried conduit and the existing wires cannot be demolished until shutdown..
 7. Complete any necessary SCADA and instrumentation modifications.
 8. Existing MCC-1 pump bucket breakers, once disconnected, shall be left in place and marked as spare.
 9. After all installations and connections are completed for the RO skid and the system is ready for power. Schedule with the Owner and Engineer for a pre-startup inspection and address inspection findings.
 10. After startup is approved by the Owner, coordinate with the Owner, Engineer, RO Skid manufacturer, VFD supplier, and pump supplier to conduct startup and pump vibration testing. Address all startup and pump vibration test findings associated with the modifications.
 11. Once the skid is fully back online repeat 1.4.E for remaining RO skids until all 4 RO skids are completed.

END OF SECTION 013513.24

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SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
 - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance

with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

- E. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
- G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" shall have the same meaning as the term "testing agency."
- H. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- I. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Engineer.

1.4 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.
- B. Delegated-Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.5 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Engineer regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Engineer for clarification before proceeding.

- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.6 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel and Delegated-Designer.
- C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.
 - 6. Number of tests and inspections required.
 - 7. Time schedule or time span for tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.
- E. Reports: Prepare and submit certified written reports and documents as specified.
- F. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, telephone number, and email address of testing agency.
 - 4. Dates and locations of samples and tests or inspections.
 - 5. Names of individuals making tests and inspections.
 - 6. Description of the Work and test and inspection method.
 - 7. Identification of product and Specification Section.

8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of technical representative making report.
 2. Statement on condition of substrates and their acceptability for installation of product.
 3. Statement that products at Project site comply with requirements.
 4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
 5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 6. Statement of whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement of whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.

1.8 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

- D. **Installer Qualifications:** A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. **Design Professional Qualifications:** A professional engineer / registered architect who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Design / engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.
- F. **Testing and Inspecting Agency Qualifications:** An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- G. **Manufacturer's Technical Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect, demonstrate, repair and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- H. **Factory-Authorized Service Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.9 QUALITY CONTROL

- A. **Owner Responsibilities:** Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
 - 2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor.
- B. **Contractor Responsibilities:** Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
 - 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 - 2. Engage a qualified testing agency to perform quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Engineer, Commissioning Authority, , and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Engineer, Commissioning Authority, , and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Delivery of samples to testing agencies.

6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspection equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Engineer.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Engineer's, Commissioning Authority's, and authorities' having jurisdiction reference during normal working hours.
1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

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SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.
 - 2. Section 013513.24 "Special Procedure for Maintenance of Plant Operation and Sequence of Construction"

1.3 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to Engineer, testing agencies, and authorities having jurisdiction.
- B. Water from Existing System: Water from Owner's existing water system is available for use for construction operations without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use for construction operations without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

- C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- E. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
 - 1. Locations of dust-control partitions at each phase of work.
 - 2. HVAC system isolation schematic drawing.
 - 3. Location of proposed air-filtration system discharge.
 - 4. Waste-handling procedures.
 - 5. Other dust-control measures.
- F. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by the Owner. Include the following:
 - 1. Methods used to meet the goals and requirements of the Owner.
 - 2. Concrete cutting method(s) to be used.
 - 3. Location of construction devices on the site.
 - 4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
 - 5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with the Owner.
 - 6. Indicate locations of sensitive equipment areas or other areas requiring special attention as identified by Owner. Indicate means for complying with Owner's requirements.

1.5 QUALITY ASSURANCE

- A. Temporary facilities shall comply with all applicable state and local ordinances, codes and regulations.
- B. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- C. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. During RO skid shutdowns, means must be provided – including temporary plumbing or hoses (NSF 61 approved or FDA approved, consistent with F.A.C. 62-555.320(3)(b)) - to enable the train to be flushed with raw water every 48 hours.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

- A. Locate facilities, in coordination with the Owner and Engineer, where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
 - 1. Locate facilities to limit site disturbance.

3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service, if approved by Owner.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

- C. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
 - 1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities is not permitted.
- D. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- E. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
 - 1. Prior to commencing work, isolate the HVAC system in areas where work is to be performed .
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 - 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
- F. Temporary Light and Power: Provided by Contractor, including 220 Volt service for welding, complete with wiring, lamps and similar equipment as required to adequately light all work areas and with sufficient power capacity to meet the project needs. Make all necessary arrangements with the local electric company for temporary electric service and pay all expenses in connection therewith.
 - 1. During shutdowns of the 1200 Amp Main Power Supply the Contractor will provide a 100 kW, 480V generator for operation of one high service pump and VFD. Additionally, 120V generator power must be provided for two PLC panels and the administration office internet server equipment during shutdown.
- G. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

3.4 SUPPORT FACILITIES INSTALLATION

- A. Comply with the following:
 - 1. Utilize designated area within existing building for temporary field offices.

- B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- C. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Clean up worksite at the end of each work shift.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- B. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide, install and maintain signage directing occupants to temporary egress.

3.6 "OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Final Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Final Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 - 2. Just prior to Final Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

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SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for Contractor requirements related to Owner-furnished products.
 - 2. Section 017700 "Closeout Procedures" for submitting warranties.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycle contract materials are considered new products, unless indicated otherwise.
 - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in PART 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
 - 1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight,

dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.
- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
 - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
 - 2. Data indicating compliance with the requirements specified in PART 2 "Comparable Products" Article.
- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
 - 1. Resolution of Compatibility Disputes between Multiple Contractors:
 - a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Engineer will determine which products shall be used.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
 - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
 - a. Name of product and manufacturer.

- b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.
- 3. See individual identification Sections in Divisions 22, 23, and 26 for additional equipment identification requirements.

1.5 COORDINATION

- A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.
- C. Storage:
 - 1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
 - 2. Store products to allow for inspection and measurement of quantity or counting of units.
 - 3. Store materials in a manner that will not endanger Project structure.
 - 4. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection for wind.
 - 5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 - 6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 7. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
 - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 - 4. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 - 5. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Submit additional documentation required by Engineer in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Engineer, whose determination is final.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 - a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product that complies with requirements.
 - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
 - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer that complies with requirements.
 - a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."

- b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
- 7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance the following requirements:
 - 1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
 - 2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
 - 3. Evidence that proposed product provides specified warranty.
 - 4. List of similar installations for completed projects, with project names and addresses and names and addresses of Engineers and owners, if requested.
 - 5. Samples, if requested.
- B. Engineer's Action on Comparable Products Submittal: If necessary, Engineer will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."
 - 1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
 - 2. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Two-Step Process: Approval by the Engineer of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 016000

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
- B. Related Requirements:
 - 1. Section 012900 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
 - 2. Section 013233 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
 - 3. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 4. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

1.3 DEFINITIONS

- A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Engineer's use prior to Engineer's inspection, to determine if the Work is substantially complete.
- B. Substantial Completion: All action, information, closeout, redline drawings, and maintenance material submittals have been received and are approved. All contract work is sufficiently complete in accordance with the plans, specifications, and contract requirements such that the Owner can use, occupy, and place the facility into its intended operational service for its intended purpose, notwithstanding the presence of minor incomplete items or corrective work (commonly referred to as punch list items) that do not materially affect safe, reliable, or regulatory-compliant operation. This includes the completion of the substantial completion procedure as provided in this specification. For this project the critical systems and key elements for substantial completion are as follows.
 - 1. A new modular in-plant office/control room is installed ready for safe occupancy with

- working power supply, heating and cooling, and necessary process communications for control of the reverse osmosis process functioning and in place.
2. All electrical room demolitions and modifications completed to install a new working air conditioning system and four (4) new variable frequency controllers for the four new reverse osmosis feed pumps.
 3. All reverse osmosis process room demolitions and modifications completed to install four new working ventilation fans.
 4. All reverse osmosis process demolitions and modifications completed to install four new working reverse osmosis feed pumps, motors, piping, valves, and instrumentation required to operate the four existing reverse osmosis membrane systems. Water treatment capability is restored, and all system tests have been completed and passed to the Owner's satisfaction. As a minimum, the criteria for substantial completion shall be the continuous operation of the RO Plant equipment after completion of all modifications, without malfunction or failure resulting from the modifications, for a duration of no less than 72 hours.
- C. Final Completion: All substantial and final completion procedures have been completed. All incomplete items have been addressed to the Owner's satisfaction and final payment has been made.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.5 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.7 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of **10** days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Engineer. Label with manufacturer's name and model number.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.
 5. Submit testing, adjusting, and balancing records.
 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
 6. Advise Owner of changeover in utility services.
 7. Participate with Owner in conducting inspection and walkthrough.
 8. Terminate and remove temporary facilities from Project site, construction tools, and similar elements.
 9. Complete final cleaning requirements.
 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

2. Results of completed inspection will form the basis of requirements for Final Completion.

1.8 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
 1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit Final Completion photographic documentation.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
 1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.9 LIST OF INCOMPLETE ITEMS

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 1. Organize list of spaces in sequential order, , listed by room or space number.
 2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Engineer.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in the following format:
 - a. MS Excel Electronic File. Engineer will return annotated file.
 - b. PDF Electronic File. Engineer will return annotated file.

1.10 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Engineer for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 - 1. Submit on digital media acceptable to Engineer by uploading to web-based project software site or by email to Engineer.
- E. Warranties in Paper Form:
 - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- F. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - d. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - e. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - f. Clean flooring, removing debris, dirt, and staining: clean according to manufacturer's recommendations.
 - g. Vacuum and mop concrete.
 - h. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - i. Remove labels that are not permanent.
 - j. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - k. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - l. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - m. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - n. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
 - o. Clean strainers.
 - p. Leave Project clean and ready for occupancy.

- B. Construction Waste Disposal: Comply with Owner's waste disposal requirements.

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations required before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Engineer will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit Initial, Draft, and Final Manuals by uploading to web-based project software site or by email to Engineer. Enable reviewer comments on draft submittals.
 - 2. Submit three Final Manual paper copies. to Owner.
- C. Initial, Draft, and Final Manual Submittal: Submit a draft copy of each manual at least 30 days before commencing demonstration and training. Engineer will comment on whether general scope and content of manual are acceptable.
 - 1. Correct or revise each manual to comply with Engineer's comments. Submit copies of each corrected manual within 15 days of receipt of Engineer's comments and prior to commencing demonstration and training.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training.
- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit Final Manuals, after all Engineer comments addressed, in the form of hard-copy, bound and labeled volumes.
 - 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 1. Title page.
 2. Table of contents.
 3. Manual contents.
- B. Title Page: Include the following information:
 1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Construction Manager.
 7. Name and contact information for Engineer.
 8. Name and contact information for Commissioning Authority.
 9. Names and contact information for major consultants to the Engineer that designed the systems contained in the manuals.
 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
 - 1. Type of emergency.
 - 2. Emergency instructions.
 - 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
 - 1. Fire.
 - 2. Flood.
 - 3. Gas leak.
 - 4. Water leak.
 - 5. Power failure.
 - 6. Water outage.
 - 7. System, subsystem, or equipment failure.
 - 8. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
 - 1. Instructions on stopping.
 - 2. Shutdown instructions for each type of emergency.
 - 3. Operating instructions for conditions outside normal operating limits.
 - 4. Required sequences for electric or electronic systems.
 - 5. Special operating instructions and procedures.

1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include

information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- D. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

- F. Piped Systems: Diagram piping as installed and identify color coding where required for identification.

1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.

4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.
- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of maintenance manuals.

1.10 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
1. Product name and model number.

2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 012900 "Payment Procedures" for maintaining and exhibiting project record documents as a prerequisite for progress payments.
 - 2. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set of marked-up record prints.
 - 2. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints.
 - 2) Engineer will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned Record Prints and three set(s) of file prints.
 - 2) Print each drawing, whether or not changes and additional information were recorded.

- B. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

1.4 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Work Change Directive.
 - k. Changes made following Engineer's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 - 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 - 4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Engineer. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
 - 1. Format: Annotated PDF electronic file.
 - 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 - 3. Refer instances of uncertainty to Engineer for resolution.
 - 4. Engineer will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
 - a. Engineer will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 - 1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 - 2. Format: Annotated PDF electronic file.
 - 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 - 4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Engineer.
 - e. Name of Contractor.

1.5 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Note related Change Orders and Record Drawings where applicable.
- B. Format: Submit Record Specifications as annotated PDF electronic file(s) or scanned PDF electronic file(s) of marked-up paper copy of Specifications.

1.6 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturers' written instructions for installation.
 - 3. Note related Change Orders and Record Drawings where applicable.
- C. Format: Submit Record Product Data as annotated PDF electronic file or scanned PDF electronic file(s) of marked-up paper copy of Product Data.
 - 1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.7 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file or scanned PDF electronic file(s) of marked-up miscellaneous record submittals.
 - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.8 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Engineer's reference during normal working hours. As a prerequisite for monthly progress payments, exhibit the updated record documents for review by Owner and Engineer for accuracy and completeness.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017839

SECTION 018839 - WIND PERFORMANCE REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Performance requirements and design criteria for wind restraint.
 - 2. Delegated Design of exterior equipment and components, nonstructural components and nonbuilding structures, due to the action of wind, to be designed by performance specification and where otherwise indicated on Drawings.
 - 3. Requirements regarding applicable Codes, basis-of-design, and load criteria to be used in the detailed design of delegated design project components and systems to be designed under other Sections.
 - 4. Design and provide complete wind restraint systems.

1.3 DEFINITIONS

- A. Anchorage: Connection to structure typically through the use of welds, bolts, screws, anchor bolts, post-installed anchors, or other fasteners selected to meet the Building Code.
- B. Code: Florida Building Code (FBC) currently in effect where Project is located.
- C. Component: A part of an architectural, electrical, or mechanical system which is manufactured as an independent unit, subsystem, or subassembly, that can be joined with other parts to form a more complex item or assembly.
- D. Nonstructural Component: A part of an architectural, mechanical, or electrical system within or without a building or nonbuilding structure including its supports and anchorage.
- E. Restraint/Bracing: Restraint, bracing or anchorage used to limit movement under wind forces. Cables or rigid elements, i.e., strut, pipe, and angles, used to resist forces by uniaxial tension or compression. Term "bracing" may also be used to describe design to resist lateral forces through the use of wall, beam, or frame elements.
- F. Support: Elements used to support the weight (gravity load) of an item. Where support is located at a wind brace, the element may also resist tension/compression reactions, and bending moments from the restraint system.
- G. Wind Deformations: Drifts, deflections and relative displacements determined in accordance with the applicable wind requirements of the Building Code.

- H. Wind Demand: Forces and deformations caused by Building Code wind loads that must be resisted or accommodated by a structure, system, component, restraint/bracing, anchorage or support.
- I. Wind Forces: Forces acting in any direction due to the action of wind as defined in the Building Code.

1.4 ACTION SUBMITTALS

- A. Provide wind restraint submittals with associated structure, equipment, or component submittal.
- B. Product Data: For each type of product.

1.5 DELEGATED DESIGN SUBMITTALS

- A. Delegated Design professional to provide necessary additional special tests and inspection requirements covering the work of their submittal. Identify items that necessitate inspections not already identified in Contract Documents.
- B. Submit analysis data documenting compliance with design criteria.
- C. Shop Drawings:
 - 1. Submit wind restraint Shop Drawings that are prepared, sealed, and signed by a Professional Engineer registered in the State of Florida.
 - 2. Include plans, elevations, sections, mounting and anchorage details in submittal. Indicate restraint details including member sizes, materials, quantities, anchorage details including size and embedment of anchor bolts, base plate setting details and locations, and location, direction and magnitudes of project related loads transferred to the structure.
 - 3. Include sufficient information regarding component anchorage to verify compliance with this Section and applicable Codes and Standards.
 - 4. Anchorage Layout Drawings, indicating size and location of anchorage bolts in relation to supporting substrate materials.
 - a. Details of structure, equipment, or component anchorage to foundation or structure, including anchor type, size, material, embedment depth, and minimum edge distance.
 - b. Summary of maximum vertical and horizontal reactions at each anchor considering applicable load and load combinations, based upon specified design criteria.
 - c. Vibration Isolation Base Details: Where required, detail fabrication including anchorages and attachment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - d. Identify specified loads and load combinations. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

D. Calculations:

1. Prepare wind restraint calculations by a Professional Engineer and submit with Shop Drawings.
2. Include sufficient information regarding component restraints, attachments, and anchorage to verify a continuous load path of sufficient strength and stiffness that demonstrates compliance with this Section and applicable Codes and Standards.
3. Calculations are submitted for Project record and will not be reviewed by Engineer.

1.6 QUALITY ASSURANCE

- A. Comply with the International Building Code (IBC) latest adopted Edition by jurisdiction where the Project is located and applicable local and statewide adopted amendments.
- B. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a registered professional engineer who is legally qualified to practice in State and jurisdiction where Project is located.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section 014000 "Quality Requirements," to design wind restraint related systems.
- B. Select products meeting requirements of applicable Codes.
- C. Provide wind restraint of nonstructural components to withstand wind demands without displacing or overturning.
- D. Provide non-building structures designed and constructed to withstand specified wind demands.

2.2 PROJECT WIND DESIGN CRITERIA

- A. Use following basic wind design criteria in project calculations. Determine other factors in accordance with ASCE 7.
 1. Basic Wind Speed:
 - a. $V_{ULT} = 143$ miles per hour
 - b. $V_{ASD} = 111$ miles per hour
 2. Wind Exposure Category: C.
 3. Risk Category: III.
 4. Tornado Wind Speed:
 - a. $V_T = 50$ miles per hour
 - b. $A_E = 1,000,000$ square feet

2.3 COMBINATION OF LOADS

- A. Use wind loads in combination with other applicable design loads, including but not limited to dead loads, live loads, rain loads, snow loads, ice loads, seismic loads, flood loads, earth and ground water pressures, self-straining, and other loads in accordance with load combinations of ASCE 7 and the Code.
- B. Determine most severe distribution, concentration, and combination of design loads and forces and then use in the design conforming with the Code. Design to meet code requirements and to satisfy all combinations of loads.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Verify that multiple systems installed in same vicinity can be installed without conflict.
- B. Use wind design criteria in conjunction with appropriate load factors and load combinations in accordance with ASCE 7 and the Code.
- C. Do not fabricate or install wind restraints until submittals have been approved by Engineer.

3.2 DESIGN AND GENERAL CONSTRUCTION

- A. Design component, support, and bracing to resist wind design force in any direction.
- B. Provide supports, braces, connections, hardware, and anchoring devices to withstand Code-required wind forces, including maximum permissible displacements, without shifting and overturning.
- C. Attach or anchor components and their supports to the structure. Provide a continuous load path meeting requirements of this Section and applicable Codes and Standards between the component and supporting structure.
- D. Install, inspect, and test wind restraints in accordance with referenced standards.

END OF SECTION 018839

SECTION 033010 – MISCELLANEOUS CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
- B. Furnish, as required to establish concrete mixes, all sampling and laboratory testing of products and materials performed by independent testing laboratory engaged by and at expense of Contractor. Provide field sampling, testing, inspection and related laboratory tests.
- C. Related Requirements:
 - 1. Section 036000 “Grouting” for grouting.
 - 2. Section 050519 “Post-Installed Anchors” for post installed adhesive anchoring system.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with fly ash or ground granulated blast furnace slag; materials subject to compliance with requirements.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Concrete Design Mixtures: Design Mixtures: For each formulation of concrete proposed for use, submit constituent quantities per cubic yard (cubic meter), water cementitious ratio, air content, concrete slump, type and manufacturer of cement and type and manufacturer of fly ash or ground granulated blast furnace slag. Provide either:
 - 1. Standard deviation data for each proposed concrete mix based on statistical records.
 - 2. Water cementitious ratio curve for concrete mixes based on laboratory tests.
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, spacing, lengths, material, grade, bar schedules, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, and supports for

concrete reinforcement. Reference bars to be the same identification marks shown on the bar bending details.

D. Construction Joint Layout: As shown on Drawings.

E. Material Certificates: For each of the following:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Curing compounds.
6. Bonding agents.

F. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates: Conformance to ASTM standards, including sieve analysis, mechanical properties, and deleterious substance content.
2. Mill Test Reports: Conformance to ASTM standards, including chemical analysis and physical tests.
 - a. Cementitious materials.
 - b. Steel Reinforcing.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For independent testing agency responsible for concrete design mixtures.

1. Name and address.
2. Names and positions of principal officers and name, position, and qualifications of responsible registered professional engineer in charge.
3. Listing of technical services to be provided. Indicate external technical services to be provided by other organizations.
4. Names and qualifications of supervising laboratory technicians.
5. Statement of conformance provided by evaluation authority defined in ASTM C1077. Provide report prepared by evaluation authority when requested by Engineer.
6. Submit as required above for other organizations that will provide external technical services.

B. Certifications:

1. Certify that admixtures used in the same concrete mix are compatible with each other and the aggregates.
2. Certify Contractor is not associated with independent testing laboratory proposed for use by Contractor nor does Contractor or its officers have beneficial interest in laboratory.
3. Certificate of conformance for concrete production facilities from the NRMCA.

C. Field quality-control reports.

D. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency , qualified according to ASTM C1077 and ASTM E329 for testing indicated. Do not use laboratories affiliated and having beneficial interest with Contractor or its officers.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Provide reinforcement free from mill scale, rust, mud, dirt, grease, oil, ice, or other foreign matter that will reduce or destroy bond. Deliver, store, and handle steel reinforcement to prevent bending and damage. Store reinforcement off the ground, protect from moisture, and keep out of standing water, and free from rust, mud, dirt, grease, oil, ice, or other contaminants and deleterious matter that will reduce or destroy bond.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions. Limit total storage time from date of manufacture to date of installation to six months or the manufacturer's recommended storage time, whichever is less.
- D. Remove immediately from the site material which becomes damp, contains lumps, or is hardened and replace with acceptable material.
- E. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location.
 - 2. Provide additional protection according to manufacturer instructions.

1.8 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average of the highest and lowest temperature from midnight to midnight is expected to fall below 40 deg F for three successive days, maintain delivered concrete

- temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301.
 2. ACI 117.
 3. ACI 318.

2.2 FORM-FACING MATERIALS

- A. Surface Finish 2.0 Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
1. Plywood, metal, or other approved panel materials.
- B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- C. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces. Form-release agent to comply with Federal, State and local VOC limitations.
1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- D. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete, heavy high frequency vibration of the concrete on forms and to prevent spalling of concrete on removal.
1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.

3. Furnish ties with integral water-barrier plates to retaining walls.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60, new deformed bars.
- B. Welded Wire Fabric: ASTM A1064, fabricated from ASTM A615 or ASTM A706, Grade 60 ksi.

2.4 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete of greater compressive strength than the specified concrete strength, according to CRSI's "Manual of Standard Practice," and as follows:
 1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
- B. Tie wires for reinforcement: 16 gauge or heavier black annealed wire to tie uncoated reinforcing.

2.5 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Cementitious Materials:
 1. Portland Cement: ASTM C150/C150M, Type II.
 2. Blended Cement:
 - a. Comply with ASTM C595.
 - b. Type I/II (MS).
 3. Fly Ash: ASTM C618, Class F.
 4. Ground Granulated Blast Furnace Slag: ASTM C989/C989M, Grade 100 or 120.
- C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
 1. Maximum Coarse-Aggregate Size: As indicated by concrete mixtures specified herein.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C260/C260M.

- E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 - 2. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
- F. Water: ASTM C94/C94M and potable.

2.6 CURING MATERIALS

- A. Absorptive Cover: AASHTO M182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1-D, Class B, dissipating.

2.7 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: limit percentage, by weight, of cementitious materials (Portland cement alone or in combination with fly ash or Ground Granulated Blast Furnace Slag) in concrete as follows:
 - 1. Fly Ash: 20-25 percent.
 - 2. Ground Granulated Blast Furnace Slag: 25-45 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture in concrete, for placement and workability.

2.8 CONCRETE MIXTURES

- A. Structural Concrete 10-inches or greater in thickness:
 - 1. Minimum Compressive Strength: 4,500 psi at 28 days.
 - 2. Maximum W/C Ratio: 0.42.
 - 3. Slump Limit: 4 inches, plus or minus 1 inch.

4. Air Content: 4 percent, plus or minus 1.5 percent at point of delivery.
5. Coarse Aggregate: ASTM C33, size 57.

B. Structural Concrete less than 10-inches in thickness:

1. Minimum Compressive Strength: 4,500 psi at 28 days.
2. Maximum W/C Ratio: 0.42.
3. Slump Limit: 4 inches, plus or minus 1 inch
4. Air Content: 4 percent, plus or minus 1.5 percent at point of delivery.
5. Coarse Aggregate: ASTM C33, size 67.

2.9 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.10 CONCRETE MIXING

Ready-Mixed Concrete: Mix and deliver concrete according to ASTM C94.

PART 3 - EXECUTION

3.1 MEASURING MATERIALS

- A. Provide concrete composed of portland cement, fly ash or ground granulated blast furnace slag, fine aggregate, coarse aggregate, water and admixtures as specified and produced by plant complying with ACI 318 and ASTM C94. Batch all constituents, including admixtures, at plant. High-range water reducing admixtures may be added in field.
- B. Measure materials for batching concrete by weighing in conformity with and within tolerances given in ASTM C94 except as otherwise specified. Use scales last certified by local Sealer of Weights and Measures within one year of use.
- C. Weigh cement and fly ash or ground granulated blast furnace slag in individual weigh batchers that are separate and distinct from weigh batchers used for other materials. When cement and fly ash or ground granulated blast furnace slag are weighed in a cumulative weigh batcher, cement shall be weighed first.
- D. Measure amount of free water in fine aggregates within 0.5 percent with a moisture meter. Compensate for varying moisture contents of fine aggregates. Record number of gallons of water as batched on printed batch tickets.
- E. Dispense admixtures either manually using calibrated containers or measuring tanks or by means of automatic dispenser approved by manufacturer of the specific admixture.
1. Charge air entrainment and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device.
 2. Inject multiple admixtures separately during batching sequence.

3.2 MIXING AND TRANSPORTING

- A. Provide ready-mixed concrete produced by equipment complying with ACI 318 and ASTM C94 and produced by a plant certified by the NRMCA. Do not hand-mix. Use truck mixers carrying a rating plate conforming to TMMB 100. Clean each transit mix truck drum and reverse drum rotation before truck proceeds under batching plant. Equip each transit-mix truck with a continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds.
- B. Transport ready-mix concrete to site in watertight agitator or mixer trucks loaded not more than their rated capacities as stated on name plate.
- C. Keep water tank valve on each transit truck always locked. Any addition of water must be directed by Engineer. Incorporate water directed to be added by additional mixing of at least 50 revolutions at mixing speed after addition of all water. Meter all added water and show amount of water added on each delivery ticket.
- D. Comply with ACI 318 and ASTM C94 for central plant and rolling stock equipment and methods.
- E. Select equipment of size and design to provide continuous flow of concrete at the delivery end. Use metal or metal-lined non-aluminum discharge chutes with slopes not exceeding one vertical to two horizontal and not less than one vertical to three horizontals. Chutes more than 20 feet long and chutes not meeting slope requirements may be used if concrete is discharged into a hopper before distribution.
- F. Do not retemper (mix with or without additional cement, aggregate, or water) concrete or mortar which has partially hardened.
- G. Handle concrete from mixer to placement providing concrete of specified quality in the placement area and not exceeding maximum time interval specified in Paragraph 3.2 I.4. Dispatch trucks from the batching plant so they arrive at the work site just before the concrete is required to avoid excessive mixing of concrete while waiting or delays in placing successive layers of concrete in the forms. Remix for a minimum of 5 minutes prior to discharge or testing.
- H. Furnish delivery ticket for ready mixed concrete to Engineer as each truck arrives. Provide printed record of weight of cement and each aggregate as batched individually on each ticket. Use type of indicator that returns for zero punch or returns to zero after a batch is discharged. Indicate for each batch the weight of fine and coarse aggregate, cement, fly ash or ground granulated blast furnace slag, and water, moisture content of fine and coarse aggregate at time of batching, and types, brand and quantity of each admixture, the quantity of concrete delivered, the time any water is added and the amount, and numerical sequence of the delivery. Show the time of day batched and time of discharge from the truck. Indicate the number of revolutions of transit mix truck.
- I. Temperature and Mixing Time Control:
 - 1. In cold weather (see Paragraph 3.8, C) maintain the as-mixed temperature of the concrete and concrete temperatures at the time of placement in the forms as indicated in Table 3.

2. If water or aggregate has been heated, combine water with aggregate in the mixer before cement is added. Do not add cement to mixtures of water and aggregate when the temperature of the mixture is greater than 90 degrees F.
3. In hot weather (see Paragraph 3.8, D), cool ingredients before mixing to maintain temperature of the concrete below the maximum placing temperature of 90 degrees F. Well-crushed ice may be substituted for all or part of the mixing water as part of the approved hot weather concreting plan.
4. Maximum time interval between the addition of mixing water and/or cement to the batch and the final placing of concrete in the forms shall not exceed the values shown in the following Table 2:

TABLE 2

AIR OR CONCRETE TEMPERATURE (WHICHEVER IS HIGHER)	MAXIMUM TIME
--	-----------------

(27 Degrees C) 80 Degrees F to 90 Degrees F (32 Degrees C)	45 minutes
(21 Degrees C) 70 Degrees F to 79 Degrees F (26 Degrees C)	60 minutes
(5 Degrees C) 40 Degrees F to 69 Degrees F (20 Degrees C)	90 minutes

5. If approved high-range water-reducing admixture (plasticizer) is used to produce plasticized concrete, maximum time interval between the addition of mixing water and/or cement to the batch and the final placing of concrete in the forms shall not exceed 90 minutes.

3.3 FORMWORK INSTALLATION

- A. Erect, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Use form-facing materials as required to meet the surface finishes (SF) requirements of ACI 301, unless otherwise specified provide as-cast form finishes per ACI 301 as follows.
 1. Surface Finish (SF-2.0).
- D. Construct forms tight to prevent loss of concrete mortar.
- E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 1. Install recesses, and the like, for easy removal.
 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

- G. Provide temporary openings for cleanouts and inspection ports where necessary. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, ice, snow and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.4 EMBEDDED ITEM INSTALLATION

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.5 REMOVING AND REUSING FORMS

- A. General: Formwork for parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations must be maintained.
 - 1. Leave formwork for structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing materials are not acceptable for exposed surfaces. Re-apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.6 STEEL REINFORCEMENT INSTALLATION

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose mill scale, rust, mud, dirt, grease, oil, ice, and other foreign materials that reduce or destroy the bond to concrete.

- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum clear concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Splicing:
 - 1. If not indicated on Drawings, locate reinforcement splices at point of minimum stress.

3.7 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.
 - 2. Locate joints for foundations in the middle third of spans.
 - 3. Locate horizontal joints in walls and at the top of footings.
 - 4. Space vertical joints in walls as indicated on the Drawings.
 - 5. At construction joints and at concrete joints indicated on Drawings to be "roughened", uniformly roughen the surface of concrete to a full amplitude (distance between high and low points and side to side) of 1/4 inch with chipping tools to expose a fresh face. Thoroughly clean joint surfaces of loose or weakened materials by waterblasting or sandblasting and prepare for bonding. At least two hours before and again shortly before the new concrete is deposited, saturate joints with water. After glistening water disappears, coat joints with neat cement slurry mixed to consistency of very heavy paste. Coat surfaces to a depth of at least 1/8 inch thick, scrubbed-in by means of stiff bristle brushes. Deposit new concrete before the neat cement dries.
 - 6. Do not use keyways in construction joints unless specifically shown on Drawings or approved by Engineer.

3.8 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid "cold" joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
4. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

D. Slabs and equipment foundations:

1. Maintain reinforcement in position on chairs during concrete placement.
2. Screed surfaces with a straightedge and strike off to correct elevations.
3. Slope surfaces uniformly to drains where required.
4. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.9 FINISHING SURFACES

- A. Finish concrete surfaces according to ACI 301 and ACI 318.
- B. Surface Finish 2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 1. Apply to concrete surfaces exposed to view, to receive a rubbed finish.
- C. Rubbed Finish: Apply a Smooth-Rubbed Finish per ACI 301 to exposed Surface Finish 2.0 as-cast vertical concrete surfaces as specified.
- D. Float Finish: Apply float finish per ACI 301 prior to broom finish or trowel finish.
- E. Broom Finish: After concrete has received a float finish, apply to smooth-formed-finished as-cast concrete surfaces subject to pedestrian traffic. Provide broom finish perpendicular to direction of pedestrian traffic.
- F. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10 MISCELLANEOUS CONCRETE ITEM INSTALLATION

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and chamfers.
- C. Equipment Pads:
 - 1. Coordinate sizes and locations of concrete pads with actual equipment provided.
 - 2. Install reinforcing dowels; to connect concrete pad to concrete floor, unless otherwise indicated.
 - 3. For supported equipment, install anchor bolts that extend through concrete pad and anchor into structural concrete substrate.
 - 4. Prior to placing concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Cast anchor-bolt insert into pads. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.11 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.
- B. Formed Surfaces: Cure formed concrete surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.
- C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

3.12 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.

- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repair surfaces containing defects. Surface defects include color and texture irregularities, voids, cracks, spalls, air bubbles, bug holes, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
- D. Limit sawcut at the perimeter of the area to a depth of 3/4 inch. Make edges of cuts perpendicular to concrete surface. Prepare surfaces per patching mortar manufacturer's recommendations.
- E. Repairing Formed Surfaces:
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects using patching mortar. On surfaces exposed to view repair by blending white Portland cement and standard Portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
- F. Repairing Unformed Surfaces:
 - 1. Inspect unformed surfaces, such as tops of foundations or equipment pads, for finish and verify surface tolerances specified for each surface.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Limit sawcut at the perimeter of the area to a depth of 3/4 inch. Finish repaired areas to blend into adjacent concrete.
 - 4. Repair defective areas, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Mix patching mortar per manufacturer's recommendations, including coarse aggregate when required. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 - 5. Correct crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
- G. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.
- H. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.13 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing and inspection agency to perform field tests and inspections and prepare test reports.
- B. Notify Owner when the reinforcing is complete and ready for inspection, at least six working hours prior to the proposed concrete placement. Do not cover reinforcing steel with concrete until the installation of the reinforcement, including the size, spacing and position of the reinforcement has been inspected by Owner's inspection agency and Owner's inspection agency release to proceed with the concreting has been obtained. Keep forms open until Owner's inspection agency has completed inspection of the reinforcement.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements by Owner's testing agency:
 - 1. Testing Frequency: One composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 2. Slump: ASTM C143/C143M; one test at point of discharge for each composite sample, but not less than one test for each day's placement of each concrete mixture. Additional tests will be performed when concrete consistency appears to change.
 - 3. Air Content: ASTM C231/C231M, pressure method, for concrete; one test for each composite sample at the point of placement, but not less than one test for each day's placement of each concrete mixture.
 - 4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
 - 5. Compression Test Specimens: ASTM C31/C31M.
 - a. Cast and cure one set of five 6 inch x 12 inches long standard cylinder specimens for each composite sample.
 - 6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at 7 days, test one specimen at 14 days, test two specimens at 28 days. Retain one cylinder for 56 days for testing when requested by Engineer.
 - 7. Strength of each concrete mixture will be satisfactory if every average of any three-consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 - 8. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break.
 - 9. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other

requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Engineer.

10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. When the average 28-day compressive strength of the cylinders in any set falls below the required compressive strength or below proportional minimum 7-day or 14-day strengths (where proper relation between 7, 14, and 28 day strengths have been established by tests), change proportions, cementitious content, or temperature conditions to achieve the required strengths without additional compensation.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. Core Compressive Strength Testing:

1. Engineer may have cores taken from any questionable area in the concrete work such as construction joints and other locations as required for determination of concrete quality. Use results of tests on such cores as basis for acceptance, rejection, or determining the continuation of concrete work. The right of Engineer to take such cores shall not be construed as creating any obligation to take such cores, and not exercising this right to do so shall not relieve Contractor from meeting specification requirements. Cooperate in obtaining cores by allowing free access to the work and permitting the use of ladders, scaffolding, and such incidental equipment as may be required. Repair core holes with non-shrink grout as specified in Section 036000 "Grouting". Work of cutting, testing, and repairing the cores will be at the expense of Contractor if defective work is uncovered. If no defective work is found, such cost will be at the expense of Owner.
2. Sampling and Testing Procedures: Comply with ASTM C42.
3. Test Acceptance: According to ACI 318.
4. Drill three cores for each failed strength test from failed concrete.

3.14 FAILURE TO MEET REQUIREMENTS

- A. Should the strengths shown by the test specimens made and tested in compliance with the previous provisions fall below the values given in Table 1, Engineer may require changes in proportions or materials, or both, to apply to the remainder of the work in accordance with Paragraph 1.7 E. Furthermore, Engineer may require additional curing on those portions of the structure represented by the test specimens which fall below the values given in Table 1. The cost of such additional curing shall be at no additional cost to Owner. In the event that such additional curing does not give the strength required, as evidenced by core and/or load tests, Engineer may require strengthening or replacement of those portions of the structure which fail to develop the required strength. Coring and testing and/or load tests and any strengthening or concrete replacement required because strengths of test specimens are below that specified, without additional compensation. In such cases of failure to meet strength requirements, Contractor and Owner shall confer to determine what adjustment, if any, can be made in compliance with Sections titled "Strength" and "Failure to Meet Strength Requirements" of ASTM C94. The "purchaser" referred to in ASTM C94 is Contractor.
- B. When the tests on control specimens of concrete fall below the required strength, Engineer will permit check tests for strengths to be made by means of typical cores drilled from the structure in compliance with ASTM C42 and C39. In cases where tests of cores fall below the values

given in Table 1, Engineer, in addition to other recourses, may require load tests on any one of the slabs, walls, beams, and columns in which such concrete was used. Test need not be made until concrete has aged 60 days. Engineer may require strengthening or replacement of those portions of the structure which fail to develop the required strength. Perform coring and testing, load tests, and any strengthening or concrete replacement required because strengths of test specimens are below that specified, without additional compensation.

- C. Should the strength of test cylinders fall below 60 percent of required minimum 28-day strength, concrete shall be rejected, removed, and replaced without additional compensation.

END OF SECTION 033010

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SECTION 036000 - GROUTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Nonshrink cementitious grout.
- B. Related Requirements:
 - 1. Section 033010 "Miscellaneous Cast-in-Place Concrete."
 - 2. Section 055000 "Metal Fabrications" for grout related to miscellaneous metals.

1.3 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer information regarding grout and surface preparation, mixing and installation.
 - 1. Commercially Manufactured Nonshrink Cementitious Grout: Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, and conformity to specified ASTM standards.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- B. Manufacturer Instructions: Submit instructions for mixing, handling, surface preparation, and placing nonshrink grouts.
- C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- D. Qualifications Statement:
 - 1. Submit qualifications for manufacturer.

1.5 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' experience in production and use of provided grouts.
- B. Independent testing laboratory shall meet requirements of ASTM E329 and ASTM C1077 and be acceptable to Engineer. Laboratories affiliated with Contractor or in which Contractor or officers of Contractor's organization have beneficial interest are not acceptable.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions. Limit total storage time from date of manufacture to date of installation to six months or manufacturer's recommended storage time, whichever is less.
- C. Remove immediately from the site material which becomes damp, contains lumps, or is hardened and replace with acceptable material.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location.
 - 2. Provide additional protection according to manufacturer instructions.

1.7 AMBIENT CONDITIONS

- A. Maximum Conditions: Do not perform grouting if temperatures exceed 90 degrees F.
- B. Minimum Conditions: Do not perform grouting if the minimum temperature of base plates, supporting concrete and grout are less than 40 degrees F. Maintain minimum temperature of 40 degrees F before, during, and after grouting, until grout has set.

PART 2 - PRODUCTS

2.1 NONSHRINK CEMENTITIOUS GROUT

- A. Description:
 - 1. Pre-mixed and ready-for-use formulation requiring only addition of water.
 - 2. Nonshrink, non-corrosive, nonmetallic, non-gas forming, not containing expansive cement and no chlorides.
 - 3. No shrinkage when tested in conformity with ASTM C827/C827M.
 - 4. For placements 3 inches and thicker, extend nonshrink cementitious grout with 3/8 inch aggregate in accordance with manufacturer's recommendations.

B. Performance and Design Criteria:

1. Certified to maintain initial placement volume or expand after set, and to meet following minimum properties when tested according to ASTM C1107/C1107M for Grades B, C, D, and CRD-C621 nonshrink grout:
 - a. Setting Time:
 - 1) Initial: Approximately two hours.
 - 2) Final: Approximately three hours.
 - 3) Comply with ASTM C191.
 - b. Maximum Expansion: 0.10 to 0.40 percent.
 - c. Minimum Compressive Strength:
 - 1) One-Day: 4,000 psi.
 - 2) Seven-Day: 7,000 psi.
 - 3) 28-Day: 10,000 to 10,800 psi.
 - 4) Comply with CRD-C621.

C. Product: Prove one of the following or equal:

1. SikaGrout 212 by Sika Corp
2. Hi-Flow Grout by The Euclid Chemical Co.
3. Or Approved equal.

2.2 FORMWORK

- A. As specified in this Section and in Section 033010 "Miscellaneous Cast-in-Place Concrete".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify areas to receive grout.

3.2 PREPARATION

- A. Place grout where indicated or specified over existing concrete and cured concrete which has attained its specified design strength unless otherwise approved by Engineer.
- B. Remove defective concrete, ice, laitance, dirt, oil, grease, form release agents, paints, and other foreign material from concrete surfaces, which may affect the bond or performance of the grout by brushing, hammering, chipping, sand blasting or other similar dry mechanical means until sound and clean concrete surface is achieved. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance and firmly embedded into the parent concrete.
 1. Air compressors used to clean surfaces in contact with grout shall be the oil-less type or equipped with an oil trap in the airline to prevent oil from being blown onto the surface.

- C. Roughen concrete lightly, but not to interfere with placement of grout.
- D. Remove foreign materials from metal surfaces in contact with grout.
- E. Align, level, and maintain final positioning of components to be grouted.
- F. Wash concrete surfaces clean and then keep moist for at least 24 hours prior to the placement of nonshrink cementitious or cement grout. Saturation may be achieved by covering the concrete with saturated burlap bags, use of a soaker hose, or flooding the surface or other method acceptable to Engineer. Upon completion of the 24 hour period, remove visible water from the surface prior to grouting.
- G. Support equipment during alignment and installation of grout by shims, wedges, blocks, or other approved means. Prevent bond of shims, wedges and blocking devices by bond breaking coatings and remove after grouting unless otherwise approved by Engineer. Grout voids created by the removal of shims, wedges, and blocks.

3.3 INSTALLATION – GENERAL

- A. Mix, apply and cure products in strict compliance with the manufacturer's recommendations and these Specifications.
- B. Formwork:
 - 1. Construct leakproof forms anchored and shored to withstand grout pressures.
 - 2. Install formwork with clearances to permit proper placement of grout.
 - 3. As specified in Section 033010 "Miscellaneous Cast-in-Place".
- C. Placing of Grout:
 - 1. Place grout material quickly and continuously.
 - 2. Do not use pneumatic-pressure or dry-packing methods.
 - 3. Apply grout from one side only to avoid entrapping air.
 - 4. Do not vibrate placed grout mixture or permit placement if area is being vibrated by nearby equipment.
 - 5. Thoroughly compact final installation and eliminate air pockets.
 - 6. Do not remove leveling shims for at least 48 hours after grout has been placed.
- D. Curing:
 - 1. Prevent rapid loss of water from grout during first 48 hours by use of approved membrane curing compound or by using wet burlap bags, soaker hoses or ponding.
 - 2. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.
 - 3. After grout has attained its initial set, keep damp for minimum three days.
- E. Reflect existing underlying expansion joints, partial contraction joints, and construction joints through the grout.

3.4 INSTALLATION – NONSHRINK CEMENTITIOUS GROUTS

- A. Mix in accordance with manufacturer's recommendations. Do not add cement, sand, pea gravel or admixtures without prior approval by Engineer.
- B. Mix in a mortar mixer with moving blades. Pre-wet mixer and empty excess water. Add pre-measured amount of water for mixing, followed by the grout. Begin with minimum amount of water recommended by manufacturer and then add minimum additional water required to obtain workability. Do not exceed manufacturer's maximum recommended water content. Do not mix by hand.
- C. Provide forms as specified in "Preparation" Article. Place grout into the designated areas and prevent segregation and entrapment of air. Do not vibrate grout to release air or to consolidate the material. Fill all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes and vent holes as necessary.
- D. Place grout rapidly and continuously to avoid cold joints. Do not place grout in layers. Do not add additional water to the mix (retemper) after initial stiffening.
- E. Just before grout reaches its final set, cut back grout to the substrate at a 45 degree angle from lower edge of bearing plate unless otherwise ordered and approved by Engineer. Finish this surface with a wood float or brush finish.
- F. Begin curing immediately after form removal, cutback, and finishing. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement, until grout compressive strength reaches 1,000 psi or as recommended by manufacturer, whichever is longer. Saturate grout surface by use of saturated burlap bags, soaker hoses or ponding. Provide sunshades. If drying winds inhibit the ability of a given curing method to keep grout moist, erect wind breaks until wind is no longer a problem or curing is finished.

3.5 SCHEDULE

- A. Use particular types of grout as follows:
 - 1. Nonshrink Cementitious Grout: Use at locations where nonshrink grout is indicated, except for base plates greater in area than 3-feet wide by 3-feet long.

END OF SECTION 036000

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SECTION 050519 - POST-INSTALLED ANCHORS AND REINFORCING BARS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Post-installed adhesive and expansion anchors for concrete substrates.
 - 2. Post-installed reinforcing bar dowels using adhesive anchoring system.

- B. Related Requirements:

- 1. Section 033010 "Miscellaneous Cast-in-Place Concrete" and related Sections for concrete, reinforcement, and accessories.
 - 2. Section 055000 "Metal Fabrications" for metal fabrications.
 - 3. Various Sections in Divisions 26 related to facility utilities.
 - 4. Various Sections in Divisions 46 related to process mechanical equipment.

1.3 ACTION SUBMITTALS

- A. Post-Installed Expansion Anchors:

- 1. Design Data: Submit manufacturer's specifications and data including recommended design values and physical characteristics for expansion anchors.
 - 2. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, materials and finishes for post-installed expansion anchors installed into cracked concrete or concrete masonry unit.
 - 3. Installation Procedures: Submit procedures stating product proposed for use, and complete installation method.

- B. Post-Installed Adhesive Anchoring System:

- 1. Design Data: Submit manufacturer's specifications and data including recommended design values and physical characteristics, including temperature, humidity, and moisture limitations for adhesive anchoring system.
 - 2. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, materials and finishes for post-installed adhesive anchoring system installed into cracked concrete or masonry.
 - 3. Installation Procedures: Submit procedures stating method of drilling, product proposed for use, and complete installation method.

1.4 INFORMATIONAL SUBMITTALS

- A. Installation procedure: Submit installation procedure for post-installed adhesive anchoring system; including method of drilling.
- B. Certificates:
 - 1. Installer Qualifications for Adhesive Anchoring System: Submit installer and testing agency qualifications as stated in following Paragraph of this Article.
 - 2. Submit current International Code Council (ICC) Evaluation Service Reports (ESR) or IAPMO-UES (ER) Report for expansion anchors and adhesive anchoring system], for installation into cracked concrete or masonry, as applicable, indicating conformance with current ICC Evaluation Service (ICC-ES) Acceptance Criteria.
- C. Qualification Data:
 - 1. Installer: Indicate manufacturer's training date and a list of personnel trained on installation of adhesive anchoring system.
 - 2. Submit qualifications of other laboratory or laboratories until approved.
- D. Evaluation Reports: From ICC-ES or IAPMO-UES for expansion anchors and adhesive anchoring system, for installation of post-installed anchors into cracked concrete or concrete masonry unit, as applicable, indicating conformance with current ICC ES Acceptance Criteria.

1.5 QUALITY ASSURANCE

- A. General: Coordinate with the work of other Sections, field verifying dimensions and work of other trades adjoining items of work before installing items specified in this Section.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver items to be incorporated into the work of other trades in sufficient time to be checked prior to installation.
- B. Handle materials with cranes or derricks. Do not dump material off transportation vehicles or handle in ways that will cause damage.
- C. Store materials elevated above grade and block up so they will not become bent or otherwise damaged.
- D. Repair items that have become damage or corroded to satisfaction of Engineer prior to incorporating them into the work.

PART 2 - PRODUCTS

2.1 EXPANSION ANCHORS

- A. Fastening to Concrete Substrate: Zinc plated carbon steel wedge type anchors, complete with zinc plated nuts and washers, unless otherwise noted.
- B. Submerged or Weather Exposed Substrates: ASTM A276 Type 316 stainless steel wedge type anchors, complete with Type 316 stainless steel nuts and washers, unless otherwise noted.
- C. Meet ICC ES AC01 or ICC ES AC193 cracked concrete qualifications.
- D. Length: When length or anchor embedment is not indicated, provide length sufficient to place the wedge and expansion cone portion of the anchor at least 1 inch behind concrete reinforcing steel.
- E. Basis-of-Design:
 - 1. Anchorage designs indicated are based on Hilti, Kwik-Bolt TZ, unless otherwise noted.
 - 2. Acceptable Anchors: Hilti Kwik-Bolt TZ; Simpson Strong-Tie Strong Bolt 2 Wedge Anchor; DeWalt Power-Stud+ SD1 (DeWalt Power-Stud+ SD6 for stainless steel); or approved equal.

2.2 ADHESIVE ANCHORING SYSTEM

- A. Fastening to Concrete Substrate: Manufactured system consisting of post installed threaded rods, nuts, washers, other anchoring hardware, and chemical dispenser for installation in hammer drilled holes.
 - 1. Anchors: Meet ICC ES AC308 cracked concrete qualifications.
 - 2. Injection Adhesive: Two-component epoxy system consisting of a hardener and a resin, furnished in pre-measured side-by-side cartridges which keep both components separate.
 - 3. Adhesive Cartridge: Side-by-side design to accept a static mixing nozzle which thoroughly blends both components and allows injection directly into a drilled hole.
 - 4. Anchor: Type 316 stainless steel as indicated consisting of an all-thread anchor rod with nut and washer, of matching material to anchor rod.
 - a. Basis-of-Design:
 - 1) Anchorage designs indicated are based on Hilti HIT- RE 500 V3, unless otherwise noted.
 - 2) Acceptable Manufacturers: Hilti HIT- RE 500 V3; Simpson Strong Tie SET-3G; or approved equal.

5. Reinforcing Bar Dowels: Reinforcing bar, per Section 033010.
 - a. Basis-of-Design:
 - 1) Anchorage designs indicated are based on Hilti HIT- RE 500 V3, unless otherwise noted.
 - 2) Acceptable Manufacturers: Hilti HIT- RE 500 V3; Simpson Strong Tie Set-3G; or approved equal.
- B. Fastening to Hollow Concrete Block, Brick, or Hollow-Core Precast Concrete Planks: Three-part threaded rod, screen tube, and chemical dispenser anchoring system.
 1. Anchors: Meet ICC ES AC58.
 2. Adhesive Cartridges: Contain pre-measured amounts of resin and hardener which are mixed and deposited in a screen tube by a dispenser.
 3. Anchor: Type 316 stainless steel as indicated consisting of an all-thread anchor rod with nut and washer, of matching material to anchor rod.
 4. Reinforcing Bar Dowel: Reinforcing bar, per Section 033010.
 5. Basis-of-Design:
 - a. Anchorage designs indicated are based on Hilti HIT-HY 270 System, unless otherwise noted; or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 1. Install anchoring system in strict compliance with manufacturer's published installation instructions and approved Shop Drawings. Comply with recommended surface preparation, temperature, and moisture of substrate and ambient conditions.
 2. Coordinate installation with Special Inspector.
 3. Use drill bit of correct diameter and drill to required depth using rotary impact type hammer drills with carbide-tipped bits.
 4. Drill holes perpendicular to concrete surface, unless otherwise indicated.
 5. Use oil free compressed air to blast out loose particles and dust from drilled holes.
- B. Expansion anchors:
 1. Check expansion anchors for tightness a minimum of 24 hours after initial installation.
- C. Adhesive anchoring system:
 1. Inject adhesive and install anchors and reinforcing bar dowels that are clean and free of dirt, oil, grease, ice, or other deleterious material which would reduce bond.

END OF SECTION 050519

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Miscellaneous items fabricated from steel, aluminum or stainless steel.
 - 2. Loose bearing and leveling plates for applications where they are not specified in other Sections.
- B. Products furnished, but not installed, under this Section include the following:
 - 1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
- C. Related Requirements:
 - 1. Section 033010 "Miscellaneous Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
 - 2. Section 036000 "Grouting" for non-shrink grout.
 - 3. Section 050519 "Post-Installed Anchors and Reinforcing Bars" for anchors in various substrates.
 - 4. Various Sections in Divisions 40 - 46 for process mechanical work scopes.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
 - 1. Miscellaneous steel items.
 - 2. Miscellaneous aluminum items.
 - 3. Miscellaneous stainless-steel items.

1.5 INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Signed by aluminum, steel and stainless-steel manufacturers, certifying that products furnished comply with requirements.
- B. Welding certificates.
 - 1. Certify that welders have been qualified under AWS, within previous 12 months, to perform welds required under this Section.

1.6 QUALITY ASSURANCE

- A. Delegated Design Engineer: Licensed professional engineer experienced in design of specified Work and licensed in the State of Florida.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless steel."

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

- B. Steel Wide Flange Shapes: ASTM A992.
- C. Steel Other Shapes, Plates, Shapes, and Bars: ASTM A36/A36M.
- D. Stainless steel Sheet, Strip, and Plate: ASTM A240/A240M or ASTM A666, Type 316.
- E. Stainless steel Bars and Shapes: ASTM A276, Type 316.
- F. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.
- G. Steel Tubing: ASTM A500/A500M, Grade B cold-formed steel tubing.
- H. Steel Pipe: ASTM A53/A53M, Type S Grade B Standard Weight (Schedule 40) unless otherwise indicated.
- I. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.
- J. Aluminum Extruded Pipe: ASTM B429, Alloy 6063 T6 and Alloy 6061 T6 as indicated.
- K. Aluminum Plate and Sheet: ASTM B209, Alloy 6061-T6.
- L. Aluminum Extrusions: ASTM B221, Alloy 6061 T6.
- M. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.
- N. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.
- O. Gray Iron Castings: ASTM A48, Class 35.
- P. Ductile Iron Castings: ASTM A536, Grade 65-45-12.
- Q. Stainless steel Bolts: ASTM F593, Type 316.
- R. Stainless steel Nuts: ASTM F594, Type 316.
- S. Carbon Steel Bolts and Studs: ASTM A307, Grade A (hot dip galvanized nuts and washers where noted)
- T. High Strength Steel Bolts, Nuts and washers: ASTM F3125, Grade A325 (mechanically galvanized per ASTM B695, Class 50, where noted).
 - 1. Elevated Temperature Exposure: Type I.
 - 2. General Application: Type I or Type II.
- U. Galvanizing: ASTM A123, Zn w/0.05 percent minimum Ni.
- V. Galvanizing, hardware: ASTM A153, Zn w/0.05 percent minimum Ni.
- W. Galvanizing, anchor bolts: ASTM F2329, Zn w/0.05 percent minimum Ni.

- X. Welding electrodes, steel: AWS A5.1 E70xx.

2.2 FASTENERS

- A. Unless otherwise noted, provide steel machine bolts for the connection of carbon steel or iron; galvanized steel or stainless-steel machine bolts for the connection of galvanized steel or iron; and stainless steel machine bolts for the connection of aluminum or stainless-steel.
- B. General: Unless otherwise indicated, provide Type 316 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
1. Provide stainless steel fasteners for fastening aluminum.
 2. Provide stainless steel fasteners for fastening stainless steel.
 3. Provide stainless steel fasteners for fastening nickel silver.
 4. Provide bronze fasteners for fastening bronze.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.
- D. Mechanically Galvanized Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM F3125, Grade A325, Type 3; with hex nuts, ASTM A563, Grade C3; and, where indicated, flat washers.
- E. Stainless steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 2.
- F. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
1. Provide standard headed bolts with heavy hex nuts and Grade A washers.
 2. Where galvanized anchor bolts are indicated or specified, provide standard headed bolts with heavy hex nuts and Grade A washers, galvanize in accordance with ASTM F2329.
- G. Machine bolts and nuts conforming to Federal Specification FF-B-575C. Bolts and nuts shall be hexagon type. Bolts, nuts, screws, washers and related appurtenances shall be Type 316 stainless steel.
- H. Toggle Bolts: shall be Hilti, Toggler Bolt or equal.
- I. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47 malleable iron or ASTM A27 cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

2.3 MISCELLANEOUS ALUMINUM

- A. Miscellaneous Aluminum: Formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Drill or punch holes. Smooth edges without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.

- B. Connections and Accessories: Sufficient strength to safely withstand the stresses and strains to which they will be subjected. Close fitting exposed joints and jointed where least conspicuous. Conceal threads on threaded connections where practical. Provide continuous welds or intermittent welds on welded connections as specified or shown. Dress face of welds flush and smooth. Weld on unexposed side as much as possible in order to prevent pitting or discoloration of the aluminum exposed surface. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.
- C. Miscellaneous Aluminum Items: Beams, angles, closure angles, grates, floor plates, stop plates, stair nosings, and other miscellaneous aluminum indicated and not otherwise specified.
- D. Angle Frames for Roof Hatches, Beams, Grates, and Similar Items: Complete with welded strap anchors attached.

2.4 MISCELLANEOUS STEEL

- A. Miscellaneous Steel Work: Formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Drill or punch holes. Smooth edges without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B. Connections and Accessories: Sufficient strength to safely withstand the stresses and strains to which they will be subjected. Close fitting exposed joints and jointed where least conspicuous. Conceal thread on threaded connections where practical. Provide continuous welds or intermittent welds on welded connections as specified or shown. Dress face of welds flush and smooth. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.
- C. Miscellaneous Steel Items: Beams, angles, lintels, metal stairs detailed on the Drawings, support brackets, base plates for other than structural steel or equipment, closure angles, bridge crane rails, monorail hoist beams, holddown straps and lugs, door frames, splice plates, subframing at roof openings and any other miscellaneous steel indicated and not otherwise specified.
- D. Steel pipe pieces for sleeves, lifting attachments and other functions: Schedule 40 pipe unless otherwise indicated. Wall and floor sleeves, of steel pipe: Provide welded circumferential steel waterstops at mid-length.
- E. Steel Finish Work: Thoroughly cleaned, by effective means, of loose mill scale, rust and foreign matter. Provide one shop coat of primer compatible with finish coat after fabrication but before shipment. Omit paint within 3 inches of proposed field welds. Apply paint to dry surfaces and be thoroughly and evenly spread and well worked into joints and other open spaces.
- F. Galvanizing, where required: Use hot-dip zinc process after fabrication, coating not less than 2 oz/sq.ft. of surface.

2.5 MISCELLANEOUS STAINLESS-STEEL

- A. Miscellaneous Stainless-Steel Work: Formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing

strength or durability. Drill or punch holes. Smooth edges without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.

- B. Connections and accessories: Sufficient strength to safely withstand the stresses and strains to which they will be subjected. Close fitting exposed joints jointed where least conspicuous. Conceal threads on threaded connections where practical. Provide continuous welds or intermittent welds on welded connections as specified or shown. Dress face of welds flush and smooth. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.
- C. Beams, angles, bar racks, and other miscellaneous stainless steel.

2.6 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/4 by 1 inch, with a minimum 6 inch embedment and 1 1/2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.7 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.8 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products. Limit maximum nickel (Ni) content of galvanizing zinc to 0.05%.
 - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean [railings] of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

2.9 ALUMINUM FINISHES

- A. As-Fabricated Finish: AA-M12.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install all items except those to be embedded in concrete or other masonry which shall be installed under Division 03 and Division 04 respectively. Install items to be attached to concrete or masonry after such work is completed in accordance with the details shown. Fastening to wood plugs in masonry will not be permitted.
 - 1. Clean and repair, after installation, zinc coating which has been burned by welding, abraded, or otherwise damaged. Thoroughly clean damaged area and remove all traces of welding flux and loose or cracked zinc coating prior to painting. Paint the cleaned area per the requirements of ASTM A780.
 - 2. Install specialty products in accordance with the manufacturer's recommendations.
 - 3. Weld headed anchor studs in accordance with manufacturer's recommendations.
 - 4. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

5. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
6. Field Welding: Comply with the following requirements:
7. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
8. Obtain fusion without undercut or overlap.
9. Remove welding flux immediately.
10. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
11. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
12. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
13. Corrosion Protection: Coat concealed surfaces of aluminum and steel that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
 - a. Aluminum Contacting a Dissimilar Metal: Apply a heavy brush coat of zinc-chromate primer followed by two coats of aluminum metal and masonry paint to the dissimilar metal.
 - b. Aluminum Contacting Masonry or Concrete: Apply a heavy coat of approved alkali resistant paint to the masonry or concrete.
 - c. Aluminum Contacting Wood: Apply two coats of aluminum metal and masonry paint to the wood.
 - d. Steel Contacting Exposed Concrete or Masonry: Apply heavy bitumastic troweling mastic.
 - e. Between aluminum stair treads, and steel supports, insert 1/4 inch thick neoprene isolator pads, 85 plus or minus 5 Shore A durometer, sized for full width and length of bracket or support.

3.2 ADJUSTING AND CLEANING

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780.

END OF SECTION 055000

SECTION 133423.16 - FABRICATED CONTROL BOOTHS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 014000 "Quality Requirements," for delegated design submittals.
- C. Section 230593 "Testing, Adjusting, and Balancing" for HVAC system testing and balancing.
- D. Section 232113 "Hydronic Piping" for HVAC condensate piping requirements.
- E. Section 237416.11 "Packaged, Small Capacity, Rooftop, Air-Conditioning Units" for HVAC system requirements.
- F. Section 260510 "Limited Electrical for Small Projects." for electrical systems.

1.2 SUMMARY

- A. Section Includes:
 - 1. Fabricated In-Plant Modular Office or Control Booth

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control booths.
 - 2. Include rated capacities, operating characteristics, and electrical characteristics, for included systems.
- B. Shop Drawings: For control booths. Include plans, elevations, sections, details, accessories, and fastening and anchorage details, including mechanical fasteners.
 - 1. Anchor-Bolt Plans: Submit anchor-bolt plans and templates. Include location, diameter, and projection of anchor bolts required to attach control booths to foundation. Indicate post reactions at each location.

1.4 DELEGATED-DESIGN SUBMITTALS

- A. Provide structural design calculations and drawings for the fabricated control booth.

- B. The structural drawings and calculations, including anchorage design and evaluation of existing slab and wall, shall be signed and sealed by the qualified professional engineer registered in the State of Florida and responsible for their preparation.
- C. For fabricated control booth heating and cooling system including analysis data signed and sealed by the qualified professional engineer or licensed Florida HVAC contractor utilizing a commercial load program. Model J loads are not acceptable. Load shall consider all building skin loads, occupant loads, lighting loads, equipment loads, and outside air requirements per the requirements of the current edition of the Florida Mechanical Code.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.
- B. Weld certificates.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For control booths to include in maintenance manuals.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair finish or replace control booths that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year from date of delivery.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design fabricated control booths.
- B. Structural Performance: Provide fabricated control booths capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated::
 - 1. Design Loads:
 - a. Superimposed Dead Load: 10 psf
 - b. Self-weight of control booth: by Manufacturer
 - c. Roof Live Load: 20 psf
 - d. Minimum Horizontal Load: 5 psf

- C. Collateral Loads: Include additional dead loads other than the weight of control booth system for permanent items such as sprinklers, mechanical systems, electrical systems, and ceilings.
- D. Load Combinations: Design control booth systems to withstand the most critical effects of load factors and load combinations as required by the Florida Building Code.
- E. Design anchorage for reactions from design loads to existing slab and walls. Evaluate existing slab and walls for new loading from control booth and related elements.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- G. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70 and marked for intended location and application.

2.2 FABRICATED CONTROL BOOTHS

- A. Basis of Design: A-Wall™ 300 Structural Building System by Warwick Products (or approved equal)
- B. Building Style: Standard square corners.
- C. Structural Framework: Fabricated from extruded aluminum structural posts factory cut to the required height. Framework shall be connected with snap-on contrasting batten strips and held in place without the use of screws or fasteners. An extruded aluminum channel shall accept and securely support the wall panels when fastened to the floor. Panels shall be capped with a continuous extruded aluminum channel. The channel shall be provided as a single extrusion with a vertical fascia. The corners shall use an extruded aluminum, 90 degree corner assembly with an exterior, protective corner, fastened to the base and top channel using cover angels. A steel corner tie plate shall be installed at the base and top channels. Panel intersections with existing walls shall use an extruded aluminum channel secured to the existing walls and panels with an engineered anchor. Wall panels shall be mounted on a 3-inch perimeter base track assembly; with surface of supporting concrete base as finished floor.
- D. Swinging Doors and Frames: Single entry doors shall be 3 feet and 0 inches by 6 feet and 8 inches by 1-3/4 inches thick; tubular-frame design fabricated from extruded aluminum. Doors shall be 24 gauge steel with a painted gray finish which complements the structural framework, windows, and panels. Doors shall be machined to accept a 2-3/4 inch keyed lock set and recessed plate on the steel doors. Door frame shall be of extruded aluminum painted to match door.
 - 1. Door Lites and Glazing: Fixed unit 22 inch by 36 inch by 1/4 inch with clear tempered safety glass. Door lite frames shall be painted to match door.
 - 2. Door Hardware: Hardware shall be commercial grade, the Standard of Component Systems, Inc. Painted steel doors with 1-1/2 pair of 4" by 4-1/4" butt hinges. Hinges to be brushed chrome finish. Including standard lever lockset and spring type door stop.

- E. Windows: Glazed panels shall be completely pre-assembled and factory glazed. Glazing members shall be of extruded aluminum and mitered at all corners with no exposed fasteners. Glass will be clear 3/16 inch tempered safety glass. Glass shall be edged with positive seal glazing compound and held in place with snap in aluminum stops.
- F. Standard Wall Panel Assembly: Standard wall panels shall be 48 inch wide by 9 inch high consisting of exterior and interior face panels fabricated from commercial grade 1/2 nominal-thickness gypsum board factory bonded to 1-5/8 inch polystyrene spacers between exterior and interior face panels to form a 2-5/8 inch total wall panel thickness. Panel interior and exterior surface shall be 6-millimeter vinyl gray. Panels shall be Class 1 fire retardant. Panels shall have a minim Sound Transmission Class (STC) rating of 32.
 - 1. Wall Insulation: R5 wall insulation.
 - 2. Wall Elevation: Wall panels shall be mounted on a 3-inch high perimeter base track assembly.
- G. Open Base: Surface of supporting concrete base as finished floor.
- H. Flat Roof/Ceiling Assembly: Assembly consisting of exterior roof panels, interior ceiling panels.
 - 1. Steel Dust Cover: Building shall be protected with a self-spanning, steel dust cover that is capable of supporting the dead load of the suspended ceiling and lights. Deflection not to exceed span length of 240-inches (L/240).
 - 2. Interior Ceiling System: A complete acoustical suspended ceiling system shall be furnished including industrial grade white enameled T-Bar grid, mineral board ceiling tile and hanging wires. Ceiling panels shall be acoustic panels and rated for dimensional stability Class A noncombustible and maintain a minimum Ceiling Attenuation Class (CAC) rating of 35.
 - 3. Ceiling Insulation: R19 ceiling insulation.
- I. Electrical:
 - 1. Grounding: Grounding electrode bonded to equipment ground conductor at single-point connection in accordance with NFPA 70 and Section 260510 "Limited Electrical for Small Projects."
 - 2. Power Distribution: Factory assembled 8-circuit 100 Amp load center.
 - 3. Power Connections:
 - a. FLEX-4 Modular Wired Electrical: Two factory installed UL listed, 115 Volt grounded receptacles 20 Amp location to be coordinated with Engineer and one light switches at each access opening. Grounded receptacles and switches shall be factory installed using UL listed 2 inch by 4 inch by 2.125 inch flush mounted device boxes, 3/8-inch 12-3 metal-clad MC cable and #12 THHN-S solid wire. One Flex-4 service location to allow for connection to adjoining extender cables in plenum area with final connection at breaker panel. Troffer light fixtures, 24 inch by 48 inch fixtures are factory fitted with connector which allows lights to be joined by designated lighting cables supplied for field wiring at breaker box only.
 - b. Provide power connections and means of disconnect for interior and exterior HVAC equipment in accordance with delegated designed HVAC system.

4. Lighting:

- a. Interior: LED Light Fixtures: 20-fc average horizontal illuminance, with uniformity not exceeding 2:1 average-to-minimum on counter work surfaces.
 - 1) Controls: Provide manual switches for interior lighting on wall inside booth for each access door.

J. Communications:

- 1. 2-inch by 3-inch data box pre-installed with pull line.
- 2. Two communications outlet(s) under counter(s) with four TIA-1096-A miniature eight-position series jack(s) for connecting telephone and data equipment.

K. Heating and Cooling Unit for Direct Expansion: Ceiling mounted or ductless split system, thermostatically controlled heat and air conditioner with cooling capacity as determined by a licensed Florida professional engineer or licensed Florida HVAC contractor. Provide 7-day programmable auto changeover thermostat. Provide ceiling mounted indoor unit with outdoor air intake connection ducted to associated outdoor air louver or wall cap as necessary. Provide outdoor air intake with motorized isolation damper to close when unoccupied. Exterior units to be provided with tie-downs to meet wind loads. Exterior units to be provided with coil and cabinet coatings meeting the requirements of Section 237416.11, Paragraph 2.10. Refrigerant piping to be type ACR copper. Provided condensate piping and new drywell. Condensate piping to meet the requirements of Section 232113. Route condensate piping to drywell meeting the requirement of Details B and C on Sheet HD-1. Ensure condensate and refrigerant pipe are provided with schedule 40 stainless steel sleeve at wall penetration.

L. Anchorage: Post installed anchors fabricated from non-ferrous or corrosion-resistant materials, with allowable load or strength design greater than or equal to the design load, as determined by testing conducted by a qualified testing agency.

M. Materials:

- 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, commercial quality, G90 coating designation; mill phosphatized.
- 2. Galvanized Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D); hot-dip galvanized in accordance with ASTM A123/A123M.
- 3. Steel Structural Tubing: ASTM A500/A500M, Grade B.
- 4. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- 5. Steel Mechanical Tubing: ASTM A513, welded-steel mechanical tubing.
- 6. Zinc-Coated (Galvanized) Steel: Hot-dip galvanized in accordance with ASTM A123/A123M.
- 7. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
 - a. Sheet: ASTM B209.
 - b. Extruded Shapes: ASTM B221.
 - c. Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T4 or Alloy 6061-T6.
- 8. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.
- 9. Plastic Laminate: NEMA LD 3, Grade HGS or HGL.

10. Plywood: DOC PS 1, Exterior grade.
11. Particleboard: ANSI A208.1, Grade M-2.
12. Clear Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Class 1, and Quality q3; 3/16 inch thick.

N. Finish:

1. Color and Gloss: As indicated by manufacturer's designations.

2.3 FABRICATION

- A. Factory preglaze windows and doors.
- B. Factory cut panels size to accommodate room dimensions.
- C. Factory prewire wall panels, with Flex 4 Modular wiring, ready for connection to service at Project site. Grounded receptacles and switches shall be factory installed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, including concrete bases; accurate placement, pattern, and orientation of anchor bolts; critical dimensions; and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical and communication systems to verify actual locations of connections before control booth installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install control booths in accordance with manufacturer's written instructions.
- B. Fasten control booths securely to concrete base with anchorage indicated.
- C. Connect to electrical power service and communication systems.
- D. Perform startup checks of heating and cooling units in accordance with manufacturer's written instructions.
- E. Perform startup checks of communication systems for operational control.

3.3 ADJUSTING

- A. Adjust doors, operable windows, and hardware to operate smoothly, easily, properly, and without binding. Confirm that locks engage accurately and securely without forcing or binding.
- B. Adjust interior and exterior lighting controls.
- C. Lubricate hardware and other moving parts.
- D. After completing installation, inspect exposed finishes and repair damaged finishes.
- E. Provide Testing and Balancing of HVAC systems per the requirements of Section 230593.

END OF SECTION 133423.16

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SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 degrees C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
 - 2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
 - 5. Provide grounding rings or straps on motors with variable frequency controller.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.6 ELECTRONICALLY COMMUTATED MOTOR (ECM)

- A. Provide pumps so they are specified or scheduled with ECM.
 - 1. Synchronous, constant torque, ECM with permanent magnet rotor. Rotor magnets to be time-stable, nontoxic ceramic magnets (Sr-Fe).
 - 2. Driven by frequency converter with an integrated power factor correction filter. Conventional induction motors will not be acceptable.
 - 3. Each motor with an integrated variable-frequency drive, tested as one unit by manufacturer.
 - 4. Motor speed adjustable over full range from 0 rpm to maximum scheduled speed.
 - 5. Variable motor speed to be controlled by a 0- to 10 V-dc or 4- to 20-mA input.
 - 6. Integrated motor protection verified by UL to protect the pump against over-/undervoltage, overtemperature of motor and/or electronics, overcurrent, locked rotor, and dry run (no-load condition).

PART 3 - EXECUTION (NOT USED)

END OF SECTION 230513

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SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Metal pipe hangers and supports.
2. Fastener systems.
3. Equipment supports.
4. Delegated Design.

- B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.
3. Section 233113 "Metal Ducts" for duct hangers and supports.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.4 DELEGATED DESIGN SUBMITTALS

- A. Shop Drawings: Signed and sealed by qualified professional engineer. Show fabrication and installation details and include calculations for the following: include Product Data for components:

1. Trapeze pipe hangers.
2. Pipe stands.
3. Equipment supports.

- B. For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

- C. Qualifications Statement: Submit qualifications for licensed professional.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Delegated Design Engineer: Licensed professional engineer experienced in design of specified Work and licensed in the jurisdiction of the project location.
- B. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design items listed.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Stainless Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- B. Copper Pipe and Tube Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.3 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Indoor Applications: Stainless steel.
 - 2. Outdoor Applications: Stainless steel.

2.4 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.5 MATERIALS

- A. Aluminum: ASTM B221.
- B. Structural Steel: ASTM A36/A36M, stainless-steel plates, shapes, and bars.
- C. Stainless Steel: ASTM A240/A240M.
- D. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

- B. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- D. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- E. Install hangers and supports to allow controlled thermal of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- F. Install lateral bracing with pipe hangers and supports to prevent swaying.
- G. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- J. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- D. Use stainless steel pipe hangers and stainless steel or corrosion-resistant attachments for all applications.
- E. Use copper-plated pipe hangers and copper or stainless steel attachments for copper piping and tubing.
- F. Use padded hangers for piping that is subject to scratching.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 degrees F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.

16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is unnecessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 degrees F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 degrees F piping installations.
- K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.

8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- L. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 230548.13 - VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Elastomeric isolation pads.
 - 2. Elastomeric isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Pipe-riser resilient supports.
 - 5. Resilient pipe guides.
 - 6. Elastomeric hangers.
 - 7. Delegated Design.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.
- B. Shop Drawings:
 - 1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.4 DELEGATED DESIGN SUBMITTALS

- A. For each vibration isolation device:
 - 1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.

- B. Qualifications Statement: Submit qualifications for licensed professional.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of vibration isolation device installation for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
- B. Qualification Data: For testing agency.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Delegated Design Engineer: Licensed professional engineer experienced in design of specified Work and licensed in the jurisdiction of the project location.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vibration isolators.

2.2 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Mason Industries, Inc.
 - b. Vibration Isolation.
 - c. Vibration Management Corp.
 - 2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
 - 3. Size: Factory or field cut to match requirements of supported equipment.
 - 4. Pad Material: Oil and water resistant with elastomeric properties.
 - 5. Surface Pattern: Smooth pattern.
 - 6. Infused nonwoven cotton or synthetic fibers.
 - 7. Load-bearing metal plates adhered to pads.

8. Sandwich-Core Material: Resilient and elastomeric.
 - a. Surface Pattern: Smooth pattern.
 - b. Infused nonwoven cotton or synthetic fibers.

2.3 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Mason Industries, Inc.
 - b. Vibration Isolation.
 - c. Vibration Management Corp.
2. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
 - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Ace Mountings Co., Inc.
 - b. Mason Industries, Inc.
 - c. Vibration Isolation.
2. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - a. Housing: Cast-ductile iron or welded steel.
 - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.5 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- thick neoprene.
 - 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 - 2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.6 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- thick neoprene.
 - 1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.7 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Mason Industries, Inc.
 - b. Vibration Isolation.
 - c. Vibration Management Corp.
 - 2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
 - 3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VIBRATION CONTROL DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033010 "Miscellaneous Cast-in-Place Concrete."
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

END OF SECTION 230548.13

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SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.
 - 5. Warning tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include listing of all equipment to be labeled with the proposed content for each label.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black.
 - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters size of principal lettering.

- 6. Fasteners: Stainless steel rivets or self-tapping screws.
- 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch Insert dimension thick and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: Yellow.
- D. Maximum Temperature: Able to withstand temperatures up to 160 degrees F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters size of principal lettering.
- G. Fasteners: Stainless steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Blue.
- D. Maximum Temperature: Able to withstand temperatures up to 160 degrees F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters size of principal lettering.
- G. Fasteners: Stainless steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

2.5 WARNING TAGS

- A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Safety-yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

- A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet Insert dimension along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- C. Pipe Label Color Schedule:
 - 1. Condensate Piping: White letters on a safety-black background.

3.5 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. Yellow: For hot-air supply ducts.
 - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
- B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

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SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - 2. Testing, Adjusting, and Balancing Equipment:
 - a. Motors.
 - b. Condensing units.
 - 3. Control system verification.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. BAS: Building Automation Systems.
- C. NEBB: National Environmental Balancing Bureau.
- D. TAB: Testing, Adjusting, and Balancing.
- E. TABB: Testing, Adjusting, and Balancing Bureau.
- F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- G. TDH: Total dynamic head.

1.4 PREINSTALLATION MEETINGS

- A. TAB Conference: If requested by Owner, conduct TAB conference at Project site after approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

- a. Contract Documents examination report.
- b. TAB plan.
- c. Needs for coordination and cooperation of trades and subcontractors.
- d. Proposed procedures for documentation and communication flow.

1.5 ACTION SUBMITTALS

- A. Certified TAB reports.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 60 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 60 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. System Readiness Checklists: Within 60 days of Contractor's Notice to Proceed, submit system readiness checklists as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Sample report forms.
- G. Instrument calibration reports, to include the following:
1. Instrument type and make.
 2. Serial number.
 3. Application.
 4. Dates of use.
 5. Dates of calibration.

1.7 QUALITY ASSURANCE

- A. TAB Specialists Qualifications: Certified by AABC.
1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
 2. TAB Technician: Employee of the TAB specialist and certified by AABC as a TAB technician.
- B. TAB Specialists Qualifications: Certified by NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
 2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB as a TAB technician.
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

1.8 FIELD CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201,

"Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible, and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.
- L. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Airside:
 - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
 - b. Duct systems are complete with terminals installed.
 - c. Volume, smoke, and fire dampers are open and functional.
 - d. Clean filters are installed.
 - e. Fans are operating, free of vibration, and rotating in correct direction.
 - f. Variable-frequency controllers' startup is complete, and safeties verified.

- g. Automatic temperature-control systems are operational.
- h. Ceilings are installed.
- i. Windows and doors are installed.
- j. Suitable access to balancing devices and equipment is provided.

2. Hydronics:

- a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
- b. Piping is complete with terminals installed.
- c. Water treatment is complete.
- d. Systems are flushed, filled, and air purged.
- e. Strainers are pulled and cleaned.
- f. Control valves are functioning per the sequence of operation.
- g. Shutoff and balance valves have been verified to be 100 percent open.
- h. Pumps are started, and proper rotation is verified.
- i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
- j. Variable-frequency controllers' startup is complete, and safeties verified.
- k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
 - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation" and Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check summation of required outlet volumes with required fan volumes.

- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. Check airflow patterns from outdoor-air louvers and dampers and return- and exhaust-air dampers through supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling-unit components.
- K. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
 - b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
 - 2. Measure fan static pressures as follows:
 - a. Measure static pressure directly at fan outlet or through flexible connection.
 - b. Measure static pressure directly at fan inlet or through flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report artificial loading of filters at the time static pressures are measured.
 - 3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 - 4. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for

- adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
1. Measure airflow of submain and branch ducts.
 2. Adjust submain and branch duct volume dampers for specified airflow.
 3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.
1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
 2. Measure inlets and outlets airflow.
 3. Adjust each inlet and outlet for specified airflow.
 4. Re-measure each inlet and outlet after they have been adjusted.
- D. Verify final system conditions.
1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
 2. Re-measure and confirm that total airflow is within design.
 3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
 4. Mark all final settings.
 5. Test system in economizer mode. Verify proper operation and adjust if necessary.
 6. Measure and record all operating data.
 7. Record final fan-performance data.

3.6 PROCEDURES FOR MOTORS

- A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Phase and hertz.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter size and thermal-protection-element rating.
 8. Service factor and frame size.
- B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.7 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record fan and motor operating data.

3.8 CONTROLS VERIFICATION

- A. In conjunction with system balancing, perform the following:
 - 1. Verify temperature control system is operating within the design limitations.
 - 2. Confirm that the sequences of operation are in compliance with Contract Documents.
 - 3. Verify that controllers are calibrated and function as intended.
 - 4. Verify that controller set points are as indicated.
 - 5. Verify the operation of lockout or interlock systems.
 - 6. Verify the operation of valve and damper actuators.
 - 7. Verify that controlled devices are properly installed and connected to correct controller.
 - 8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
 - 9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.
- B. Reporting: Include summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.9 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
 - 2. Air Outlets and Inlets: Plus or minus 10 percent.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.10 FINAL REPORT

- A. General: Prepare certified written report; tabulate and divide report into separate sections for tested systems and balanced systems.
 - 1. Include certification sheet at the front of the report's binder, signed and sealed by certified testing and balancing engineer.
 - 2. Include list of instruments used for procedures, along with proof of calibration.
 - 3. Certify validity and accuracy of field data.

- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
 2. Name and address of TAB specialist.
 3. Project name.
 4. Project location.
 5. Engineer's name and address.
 6. Contractor's name and address.
 7. Report date.
 8. Signature of TAB supervisor who certifies the report.
 9. Table of Contents with total number of pages defined for each section of the report. Number each page in the report.
 10. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from Contract Documents.
 11. Nomenclature sheets for each item of equipment.
 12. Data for terminal units, including manufacturer's name, type, size, and fittings.
 13. Notes to explain why certain final data in the body of reports vary from indicated values.
 14. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

- a. Unit identification.
- b. Location.
- c. Make and type.
- d. Model number and unit size.
- e. Manufacturer's serial number.
- f. Unit arrangement and class.
- g. Discharge arrangement.
- h. Sheave make, size in inches, and bore.
- i. Center-to-center dimensions of sheave and amount of adjustments in inches.
- j. Number, make, and size of belts.
- k. Number, type, and size of filters.

2. Motor Data:

- a. Motor make, and frame type and size.
- b. Horsepower and rpm.
- c. Volts, phase, and hertz.
- d. Full-load amperage and service factor.
- e. Sheave make, size in inches, and bore.
- f. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

- a. Total airflow rate in cfm.
- b. Total system static pressure in inches wg.
- c. Fan rpm.
- d. Discharge static pressure in inches wg.
- e. Filter static-pressure differential in inches wg.
- f. Preheat-coil static-pressure differential in inches wg.
- g. Cooling-coil static-pressure differential in inches wg.
- h. Heating-coil static-pressure differential in inches wg.
- i. Outdoor airflow in cfm.
- j. Return airflow in cfm.
- k. Outdoor-air damper position.
- l. Return-air damper position.
- m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

- a. System identification.
- b. Location.
- c. Coil type.
- d. Number of rows.
- e. Fin spacing in fins per inch o.c.
- f. Make and model number.

- g. Face area in sq. ft..
- h. Tube size in NPS.
- i. Tube and fin materials.
- j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm.
- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.
- d. Outdoor-air, wet- and dry-bulb temperatures in degrees F.
- e. Return-air, wet- and dry-bulb temperatures in degrees F.
- f. Entering-air, wet- and dry-bulb temperatures in degrees F.
- g. Leaving-air, wet- and dry-bulb temperatures in degrees F.
- h. Water flow rate in gpm.
- i. Water pressure differential in feet of head or psig.
- j. Entering-water temperature in degrees F.
- k. Leaving-water temperature in degrees F.
- l. Refrigerant expansion valve and refrigerant types.
- m. Refrigerant suction pressure in psig.
- n. Refrigerant suction temperature in degrees F.
- o. Inlet steam pressure in psig.

G. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

- a. System identification.
- b. Location.
- c. Coil identification.
- d. Capacity in Btu/h.
- e. Number of stages.
- f. Connected volts, phase, and hertz.
- g. Rated amperage.
- h. Airflow rate in cfm.
- i. Face area in sq. ft..
- j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

- a. Heat output in Btu/h.
- b. Airflow rate in cfm.
- c. Air velocity in fpm.
- d. Entering-air temperature in degrees F.
- e. Leaving-air temperature in degrees F.
- f. Voltage at each connection.
- g. Amperage for each phase.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave and amount of adjustments in inches.
2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.

I. Rectangular Duct Traverse Reports: Include diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in degrees F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft..
 - g. Indicated airflow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual airflow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.

J. Air-Terminal-Device Reports:

1. Unit Data:

- a. System and air-handling unit identification.
- b. Location and zone.
- c. Apparatus used for test.
- d. Area served.
- e. Make.
- f. Number from system diagram.
- g. Type and model number.
- h. Size.
- i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm.
- b. Air velocity in fpm.
- c. Preliminary airflow rate as needed in cfm.
- d. Preliminary velocity as needed in fpm.
- e. Final airflow rate in cfm.
- f. Final velocity in fpm.
- g. Space temperature in degrees F.

K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

- a. System and air-handling-unit identification.
- b. Location and zone.
- c. Room or riser served.
- d. Coil make and size.
- e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm.
- b. Entering-water temperature in degrees F.
- c. Leaving-water temperature in degrees F.
- d. Water pressure drop in feet of head or psig.
- e. Entering-air temperature in degrees F.
- f. Leaving-air temperature in degrees F.

3.11 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Engineer and Construction Manager.

- B. Engineer shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- E. If TAB work fails, proceed as follows:
 - 1. TAB specialists shall recheck all measurements and make adjustments. Revise final report and balancing device settings to include all changes; resubmit final report and request a second final inspection.
 - 2. If the second final inspection also fails, Owner may contract services of another TAB specialist to complete TAB work according to Contract Documents and deduct cost of the services from original TAB specialist's final payment.
 - 3. If the second verification also fails, Owner may contact AABC Headquarters regarding the AABC National Performance Guaranty.
- F. Prepare test and inspection reports.

3.12 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes pipe and fitting materials and joining methods for the following:
 - 1. Copper tube and fittings.
 - 2. Joining materials.
 - 3. Dielectric fittings.
- B. Section includes:
 - 1. Delegated Design.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Pipe.
 - 2. Fittings.
 - 3. Joining materials.

1.4 DELEGATED DESIGN SUBMITTALS

- A. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
- B. Locations of pipe anchors and alignment guides and expansion joints and loops.
- C. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
- D. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Other building services, including light fixture and sprinkler layouts.
 - 3. Structural members.
 - 4. Architectural layout showing smoke and firewalls, floors and full height walls/partitions.
- B. Qualification Data: For Installer.
- C. Welding certificates.
- D. Field quality-control reports.
- E. Welding inspection certificates
- F. Preconstruction Test Reports:
 - 1. Water Analysis: Submit copy of the water analysis to illustrate water quality available at Project site.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
- B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with ASME B31.9, "Building Services Piping," ASME B31.3 "Process Piping" or ASME B31.1 "Power Piping" for materials, products, and installation.
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage qualified testing agency to perform preconstruction testing on water quality.
- B. Preconstruction Testing for Existing Hydronic Systems: Contractor shall engage a Testing and Balancing agent/organization. Agency shall test and document water flows of existing pumps,

mains and specified branches. Agency shall comply with requirements of Section 230593 "Testing, Adjusting, and Balancing for HVAC."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping, gaskets, and covering shall comply with ASTM 25/50, Flame Spread/Smoke Developed testing.
- B. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
 - 1. Cooling Coil Condensate-Drain Piping: 150 degrees F.

2.2 COPPER TUBE AND FITTINGS

- A. Hard-Drawn-Temper Copper Tubing: ASTM B88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B88, Type K.
- C. DWV Copper Tubing: ASTM B306, Type DWV.
- D. Grooved, Mechanical-Joint, Wrought-Copper Fittings: ASME B16.22.
 - 1. Grooved-End Copper Fittings: ASTM B75, copper tube or ASTM B584, bronze casting.
 - 2. Grooved-End-Tube Couplings: Rigid pattern unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, prelubricated EPDM gasket rated for minimum 230 degrees F for use with housing, and steel bolts and nuts.
- E. Wrought-Copper Unions: ASME B16.22.

2.3 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.

- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- E. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Acceptable manufacturers are: Watts Water Technologies Co., Hart Industrial Unions, LLC; or approved equal.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. HART Industrial Unions, LLC.
 - b. WATTS; A Watts Water Technologies Company.
 - c. Wilkins.
 - d. Zurn Industries, LLC.
 - 3. Description:
 - a. Standard: ASSE 1079.
 - b. Pressure Rating: 125 psig minimum at 180 degrees F.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Acceptable manufacturers are: Watts Water Technologies Co., CTS Flange, USA, Federal Process Corp.; or approved equal.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. WATTS; A Watts Water Technologies Company.
 - b. Wilkins.
 - c. Zurn Industries, LLC.
 - 3. Description:
 - a. Standard: ASSE 1079.
 - b. Factory-fabricated, bolted, companion-flange assembly.
 - c. Pressure Rating: 125 psig minimum at 180 degrees F.
 - d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Acceptable manufacturers are: Ramco Sealing Solutions, Flange Protection and Gasket, Inc., Northtown Co.; or approved equal.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, LLC.
 - b. CALPICO, Inc.
 - c. GPT Industries, LLC.
3. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Acceptable manufacturers are: Matco-Norca, MIFAB, Inc., Camco Manufacturing, Inc.; or approved equal.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil; an ASC Engineered Solution.
 - b. Elster Perfection; Honeywell.
 - c. GPT Industries, LLC.
 - d. Matco-Norca.
 - e. Precision Plumbing Products.
3. Description:
 - a. Standard: IAPMO PS 66.
 - b. Electroplated steel nipple, complying with ASTM F1545.
 - c. Pressure Rating: 300 psig at 225 degrees F.
 - d. End Connections: Male threaded or grooved.
 - e. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Coil Condensate-Drain Piping: Type DWV, hard-drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install air vents, consisting of a tee, 3/4-inch ball valve, short threaded nipple with cap or an automatic vent at all system high points.
- N. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- O. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- P. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated. Route piping and install unions and shutoff valves to allow equipment removal without disturbing piping.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install shutoff valve immediately upstream of each dielectric fitting.

- T. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

3.3 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.
- B. Install hangers for copper tubing, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping within 12 inches of each fitting and coupling.
- D. Support vertical runs of copper tubing to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.5 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Soldered Joints: Apply flux to tube end. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using solder alloy.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.
- I. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.
- J. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.6 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or another source of overpressure during test.
- B. Perform the following tests on hydronic piping:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 - 3. Isolate expansion tanks and determine that hydronic system is full of water.
 - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 - 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 - 6. Prepare written report of testing.
- C. Perform the following before operating the system:
 - 1. Open manual valves fully.
 - 2. Inspect pumps for proper rotation.

3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113

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SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Double-wall rectangular ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Delegated Design.

- B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
3. Section 018839 "Wind Performance Requirements" for design of exterior structural supports.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

- B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top and bottom of ducts.
5. Dimensions of all duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.

8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

1.4 DELEGATED DESIGN SUBMITTALS

- A. Sheet metal thicknesses.
- B. Joint and seam construction and sealing.
- C. Reinforcement details and spacing.
- D. Materials, fabrication, assembly, and spacing of hangers and supports.
- E. Design Calculations: Calculations, including analysis data signed and sealed by qualified professional engineer responsible for their preparation for selecting hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing items described in this Section, and coordinated with all building trades.
- B. Welding certificates.
- C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 3. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Engage qualified professional engineer, as defined in Section 014000 "Quality Requirements" to design the following:
 1. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct

Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.

- B. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- D. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- E. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
 - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
- B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
 - 2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. Rectangular Ducts: Fabricate ducts with indicated dimensions for clear internal dimensions of the inner duct.
- B. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
 - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
 - 2. For ducts exposed to weather, construct outer duct of Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.
- C. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
 - 2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
- D. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 degrees F mean temperature.
 - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 3. Coat insulation with antimicrobial coating.
 - 4. Cover insulation with polyester film complying with UL 181, Class 1.
- F. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C534/C534M, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
 - 1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 degrees F mean temperature.

2.4 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct

construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

- B. Stainless-Steel Sheets: Comply with ASTM A480/A480M, Type 316, as indicated in "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in "Duct Schedule" Article.
- C. Aluminum Sheets: Comply with ASTM B209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- D. Tie Rods: Stainless steel, 1/4-inch- minimum diameter for lengths 36 inches or less; 3/8-inch- minimum diameter for lengths longer than 36 inches.

2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: 3 inches.
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
 - 7. Service: Indoor and outdoor.
 - 8. Service Temperature: Minus 40 to plus 200 degrees F.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 - 10. Sealant shall have a VOC content of 420 g/L or less.
 - 11. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Water-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Solids Content: Minimum 65 percent.
 - 3. Shore A Hardness: Minimum 20.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. VOC: Maximum 75 g/L (less water).
 - 7. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
 - 8. Service: Indoor or outdoor.

9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C920.
1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
 6. Sealant shall have a VOC content of 420 g/L or less.
 7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Stainless-steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Stainless-steel, all-thread rods.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Stainless Steel Ducts: Stainless steel complying with ASTM A492.
- E. Steel Cable End Connections: Stainless-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports:
1. Supports for Stainless Steel Ducts: Stainless-steel shapes and plates.
 2. Supports for Aluminum Ducts: Aluminum.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.
- B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- J. Install fire and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.
- K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation.
- M. Elbows: Use long-radius elbows wherever they fit.
- N. Branch Connections: Use lateral or conical branch connections.

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCTWORK EXPOSED TO WEATHER

- A. All external joints are to be welded. Seal all openings to provide weatherproof construction.
- B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.
- C. Double Wall:
 - 1. Ductwork shall comply with requirements in "Double-Wall Rectangular Ducts and Fittings" Article.
 - 2. Ductwork outer wall shall be Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.
 - 3. Provide interstitial insulation.

3.4 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Outdoor, Supply-Air Ducts: Seal Class A.
 - 3. Outdoor, Exhaust Ducts: Seal Class C.
 - 4. Outdoor, Return-Air Ducts: Seal Class C.
 - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
 - 7. Unconditioned Space, Exhaust Ducts: Seal Class C.

8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Where practical, install concrete inserts before placing concrete.
 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 - 2. Test the following systems:
 - a. Ducts with a Pressure Class of 2- Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 4. Testing of each duct section is to be performed with access doors, coils, filters, dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.
 - 5. Test for leaks before applying external insulation.
 - 6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 - 7. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
 - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness in accordance with "Description of Method 3 - NADCA Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.9 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Use duct cleaning methodology as indicated in NADCA ACR.

C. Use service openings for entry and inspection.

1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

D. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

E. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

F. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans in accordance with NADCA ACR. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.

7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents in accordance with manufacturer's written instructions after removal of surface deposits and debris.

3.10 STARTUP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

- A. Fabricate ducts with stainless sheet steel for exterior ductwork, aluminum sheet for Process Room ductwork and as follows:

1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.

- B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

- a. Pressure Class: Positive 2-inch wg.
- b. Minimum SMACNA Seal Class: B.
- c. SMACNA Leakage Class for Rectangular: 2.

2. Ducts Connected to Constant-Volume Air-Handling Units:

- a. Pressure Class: Positive 2-inch wg.
- b. Minimum SMACNA Seal Class: A.
- c. SMACNA Leakage Class for Rectangular: 2.

3. Ducts Connected to Equipment Not Listed Above:

- a. Pressure Class: Positive 3-inch wg.
- b. Minimum SMACNA Seal Class: B C.
- c. SMACNA Leakage Class for Rectangular: 8.

- C. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

- a. Pressure Class: Positive or negative 1-inch wg.
- b. Minimum SMACNA Seal Class: C.
- c. SMACNA Leakage Class for Rectangular: 2.

2. Ducts Connected to Air-Handling Units:

- a. Pressure Class: Positive or negative 2-inch wg.
- b. Minimum SMACNA Seal Class: A.
- c. SMACNA Leakage Class for Rectangular: 2.

3. Ducts Connected to Equipment Not Listed above:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A.
 - c. SMACNA Leakage Class for Rectangular: 2.
- D. Exhaust Ducts:
 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 8.
 2. Ducts Connected to Equipment Not Listed above:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: A if negative pressure; A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 2.
- E. Intermediate Reinforcement:
 1. Stainless Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
 2. Aluminum Ducts: Aluminum.
- F. Double-Wall Duct Interstitial Insulation:
 1. Supply-Air Ducts: 2 inches thick.
 2. Return-Air Ducts: 2 inches thick.
- G. Elbow Configuration:
 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.

- 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

c. Velocity 1500 fpm or Higher:

- 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
- 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
- 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

H. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Control dampers.
 - 2. Duct smoke detectors.
 - 3. Flange connectors.
 - 4. Turning vanes.
 - 5. Duct-mounted access doors.
 - 6. Flexible connectors.
 - 7. Duct accessory hardware.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances, and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 CONTROL DAMPERS

- A. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- B. Frames:
 - 1. Hat shaped.
 - 2. 0.05-inch- thick stainless steel.
 - 3. Mitered and welded corners.
- C. Blades:
 - 1. Multiple blade with maximum blade width of 6 inches.
 - 2. Parallel-blade design.
 - 3. Stainless steel.
 - 4. 0.064 inch thick single skin.
 - 5. Blade Edging: Closed-cell neoprene.
- D. Blade Axles: 1/2-inch- diameter; stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
 - 1. Operating Temperature Range: From minus 40 to plus 200 degrees F.
- E. Bearings:
 - 1. Oil-impregnated stainless steel sleeve.
 - 2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 3. Thrust bearings at each end of every blade.

2.2 DUCT SMOKE DETECTORS FOR UNCLASSIFIED AIR

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal:
 - 1. Air Products and Controls.
 - 2. System Sensor.
- B. Type: UL or CSA listed, photoelectric.
- C. Housing: Refer to Materials of Construction Schedule.
 - 1. Provide with enclosure that has integral test/reset button.
- D. Sampling Tube Material: Stainless steel for stainless steel ducts. Aluminum for aluminum ducts.
- E. Operating Voltage: 24 VDC.
- F. Relay Contacts: Alarm condition, trouble condition, and equipment shutdown.

2.3 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc; a DMI company.
 - 2. DynAir; a Carlisle Company.
 - 3. Elgen Manufacturing.
- B. Description: roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Stainless steel.
- D. Gauge and Shape: Match connecting ductwork.

2.4 TURNING VANES

- A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- C. Vane Construction: Double wall.
- D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.5 DUCT-MOUNTED ACCESS DOORS

- A. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Stainless-steel sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Stainless-steel sheet steel, with bend-over tabs and foam gaskets.
 - 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.6 FLEXIBLE CONNECTORS

- A. Materials: Flame-retardant or noncombustible fabrics.
- B. Coatings and Adhesives: Comply with UL 181, Class 1.
- C. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, stainless sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd..
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 degrees F.
- E. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
 - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 - 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.7 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.
- C. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 1. On both sides of duct coils.
 2. Upstream and downstream from duct filters.
 3. At outdoor-air intakes and mixed-air plenums.
 4. At drain pans and seals.
 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 7. At each change in direction and at maximum 50-foot spacing.

8. Upstream and downstream from turning vanes.
 9. Upstream or downstream from duct silencers.
 10. Control devices requiring inspection.
 11. Elsewhere as indicated.
- G. Install access doors with swing against duct static pressure.
- H. Access Door Sizes:
1. One-Hand or Inspection Access: 8 by 5 inches.
 2. Two-Hand Access: 12 by 6 inches.
 3. Head and Hand Access: 18 by 10 inches.
 4. Head and Shoulders Access: 21 by 14 inches.
 5. Body Access: 25 by 14 inches.
 6. Body plus Ladder Access: 25 by 17 inches.
- I. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- J. Install flexible connectors to connect ducts to equipment.
- K. Install duct test holes where required for testing and balancing purposes.
- L. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 4. Inspect turning vanes for proper and secure installation.
 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Sidewall propeller fans.
 - 2. Delegated Design.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
 - 2. Rated capacities, operating characteristics, and furnished specialties and accessories.
 - 3. Certified fan performance curves with system operating conditions indicated.
 - 4. Certified fan sound-power ratings.
 - 5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 6. Material thickness and finishes, including color charts.
 - 7. Dampers, including housings, linkages, and operators.
 - 8. Prefabricated roof curbs.
 - 9. Fan speed controllers.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
 - 4. Design Calculations: Calculate requirements for selecting vibration isolators.

1.4 DELEGATED DESIGN SUBMITTALS

- A. For unit hangers and supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
- B. Qualifications Statement: Submit qualifications for licensed professional.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, or BIM model, drawn to scale, showing the items described in this Section and coordinated with all building trades.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For HVAC power ventilators to include in normal and emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Delegated Design Engineer: Licensed professional engineer experienced in design of specified Work and licensed in the jurisdiction of the project location.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vibration isolation, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Capacities and Characteristics: Refer to Drawings.

2.2 SIDEWALL PROPELLER FANS

- A. Housing: All aluminum construction with flanged edges and integral orifice ring, with baked-enamel finish coat applied after assembly.
- B. Fan Wheel: Replaceable, cast-aluminum, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.
- C. Fan Drive: Direct-drive motor mounted in airstream; factory wired to disconnect switch located on outside of fan housing.
- D. Accessories:

1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
2. Motorized Dampers: Parallel-blade dampers with electric actuator wired to close when fan stops.
3. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.4 SOURCE QUALITY CONTROL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. AMCA Certification: Fans shall comply with AMCA 11 and bear AMCA-Certified Ratings Seal.
- C. Fan Sound Ratings: Comply with AMCA 311, and label fans with AMCA-Certified Ratings Seal. Sound ratings shall comply with AMCA 301. Fans shall be tested according to AMCA 300.
- D. Fan Performance Ratings: Comply with AMCA 211 and label fans with AMCA-Certified Rating Seal. Fans shall be tested for air performance - flow rate, fan pressure, power, fan efficiency, air density, speed of rotation, and fan efficiency - according to AMCA 210/ASHRAE 51.
- E. Operating Limits: Classify according to AMCA 99.
- F. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

PART 3 - EXECUTION

3.1 INSTALLATION OF HVAC POWER VENTILATORS

- A. Install power ventilators level and plumb.
- B. Equipment Mounting:
 1. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

- C. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 1 inch. Vibration-control devices are specified in Section 230548.13 "Vibration Controls for HVAC."
- D. Install units with clearances for service and maintenance.
- E. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 DUCTWORK CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring and ground equipment according to Section 260510 "Limited Electrical for Small Projects."
- B. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
 - 1. Nameplate shall be as specified in Section 260510 "Limited Electrical for Small Projects."

3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 260510 "Limited Electrical for Small Projects."

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that there is adequate maintenance and access space.
 - 4. Verify that cleaning and adjusting are complete.
 - 5. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 6. Adjust belt tension.

7. Adjust damper linkages for proper damper operation.
 8. Verify lubrication for bearings and other moving parts.
 9. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 10. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 11. Shut unit down and reconnect automatic temperature-control operators.
 12. Remove and replace malfunctioning units and retest as specified above.
- C. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- C. Replace fan and motor pulleys as required to achieve design airflow.
- D. Lubricate bearings.

3.7 DEMONSTRATION

- A. Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION 233423

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SECTION 233713.23 - REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Adjustable blade face registers.
- B. Related Requirements:
 - 1. Section 233300 "Air Duct Accessories" for volume-control dampers not integral to registers and grilles.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 5. Duct access panels.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 REGISTERS

A. Adjustable Blade Face Register (SR):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. METALAIRE, Inc.
 - b. Nailor Industries Inc.
 - c. Price Industries Limited.
 - d. Titus; brand of Johnson Controls International plc, Global Products.
2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Horizontal spaced 1 1/2 inch apart.
5. Rear-Blade Arrangement: Vertical spaced 1 1/2 inch apart.
6. Frame: 1 inches wide.
7. Mounting: Countersunk screw.
8. Damper Type: Adjustable opposed blade.

2.2 SOURCE QUALITY CONTROL

- #### A. Verification of Performance: Rate registers and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- #### A. Examine areas where registers and grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- #### B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- #### A. Install registers and grilles level and plumb.
- #### B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Engineer for a determination of final location.

- C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.23

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SECTION 237416.11 - PACKAGED, SMALL-CAPACITY AIR-CONDITIONING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes packaged, small-capacity, packaged air-conditioning units (PACs) with the following components:
 - 1. Casings.
 - 2. Fans, drives, and motors.
 - 3. Coils.
 - 4. Refrigerant circuit components.
 - 5. Air filtration.
 - 6. Electrical power connections.
 - 7. Controls.
 - 8. Accessories.
- B. Section Includes:
 - 1. Delegated Design.
- C. Related Requirements:
 - 1. Section 033010 "Miscellaneous Cast-in-Place Concrete."
 - 2. Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 3. Section 230548.13 "Vibration Controls for HVAC."
 - 4. Section 230593 "Testing, Adjusting, and Balancing for HVAC."
 - 5. Section 233113 "Metal Ducts."
 - 6. Section 233300 "Air Duct Accessories."
 - 7. Section 260510 "Limited Electrical for Small Projects."

1.3 DEFINITIONS

- A. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.

1.4 ACTION SUBMITTALS

A. Product Data: For each PAC.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, dimensions, required clearances, characteristics, and furnished specialties and accessories.
3. Include unit dimensions and weight.
4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
5. Fans:
 - a. Include certified fan-performance curves with system operating conditions indicated.
 - b. Include certified fan-sound power ratings.
 - c. Include fan construction and accessories.
 - d. Include motor ratings, electrical characteristics, and motor accessories.
6. Include certified coil-performance ratings with system operating conditions indicated.
7. Include filters with performance characteristics.
8. Include gas furnaces with performance characteristics.
9. Include dampers, including housings, linkages, and operators.

B. Shop Drawings: For each packaged, small-capacity air-conditioning unit.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 DELEGATED DESIGN SUBMITTALS

A. For PAC supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.
2. Wind-Restraint Details: Detail fabrication and attachment of wind and seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Sample Warranty: For manufacturer's warranty.

- C. Product Certificates: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article and in Section 230548.13 "Vibration Controls for HVAC."
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For PACs to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of PACs and components.
- C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- D. ASHRAE 15 Compliance: For refrigeration system safety.
- E. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- F. UL Compliance: Comply with UL 1995.
- G. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design mounting and restraints for PACs, including comprehensive engineering analysis.
 - 1. Design PAC supports to comply with wind performance requirements.
- H. Wind-Restraint Performance:
 - 1. Basic Wind Speed: Refer to the Structural Drawings.
 - 2. Building Classification Category: Refer to the Structural Drawings.
 - 3. Minimum 10 lb/sq. ft. multiplied by the maximum area of the mechanical component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Trane.
 2. AAON.
 3. Carrier Global Corporation.
 4. Daikin Applied.
 5. Lennox.
 6. YORK; brand of Johnson Controls International plc, Building Solutions North America.

2.3 UNIT CASINGS

- A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.
- B. Double-Wall Construction:
1. Outside Casing Wall: Galvanized steel, minimum 18 gauge thick with corrosion-resistant coating, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
 2. Inside Casing Wall: G90-coated galvanized steel, 0.034 inch thick.
 3. Floor Plate: G90 galvanized steel, minimum 18 gauge thick.
 4. Casing Insulation:
 - a. Materials: Injected polyurethane foam insulation.
 - b. Casing Panel R-Value: Minimum 8.
 - c. Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roof of unit.
- C. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- D. Static-Pressure Classifications:
1. For Unit Sections Upstream of Fans: Minus 2-inch wg.
 2. For Unit Sections Downstream and Including Fans: 2-inch wg.
- E. Panels and Doors:
1. Panels:
 - a. Fabrication: Formed and reinforced with same materials and insulation thickness as casing.
 - b. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against air-pressure differential.
 - c. Gasket: Neoprene, applied around entire perimeters of panel frames.
 - d. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.

2. Access Doors:

- a. Hinges: A minimum of two ball-bearing hinges or stainless steel piano hinge and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against air-pressure differential.
- b. Gasket: Neoprene, applied around entire perimeters of panel frames.
- c. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.

F. Condensate Drain Pans:

- 1. Location: Each type of cooling coil.
- 2. Construction:
 - a. Single-wall, stainless steel sheet.
- 3. Drain Connection:
 - a. Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on both ends of pan.
 - b. Minimum Connection Size: NPS 1.

2.4 FANS, DRIVES, AND MOTORS

- A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
- B. Supply-Air Fans: Centrifugal, rated according to AMCA 210; galvanized or painted steel; mounted on solid-steel shaft.
 - 1. Shafts: With field-adjustable alignment.
 - a. Turned, ground, and polished hot-rolled steel with keyway.
 - 2. Shaft Bearings:
 - a. Heavy-duty, self-aligning, pillow-block type with an L-50 rated life of minimum 100,000 hours according to ABMA 9.
 - 3. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.
 - a. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 - 4. Centrifugal Fan Wheels: Inlet flange, backplate, and shallow blades with inlet and tip curved forward in direction of airflow and mechanically fastened to flange and backplate; steel or aluminum hub swaged to backplate and fastened to shaft with setscrews.
 - 5. Mounting: For internal vibration isolation. Factory-mount fans with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 1 inch.

6. Shaft Lubrication Lines: Extended to a location outside the casing.
 7. Flexible Connector: Factory fabricated with a fabric strip minimum 3-1/2 inches wide, attached to two strips of minimum 2-3/4-inch-wide by 0.028-inch-thick, galvanized-steel sheet.
 - a. Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.
- C. Drives, Direct: Factory-mounted, direct drive.
- D. Condenser-Coil Fan: propeller, mounted on shaft of permanently lubricated ECM motors.
- E. Motors:
1. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 3. Enclosure Type: Totally enclosed, fan cooled.
 4. Enclosure Materials: Cast iron.
 5. Efficiency: Premium efficient as defined in NEMA MG 1.
 6. Motor Pulleys: Adjustable pitch for use with 5-hp motors and smaller; fixed pitch for use with motors larger than 5 hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.
 7. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

2.5 COILS

- A. General Requirements for Coils:
1. Comply with AHRI 410.
 2. Fabricate coils section to allow for removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
 3. Coils shall not act as structural component of unit.
- B. Supply-Air Refrigerant Coil:
1. Tubes: Copper.
 2. Fins:
 - a. Material: Aluminum.
 - b. Fin Spacing: Maximum 12 fins per inch.
 3. Fin and Tube Joints: Mechanical bond.
 4. Headers: Seamless-copper headers with brazed connections.
 5. Frames: Stainless steel.
 6. Coatings: Corrosion-resistant coating.

7. Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.
 - a. Working Pressure: Minimum 300 psig.

C. Outdoor-Air Refrigerant Coil:

1. Tubes: Copper.
2. Fins:
 - a. Material: Aluminum.
 - b. Fin Spacing: Maximum 12 fins per inch.
3. Fin and Tube Joints: Mechanical bond.
4. Headers: Seamless-copper headers with brazed connections.
5. Frames: Stainless steel.
6. Coatings: Corrosion-resistant coating.
7. Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.
 - a. Working Pressure: Minimum 300 psig.

2.6 REFRIGERANT CIRCUIT COMPONENTS

- A. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief.
- B. Refrigeration Specialties:
 1. Refrigerant: R-454B.
 2. Expansion valve with replaceable thermostatic element.
 3. Refrigerant filter/dryer.
 4. Manual-reset high-pressure safety switch.
 5. Automatic-reset low-pressure safety switch.
 6. Minimum off-time relay.
 7. Automatic-reset compressor motor thermal overload.
 8. Brass service valves installed in compressor suction and liquid lines.
 9. Low-ambient kit high-pressure sensor.
 10. Four-way reversing valve with a replaceable magnetic coil, thermostatic expansion valves with bypass check valves, and a suction line accumulator.

2.7 AIR FILTRATION

- A. Particulate air filtration as specified.
- B. Panel Filters:
 1. Description: Pleated factory-fabricated, self-supported, disposable air filters with holding frames.
 2. Filter Unit Class: UL 900.
 3. Media: Interlaced glass, synthetic or cotton fibers coated with nonflammable adhesive and antimicrobial coating.

4. Filter-Media Frame: Beverage board with perforated metal retainer, or metal grid, on outlet side.
- C. Adhesive, Sustainability Projects: As recommended by air-filter manufacturer and with a VOC content of 80 g/L or less.
- D. Adhesive, LEED for Schools Projects: As recommended by air-filter manufacturer and that complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.8 ELECTRICAL POWER CONNECTIONS

- A. PAC shall have a single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.9 SOURCE QUALITY CONTROL

- A. AHRI Compliance:
 1. Comply with AHRI 210/240 for testing and rating energy efficiencies for PACs.
 2. Comply with AHRI 340/360 for testing and rating energy efficiencies for PACs.
 3. Comply with AHRI 270 for testing and rating sound performance for PACs.
 4. Comply with AHRI 1060 for testing and rating performance for air-to-air exchanger.
- B. AMCA Compliance:
 1. Comply with AMCA 11 and bear the AMCA-Certified Ratings Seal for air and sound performance according to AMCA 211 and AMCA 311.
 2. Damper leakage tested according to AMCA 500-D.
 3. Operating Limits: Classify according to AMCA 99.

2.10 PAINTING AND COATINGS

- A. Unless otherwise specified, all machinery and factory finished equipment such as pumps, fans, air handling units, air conditioning units, and other items of manufacture shall be hot dipped galvanized or will have a factory applied finish, color as standard with the manufacturer. Components fabricated from stainless steel do not require a coating finish unless otherwise specified. Tanks, supporting steel, hangers, rods and all other uncoated or non-galvanized steel other than standard piping and fittings shall have a shop coat consisting of a suitable primer and finish coat. If not factory-applied, the prime coat shall be as specified in Division 09. Items not factory or shop primed prior to installation shall be suitably cleaned of rust and mill scale by wire brushing, sanding, or other means and prime painted, immediately after installation.
- B. Contractor shall be responsible for the repair of defects, blemishes, holidays, and the like apparent in manufactures coatings and shall ensure that the materials used for such repair shall match and be compatible with the manufacturer's standard color, coatings and practices.

Surfaces to be repaired or recoated are to be prepared as recommended by the paint or coating supplier. Care shall be taken not to paint over nameplates.

- C. Furnish touch up paint for the various types of equipment furnished and deliver unopened paint to the Owner at completion of the project. The amount of touch-up paint supplied shall be sufficient to cover 15 percent of the applicable painted surfaces or one pint, whichever is greater.
- D. Where specified or called for on the equipment schedules on the drawings, special corrosion resistant/protective coatings shall be provided. Whenever a protective coating is specified, the equipment shall be coated both inside and out. Whenever necessary to provide full coverage of the equipment, the equipment shall be completely disassembled to allow proper preparation and coating application. Any component that would block the coating process shall be removed. Equipment provided with gaskets or liners shall be coated before the application of the gasketing or liner. The equipment Vendor shall test rotating equipment after coating to confirm dynamic balance. If work needs to be done to correct the equipment balance, the integrity of the coating must be corrected after such work.
- E. Ductwork connections to units that require corrosion resistant coatings shall be made with flanges. Flanges shall be factory drilled before coating. Resilient washers suitable for the environment shall be used to protect the coating from the bolts in the flange. The use of self-tapping screws or other fastening methods that will damage the coating are not acceptable.
- F. Items to be provided with a protective coating shall have the following data on the coating included with the unit submittal. Submittal shall include vendor data sheets on the specific coating being used, corrosion resistance data sheets, detailed application data sheets to include surface preparation procedures. For baked coatings submit a letter from the coating manufacturer, that the company doing the actual coating operation is an approved coating company. When an equipment supplier provides the coating, the information shall be supplied by the coating manufacturers.
- G. Inspection and Preparation of Coil prior to Cleaning and Coating:
 - 1. Coil shall be inspected for fin damage. Bent fins shall be straightened using the proper fitting fin comb. Tubes and tube "U" bends shall be inspected for dents, punctures or pinched areas. Where possible, and with equipment manufacturer's approval bent, punctured, pinched tube or "U" bend areas shall be repaired and leak tested by coating vendor's A/C technician prior to coating. Vendor shall securely seal all open tubes to prevent the infiltration of dirt, water, cleaning and coating solutions into the tube. The header tube shall be fitted with a Schrader valve and the coil placed under no less than 5 and no greater than 50 psi nitrogen blanket throughout the cleaning and coating process. The charge shall be recorded and verified following coating to ensure the coil was not damaged allowing cleaning or coating solutions to infiltrate the tube side.
- H. Cleaning and Conditioning of the Coil Fin and Tube Surfaces Prior to Coating:
 - 1. Following initial preparation of the coil, the coil shall be thoroughly cleaned using a non-etching and non-oxidizing detergent solution having less than 10- ppm chlorides, and formulated for use on ferrous and non-ferrous metals to remove shop soils, dirt, grease, and oils from the surface of the coil fins, tubes and casings. Following the detergent cleaning, the coil shall be thoroughly rinsed using clean filtered water to flush off soils

removed by the detergent. The surface to be water break free when rinsed ensuring a clean surface. A non-oxidizing chemical solution sealer shall then be applied to enhance adhesion and provide secondary corrosion protection. Coil shall then be dried at temperatures up to 220 degrees F until thoroughly dry prior to applying the coating.

I. Coatings shall be of the following types:

1. MANUFACTURER STANDARD COATINGS

- a. Coating material shall be manufacturer's standard as specified in the schedule below. Surfaces shall be prepared, primed and coated as required by the coating supplier. Heat curing shall be provided where required by the coating supplier.

2. BAKED PHENOLIC (for heat transfer coils, dipped) TYPE 1A and TYPE 1B

- a. Type 1A: Coating Material Heresite P-413C baking phenolic with a plastizer or approved equal. The surface shall be degreased and etched or phosphatizing by immersion. The coating shall be applied in multiple coats by immersion, with a baking (partial cure) in an oven following each immersion. After the final immersion and the application of one spray coat, the coating shall be completely cured with a baking at 400 degrees F. The coating shall provide a final dry film thickness of approximately 2 mils.
- b. Type 1B: Coating material Husky Coil Coat and Husky E-Vap Coat from Bronz-Glow. Coil shall receive corrosion protection treatment from a qualified coating vendor through application of vendor's in-house dip coating process. The coating material applied by this process shall have passed a minimum 3,500 hours salt spray test in accordance with ASTM B-117.85. Coating solution shall provide effective corrosion protection throughout the entire pH range of 1.0 to 14.0. Coating material shall consist of a synthetic polyelastomer material having properties of a minimum 5,000 psi tensile strength, 400% or greater flexibility, 250% or greater elasticity to prevent chipping, cracking or flaking, have negligible (less than 1/2 of 1%) effect on heat transfer coefficients, coating shall contain a UV inhibitor rating at 10 year Florida sun protection and coating shall be of a type that can be repaired in the field in the event of damage to the coating. The protective coating shall be applied by dip application (complete immersion) of the coil into the coating solution. Following curing of the coating the dry mill thickness of the coating shall be not less than 1 or greater than 1-1/2 dry mills. Following dip coating the coil fin edges shall be sprayed to enhance fin edge coverage then the coating shall be cured at temperature of not greater than 200 degrees F until fully cured.
- c. Equivalent complete immersion coating products by ElectroFin or equal will be considered upon Engineer's review and approval of product data, application data, and corrosion resistance data.

3. BAKED PHENOLIC (equipment) TYPE 2A and TYPE 2B

- a. Coating Material Heresite baked phenolic coating. The surface shall be prepared by degreasing with an appropriate solvent. Steel surfaces for immersion shall be sand blasted in accordance with NACE No.1 or SSPC-SP5. Steel surfaces for non-immersion shall be sand blasted in accordance with NACE No. 3 or SSPC-SP6. Surface profile shall be 20 to 25 percent of dry film thickness in accordance with

the supplier's recommendations. Thinner where required shall be of the same manufacturer as the coating. Coating shall be applied by spraying in multiple passes. The piece shall be baked in accordance to the manufacturer's time and temperature schedules with the final baking at 400 degrees F.

- b. Type 2A: Heresite P-403 baked phenolic coatings. Dry film thickness shall be 5 to 7 mils applied in 3 to 4 coats.
- c. Type 2B: Heresite P-413 baked pheniloc coating. If surface cannot be adequately cleaned use Heresite P-700A primer in accordance with the manufacturer's recommendations. Dry film thickness shall be 4 to 6 mils applied in 4 to 5 coats.
- d. Equivalent complete immersion coating products will be considered upon Engineer's review and approval of product data, application data, and corrosion resistance data.

4. AIR DRIED PHENOLIC (equipment) TYPE 3A and TYPE 3B

- a. Type 3A: Coating Material Heresite VR-507 air dried phenolic coating. The surface shall be prepared by degreasing with an appropriate solvent. Steel surfaces for non-immersion shall be sand blasted in accordance with NACE No. 3 or SSPC-SP6. Surface profile shall be 20 to 25 percent of dry film thickness. If blasting is not possible, the surface shall be primed with Heresite P-750 in accordance with the supplier's recommendations. Dry film thickness shall be 0.5 to 0.75 mills. Thinner where required shall be of the same manufacturer as the coating. Coating shall be applied by spraying in multiple passes. The piece shall be dried in accordance to the manufactures time schedule. The equipment shall be given a minimum of three coats resulting in a dry film thickness of 4 to 6mils. All equipment coated with VR-500 shall be given a topcoat of Heresite UC-5500. The UC-5500 series shall be applied by spraying and shall have a dry film thickness of 4 to 5 mils.
- b. Type 3B: Coating material Husky SPC or Husky Pat Coat and Lin Coat from Bronz-Glow. When spray coating interior or exterior metal surfaces for corrosion protection vendor shall prepare the coated or uncoated metal surface in accordance with coating manufacture's specification. Coating shall have passed 3,000 hours salt spray test in accordance with ASTM B-117.85 Coating shall be a synthetic resin elastomer having a minimum 300% flexibility, 200% elongation, and effectively provide protection throughout the entire a pH range of 1.0-14.0. The coating shall be applied to a dry thickness of 4-6 mils. Coating to be field repairable in the event of damage to the coating. Following coating application coating shall be fully cured in accordance with manufacture's specifications prior to being placed in service or packaged for shipment.
- c. Equivalent spray-on or roll-on cabinet coating products will be considered upon Engineer's review and approval of product data, application data, and corrosion resistance data.

5. AIR DRY SPRAY ON COATING (Equipment, coils, fins, etc.) TYPE 4A and TYPE 4B

- a. Type 4A: Coating Material Adsil Micro Guard HVAC/R Coil and Fin Clear Protective Treatment AD35. Surface preparation, mixing and catalyzing, application, and clean-up shall be in strict accordance with the manufacturer's instructions. All recommended cleaning agents (Micro Kleen products) shall be utilized and applied per the manufacturer's instructions. Drying times and curing times shall be in accordance with the manufacturer's time schedule.

- b. Type 4B: Coating Material Husky Coil Coat from Bronz-Glow. Prior to spray coat application the coil shall be cleaned and in accordance with the coating manufacture's specifications. Coil shall be allowed to dry thoroughly after cleaning prior to applying the coating. Coil shall receive corrosion protection treatment from a qualified coating vendor through application of vendor's in-house or field applied spray coating process. The coating material applied by this process shall have passed a minimum 3,000 hours salt spray test in accordance with ASTM B-117.85. Coating solution shall provide effective corrosion protection throughout the entire pH range of 1.0 to 14.0. Coating material shall consist of a synthetic polyelastomer material having properties of a minimum 5,000 psi tensile strength, 400% or greater flexibility, 250% or greater elasticity to prevent chipping, cracking or flaking, have negligible (less than 1/2 of 1%) effect on heat transfer coefficients, coating shall contain a UV inhibitor rated at 10-year Florida sun protection. The unit to be disassembled to the point to where the face of the coil from both sides are exposed and can be coated. The vendor shall further ensure the "U" bend and header areas shall also be exposed to allow maximum coating coverage on both the inner and outer radius of the "U" bend and header surfaces. The protective coating shall be applied by spray application on both sides of the coil and using a method that ensures maximum coating penetration into the fin area. Following curing of the coating the dry mill thickness shall not greater than 1-1/2 - 2 dry mills. Following coating the coil shall be cured in accordance with coating manufacture's specification prior to restoring power to the unit. It is not recommended a coil of more than two rows be spray coated. Cabinet coating shall be Type 3B as described above.
 - c. Special care must be taken to follow coating manufacturer's instructions for coating coils to be sure that the entire surface of the fins and the tubes in the coil are coated. It is imperative that as much of the internal coil surfaces be coated as possible to prevent failure of the coil.
 - d. Equivalent spray-on coil coating products by Heresite (PC-2000 with PC-2000-C cabinet coating), Blygold (PoluAl coil coating with Type 3A or equal cabinet coating), Thermoguard (Total Coat), or equal will be considered upon Engineer's review and approval of product data, application data, and corrosion resistance data.
- J. Coatings shall be factory applied by the equipment manufacturer/supplier. If this is not possible, coating shall be applied by a specialty shop under contract to the equipment manufacturer/supplier.
- 1. Corrosion protection shall be provided, by an authorized coating vendor for each applicable unit component as specified herein. A "Certificate of Coating Compliance" shall be issued by the coating vendor verifying use of the specified products and processes. Coating vendor shall supply owner a written "Owner's Coated Coil Cleaning Service and Maintenance Manual". Aforementioned certificate and manual shall be submitted upon completion of the project with all other closing documents.
 - 2. Prior to shipment or installation of a coil into a cabinet coil shall be pressure tested to 110% of operating pressure and held for 45 minutes to ensure no leaks have occurred. Coil shall then be evacuated and placed under nitrogen blanket or installed in the cabinet.
 - 3. When coil is being shipped as a single unit vendor shall protect coil tubes from soil or moisture infiltration by shipping coil under a nitrogen blanket of not less than 5 psi on the fluid side. Coil shall be tagged advising coil is under nitrogen blanket and psi rating of the nitrogen blanket.

4. Following installation of coil into the cabinet coating vendor's a/c technician shall place coil under a 200 - 400 micron vacuum to ensure integrity of coil and absence of moisture within the coil.
 5. Coil shall be issued a registration number and number shall be affixed to the coil by means of a non-removable polymer seal. Coating vendor shall maintain a job warranty file for each coil coated for the period of the warranty.
 6. After coating application is completed, the equipment manufacturer/supplier shall test the equipment and certify system operation prior to releasing the equipment to the job site.
- K. Holidays, runs, sags, blisters, or inclusions in the coating are unacceptable and will be corrected. With the approval of the engineer, small areas no more than 4-in by 4-in may be corrected in the field. Larger faults shall be returned to the coater to be repaired. The faulty material shall be removed by sanding and in the case of blisters, the edges feathered. The material used for recoating shall be manufactured by the same manufacturer as the original coating and shall be suitable for field repairs. The touch up material shall have the same corrosion resistance as the original coating, and if the original coating required an ultraviolet protection, the same protection will be provided as part of the repair. The final mil thickness of the repaired coating shall be equal to the originally specified thickness. Where baked coatings have been damaged, the repair shall be made with heat applied to the repaired surface to cure the coating. After curing a solvent test as recommended by the manufacturer shall be used to confirm that the coating is cured.
- L. Coating manufacturer shall supply direct to the engineer, a set of coupons showing the final appearance of the cured coatings. Any coating that does not match the supplied coupons will be rejected.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of PACs.
- B. Examine roughing-in for PACs to verify actual locations of piping and duct connections before equipment installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure PACs to structural support with anchor bolts.
- B. Equipment Mounting:
 1. Install PACs on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033010 "Miscellaneous Cast-in-Place Concrete."

2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- C. Arrange installation of units to provide clear access space around air-handling units for service and maintenance.
- D. Do not operate fan system until filters (temporary or permanent) are in place.

3.3 DUCT CONNECTIONS

- A. Comply with duct installation requirements specified in other HVAC Sections. Drawings indicate general arrangement of ducts. The following are specific connection requirements:
 1. Connect supply ducts to PACs with flexible duct connectors specified in Section 233300 "Air Duct Accessories."

3.4 ELECTRICAL CONNECTIONS

- A. Connect electrical wiring according to Section 260510 "Limited Electrical for Small Projects."
- B. Ground equipment according to Section 260510 "Limited Electrical for Small Projects."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection according to Section 260510 "Limited Electrical for Small Projects."

3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 260510 "Limited Electrical for Small Projects."

3.6 STARTUP SERVICE

- A. Perform startup service.
 1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Verify that shipping, blocking, and bracing are removed.
 3. Inspect for visible damage to unit casing.
 4. Inspect for visible damage to compressor, coils, and fans.
 5. Inspect internal insulation.
 6. Verify that labels are clearly visible.
 7. Verify that clearances have been provided for servicing.
 8. Verify that controls are connected and operable.

9. Verify that filters are installed.
10. Clean condenser coil and inspect for construction debris.
11. Remove packing from vibration isolators.
12. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
13. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete.
14. Verify lubrication on fan and motor bearings.
15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain PACs.
 1. Provide instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
 2. Obtain Owner sign-off that training is complete.
 3. Owner training shall be held at Project site.
 4. Video record the training sessions and provide electronic copy to Owner.

END OF SECTION 237416.11

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SECTION 260010 - SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Supplemental requirements generally applicable to the Work specified in Division 26. This Section is also referenced by related Work specified in other Divisions.

- B. Related Requirements:

- 1. Section 124843.33 "Rubber Insulating Floor Mats" for mats related to electrical equipment.
 - 2. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 3. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
 - 4. Division 03 "Concrete" for cast in place concrete work, including concrete encasements for electrical duct banks, equipment pads, and light pole bases.
 - 5. Division 40 "Process Interconnections" for SCADA, instrumentation, and process control equipment.

1.3 REFERENCES

- A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:

- 1. 8P8C: An 8-position 8-contact modular jack.
 - 2. A: Ampere, unit of electrical current.
 - 3. AC or ac: Alternating current.
 - 4. AFCI: Arc-fault circuit interrupter.
 - 5. AIC: Ampere interrupting capacity.
 - 6. AL, Al, or ALUM: Aluminum.
 - 7. ASD: Adjustable-speed drive.
 - 8. ATS: Automatic transfer switch.
 - 9. AWG: American wire gauge; see ASTM B258.
 - 10. BAS: Building automation system.
 - 11. BIL: Basic impulse insulation level.
 - 12. BIM: Building information modeling.

13. CAD: Computer-aided design or drafting.
14. CATV: Community antenna television.
15. CB: Circuit breaker.
16. cd: Candela, the SI fundamental unit of luminous intensity.
17. CO/ALR: Copper-aluminum, revised.
18. COPS: Critical operations power system.
19. CU or Cu: Copper.
20. CU-AL or AL-CU: Copper-aluminum.
21. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
22. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
23. dB(adjusted) or dBa: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).
24. dBm: Decibel absolute power with respect to 1 mW.
25. DC or dc: Direct current.
26. DCOA: Designated critical operations area.
27. DDC: Direct digital control (HVAC).
28. EGC: Equipment grounding conductor.
29. ELV: Extra-low voltage.
30. EMF: Electromotive force.
31. EMI: Electromagnetic interference.
32. EPM: Electrical preventive maintenance.
33. EPS: Emergency power supply.
34. EPSS: Emergency power supply system.
35. ESS: Energy storage system.
36. EV: Electric vehicle.
37. EVPE: Electric vehicle power export equipment.
38. EVSE: Electric vehicle supply equipment.
39. fc: Footcandle, an internationally recognized unit of illuminance equal to one lumen per square foot or 10.76 lx. The simplified conversion $1 \text{ fc} = 10 \text{ lx}$ in the Specifications is common practice and considered adequate precision for building construction activities. When there are conflicts, lux is the primary unit; footcandle is specified for convenience.
40. FLC: Full-load current.
41. ft: Foot.
42. ft-cd: Foot-candle, the antiquated U.S. Standard unit of illuminance, equal to one international candle measured at a distance of one foot, that was superseded in 1948 by the unit "footcandle" after the SI unit candela (cd) replaced the international candle; see "fc."
43. GEC: Grounding electrode conductor.
44. GFCI: Ground-fault circuit interrupter.
45. GFPE: Ground-fault protection of equipment.
46. GND: Ground.
47. HACR: Heating, air conditioning, and refrigeration.
48. HDPE: High-density polyethylene.
49. HID: High-intensity discharge.
50. HP or hp: Horsepower.
51. HVAC: Heating, ventilating, and air conditioning.
52. Hz: Hertz.
53. IBT: Intersystem bonding termination.
54. inch: Inch. To avoid confusion, the abbreviation "in." is not used.

- 55. IP: Ingress protection rating (enclosures); Internet protocol (communications).
- 56. IR: Infrared.
- 57. IS: Intrinsically safe.
- 58. IT&R: Inspecting, testing, and repair.
- 59. ITE: Information technology equipment.
- 60. kAIC: Kiloampere interrupting capacity.
- 61. kcmil or MCM: One thousand circular mils.
- 62. kV: Kilovolt.
- 63. kVA: Kilovolt-ampere.
- 64. kVAr or kVAR: Kilovolt-ampere reactive.
- 65. kW: Kilowatt.
- 66. kWh: Kilowatt-hour.
- 67. LAN: Local area network.
- 68. lb: Pound (weight).
- 69. lbf: Pound (force).
- 70. LCD: Liquid-crystal display.
- 71. LCDI: Leakage-current detector-interrupter.
- 72. LED: Light-emitting diode.
- 73. Li-ion: Lithium-ion.
- 74. lm: Lumen, the SI derived unit of luminous flux.
- 75. LNG: Liquefied natural gas.
- 76. LP-Gas: Liquefied petroleum gas.
- 77. LRC: Locked-rotor current.
- 78. LV: Low voltage.
- 79. lx: Lux, the SI derived unit of illuminance equal to one lumen per square meter.
- 80. m: Meter.
- 81. MCC: Motor-control center.
- 82. MDC: Modular data center.
- 83. MG set: Motor-generator set.
- 84. MIDI: Musical instrument digital interface.
- 85. MLO: Main lugs only.
- 86. MV: Medium voltage.
- 87. MVA: Megavolt-ampere.
- 88. mW: Milliwatt.
- 89. MW: Megawatt.
- 90. MWh: Megawatt-hour.
- 91. NC: Normally closed.
- 92. Ni-Cd: Nickel-cadmium.
- 93. Ni-MH: Nickel-metal hydride.
- 94. NIU: Network interface unit.
- 95. NO: Normally open.
- 96. NPT: National (American) standard pipe taper.
- 97. OCPD: Overcurrent protective device.
- 98. ONT: Optical network terminal.
- 99. PC: Personal computer.
- 100. PCS: Power conversion system.
- 101. PCU: Power-conditioning unit.
- 102. PF or pf: Power factor.
- 103. PHEV: Plug-in hybrid electric vehicle.
- 104. PLC: Programmable logic controller.
- 105. PLFA: Power-limited fire alarm.

106. PoE: Power over Ethernet.
107. PV: Photovoltaic.
108. PVC: Polyvinyl chloride.
109. pW: Picowatt.
110. RFI: (electrical) Radio-frequency interference; (contract) Request for interpretation.
111. RMS or rms: Root-mean-square.
112. RPM or rpm: Revolutions per minute.
113. SCADA: Supervisory control and data acquisition.
114. SCR: Silicon-controlled rectifier.
115. SPD: Surge protective device.
116. sq.: Square.
117. SWD: Switching duty.
118. TCP/IP: Transmission control protocol/Internet protocol.
119. TEFC: Totally enclosed fan-cooled.
120. TR: Tamper resistant.
121. TVSS: Transient voltage surge suppressor.
122. UL: (standards) Underwriters Laboratories, Inc.; (product categories) UL, LLC.
123. UL CCN: UL Category Control Number.
124. UPS: Uninterruptible power supply.
125. USB: Universal serial bus.
126. UV: Ultraviolet.
127. V: Volt, unit of electromotive force.
128. V(ac): Volt, alternating current.
129. V(dc): Volt, direct current.
130. VA: Volt-ampere, unit of complex electrical power.
131. VAR: Volt-ampere reactive, unit of reactive electrical power.
132. VFC: Variable-frequency controller.
133. VFD: Variable-frequency drive. See VFC.
134. VOM: Volt-ohm-multimeter.
135. VPN: Virtual private network.
136. VRLA: Valve regulated lead acid; also called "sealed lead acid (SLA)" or "valve regulated sealed lead acid."
137. W: Watt, unit of real electrical power.
138. Wh: Watt-hour, unit of electrical energy usage.
139. WPT: Wireless power transfer.
140. WPTE: Wireless power transfer equipment.
141. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:

1. EMT: Electrical metallic tubing.
2. EMT-A: Aluminum electrical metallic tubing.
3. EMT-S: Steel electrical metallic tubing.
4. EMT-SS: Stainless steel electrical metallic tubing.
5. ENT: Electrical nonmetallic tubing.
6. EPEC: Electrical HDPE underground conduit (thin wall).
7. EPEC-A: Type A electrical HDPE underground conduit.
8. EPEC-B: Type B electrical HDPE underground conduit.
9. ERMC: Electrical rigid metal conduit.
10. ERMC-A: Aluminum electrical rigid metal conduit.
11. ERMC-S: Steel electrical rigid metal conduit.

12. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
13. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
14. ERMC-SS: Stainless steel electrical rigid metal conduit.
15. FMC: Flexible metal conduit.
16. FMC-A: Aluminum flexible metal conduit.
17. FMC-S: Steel flexible metal conduit.
18. FMT: Steel flexible metallic tubing.
19. FNMC: Flexible nonmetallic conduit. See "LFNC."
20. GRS: Galvanized rigid steel conduit. See ERMC-S-G.
21. HDPE: HDPE underground conduit (thick wall).
22. HDPE-40: Schedule 40 HDPE underground conduit.
23. HDPE-80: Schedule 80 HDPE underground conduit.
24. IMC: Steel electrical intermediate metal conduit.
25. LFMC: Liquidtight flexible metal conduit.
26. LFMC-A: Aluminum liquidtight flexible metal conduit.
27. LFMC-S: Steel liquidtight flexible metal conduit.
28. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
29. LFNC: Liquidtight flexible nonmetallic conduit.
30. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
31. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
32. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
33. PVC: Rigid PVC conduit.
34. PVC-40: Schedule 40 rigid PVC conduit.
35. PVC-80: Schedule 80 rigid PVC Conduit.
36. PVC-A: Type A rigid PVC concrete-encased conduit.
37. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.
38. RAC: Rigid aluminum conduit. See ERMC-A.
39. RGS: Rigid galvanized steel conduit. See ERMC-S-G.
40. RMC: Rigid metal conduit. See ERMC.
41. RTRC: Reinforced thermosetting resin conduit.
42. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.
43. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
44. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
45. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
46. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.

C. Abbreviations and Acronyms for Electrical Single-Conductor and Multiple-Conductor Cable Types:

1. AC: Armored cable.
2. CATV: Coaxial general-purpose cable.
3. CATVP: Coaxial plenum cable.
4. CATVR: Coaxial riser cable.
5. CI: Circuit integrity cable.
6. CL2: Class 2 cable.
7. CL2P: Class 2 plenum cable.
8. CL2R: Class 2 riser cable.
9. CL2X: Class 2 cable, limited use.

10. CL3: Class 3 cable.
11. CL3P: Class 3 plenum cable.
12. CL3R: Class 3 riser cable.
13. CL3X: Class 3 cable, limited use.
14. CM: Communications general-purpose cable.
15. CMG: Communications general-purpose cable.
16. CMP: Communications plenum cable.
17. CMR: Communications riser cable.
18. CMUC: Under-carpet communications wire and cable.
19. CMX: Communications cable, limited use.
20. DG: Distributed generation cable.
21. FC: Flat cable.
22. FCC: Flat conductor cable.
23. FPL: Power-limited fire-alarm cable.
24. FPLP: Power-limited fire-alarm plenum cable.
25. FPLR: Power-limited fire-alarm riser cable.
26. IGS: Integrated gas spacer cable.
27. ITC: Instrumentation tray cable.
28. ITC-ER: Instrumentation tray cable, exposed run.
29. MC: Metal-clad cable.
30. MC-HL: Metal-clad cable, hazardous location.
31. MI: Mineral-insulated, metal-sheathed cable.
32. MTW: (machine tool wiring) Moisture-, heat-, and oil-resistant thermoplastic cable.
33. MV: Medium-voltage cable.
34. NM: Nonmetallic sheathed cable.
35. NMC: Nonmetallic sheathed cable with corrosion-resistant nonmetallic jacket.
36. NMS: Nonmetallic sheathed cable with signaling, data, and communications conductors, plus power or control conductors.
37. NPLF: Non-power-limited fire-alarm circuit cable.
38. NPLFP: Non-power-limited fire-alarm circuit cable for environmental air spaces.
39. NPLFR: Non-power-limited fire-alarm circuit riser cable.
40. NUCC: Nonmetallic underground conduit with conductors.
41. OFC: Conductive optical fiber general-purpose cable.
42. OFCG: Conductive optical fiber general-purpose cable.
43. OFCP: Conductive optical fiber plenum cable.
44. OFCR: Conductive optical fiber riser cable.
45. OFN: Nonconductive optical fiber general-purpose cable.
46. OFNG: Nonconductive optical fiber general-purpose cable.
47. OFNP: Nonconductive optical fiber plenum cable.
48. OFNR: Nonconductive optical fiber riser cable.
49. P: Marine shipboard cable.
50. PLTC: Power-limited tray cable.
51. PLTC-ER: Power-limited tray cable, exposed run.
52. PV: Photovoltaic cable.
53. RHH: (high heat) Thermoset rubber, heat-resistant cable.
54. RHW: Thermoset rubber, moisture-resistant cable.
55. SA: Silicone rubber cable.
56. SE: Service-entrance cable.
57. SER: Service-entrance cable, round.
58. SEU: Service-entrance cable, flat.
59. SIS: Thermoset cable for switchboard and switchgear wiring.

- 60. TBS: Thermoplastic cable with outer braid.
- 61. TC: Tray cable.
- 62. TC-ER: Tray cable, exposed run.
- 63. TC-ER-HL: Tray cable, exposed run, hazardous location.
- 64. THW: Thermoplastic, heat- and moisture-resistant cable.
- 65. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.
- 66. THHW: Thermoplastic, heat- and moisture-resistant cable.
- 67. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
- 68. TW: Thermoplastic, moisture-resistant cable.
- 69. UF: Underground feeder and branch-circuit cable.
- 70. USE: Underground service-entrance cable.
- 71. XHH: Cross-linked polyethylene, heat-resistant cable.
- 72. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Definitions:

- 1. 8-Position 8-Contact (8P8C) Modular Jack: An unkeyed jack with up to eight contacts commonly used to terminate twisted-pair and multiconductor Ethernet cable. Also called a "TIA-1096 miniature 8-position series jack" (8PSJ), or an "IEC 8877 8-pole jack."
 - a. Be careful when suppliers use "RJ45" generically. Obsolete RJ45 jacks used for analog telephone cables have rejection keys. 8P8C jacks used for digital telephone cables and Ethernet cables do not have rejection keys.
- 2. Basic Impulse Insulation Level (BIL): Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
- 3. Cable: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "cable" is (1) a conductor with insulation, or a stranded conductor with or without insulation (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).
- 4. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.
- 5. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
- 6. Conductor: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "conductor" is (1) a wire or combination of wires not insulated from one another, suitable for carrying an electric current; (2) (National Electrical Safety Code) a material, usually in the form of wire, cable, or bar, suitable for carrying an electric current; or (3) (general) a substance or body that allows a current of electricity to pass continuously along it.
- 7. Designated Seismic System: A system component that requires design in accordance with Ch. 13 of ASCE/SEI 7 and for which the Component Importance Factor is greater than 1.0.
- 8. Direct Buried: Installed underground without encasement in concrete or other protective material.

9. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:
- a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
 - b. Concrete Box: A box intended for use in poured concrete.
 - c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
 - d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
 - e. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
 - f. Device Box: A box with provisions for mounting a wiring device directly to the box.
 - g. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
 - h. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
 - i. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
 - j. Floor Nozzle: An enclosure used on a wiring system, intended primarily as a housing for a receptacle, provided with a means, such as a collar, for surface-mounting on a floor, which may or may not include a stem to support it above the floor level, and is sealed against the entrance of scrub water at the floor level.
 - k. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
 - l. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
 - m. Pedestal Floor Box Cover: A floor box cover that, when installed as intended, provides a means for typically vertical or near-vertical mounting of receptacle outlets above the floor's finished surface.
 - n. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
 - o. Raised-Floor Box: A floor box intended for use in raised floors.
 - p. Recessed Access Floor Box: A floor box with provisions for mounting wiring devices below the floor surface.
 - q. Recessed Access Floor Box Cover: A floor box cover with provisions for passage of cords to recessed wiring devices mounted within a recessed floor box.
 - r. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.

- s. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
 - t. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.
10. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
11. Fault Limited: Providing or being served by a source of electrical power that is limited to not more than 100 W when tested in accordance with UL 62368-1.
- a. The term "fault limited" is intended to encompass most Class 1, 2, and 3 power-limited sources complying with Article 725 of NFPA 70; Class ES1 and ES2 electrical energy sources that are Class PS1 electrical power sources (e.g., USB); and Class ES3 electrical energy sources that are Class PS1 and PS2 electrical power sources (e.g., PoE). See UL 62368-1 for discussion of classes of electrical energy sources and classes of electrical power sources.
12. Jacket: A continuous nonmetallic outer covering for conductors or cables.
13. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
14. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the Energy Independence and Security Act (EISA) of 2007.
15. Multi-Outlet Assembly: A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
16. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
17. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
18. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
19. Sheath: A continuous metallic covering for conductors or cables.
20. UL Category Control Number (CCN): An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
21. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
- a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
 - b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.

- c. Extra-Low Voltage (ELV): Not having electromotive force between any two conductors, or between a single conductor and ground, exceeding 30 V(ac rms), 42 V(ac peak), or 60 V(dc).
 - d. Low Voltage (LV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
 - e. Medium Voltage (MV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated about 1 kV but not exceeding 69 kV.
 - f. High Voltage: (1) (circuits) Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 69 kV but not exceeding 230 kV. (2) (safety) Having sufficient electromotive force to inflict bodily harm or injury.
22. Wire: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "wire" is a slender rod or filament of drawn metal. A group of small wires used as a single wire is properly called a "stranded wire." A wire or stranded wire covered with insulation is properly called an "insulated wire" or a "single-conductor cable." Nevertheless, when the context indicates that the wire is insulated, the term "wire" will be understood to include the insulation.

1.4 INTERPRETATION OF CONTRACT DOCUMENTS

- A. If during performance of work, there is a conflict, error, or discrepancy between or among Contract Documents and laws and regulations, provide the higher performance standard unless otherwise directed by Engineer.
- B. Priority of Documents: Figured dimensions govern over scaled dimensions, detailed drawings govern over general drawing, larger scale drawings take precedence over smaller scale drawings, change order drawings supersede original contract drawings, and contract drawings govern shop drawings.
- C. In general, Drawings do not show conduit routing. Plan and route conduits in compliance with specifications and drawing details. Coordinate installation with other trades and actual supplied equipment.
- D. Ductbank routing shown on electrical site plans is diagrammatic in nature and may not include interferences that may be present.

1.5 COORDINATION

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.

- B. Arrange to provide temporary electrical service or power in accordance with requirements specified in Division 01.

1.6 PREINSTALLATION MEETINGS

- A. Schedule Preconstruction Meeting and other Preinstallation Meetings in accordance with Project Meetings Section in Division 01.

1.7 SEQUENCING

- A. Conduct and submit results of preliminary power system studies before submitting Product Data and Shop Drawings for electrical equipment.
- B. Coordinate installation work with other trades.

1.8 ACTION SUBMITTALS

- A. Submit Division 26 equipment and materials as specified in each Section at one time and not piecemeal. For example, all low voltage motor control centers on a project are to be submitted under one submittal number. Submittals that do not comply will be returned disapproved.
- B. Subject to Engineer's approval, related items may be submitted together under one submittal. Contractor shall identify the multiple Sections included. For example, multiple Sections specify lighting fixtures and poles. A single submittal for lighting could be acceptable.
- C. Electrical Installation Drawings:
 - 1. Drawings in general do not show conduit routing other than major conduit and ductbank routes. Submit conduit layouts for exposed, concealed, and buried conduits.
 - 2. Submit electrical room layouts using approved shop drawing dimensions for equipment.
 - 3. Submit layouts at an appropriate scale for clarity.
 - 4. Include type written conduit schedules for easy cross check.
 - 5. Installation submittal drawing must be approved before concrete pours are made that will conceal conduits.
- D. Training Plans: Submit instructional program outline for Engineer's review and approval, where demonstration and/or training is specified.

1.9 INFORMATIONAL SUBMITTALS

- A. Electrical Installation Schedule: At preconstruction meeting, and periodically thereafter as dates change, provide schedule for electrical installation Work to Owner and Engineer including, but not limited to, milestone dates for the following activities:
 - 1. Submission of power system studies.
 - 2. Submission of specified coordination drawings.
 - 3. Submission of action submittals specified in Division 26.
 - 4. Orders placed for major electrical equipment.

5. Arrival of major electrical equipment on-site.
6. Preinstallation meetings specified in Division 26.
7. Utility service outages.
8. Utility service inspection and activation.
9. Closing of walls and ceilings containing electrical Work.
10. System startup, testing, and commissioning activities for major electrical equipment.
11. System startup, testing, and commissioning activities for emergency lighting.
12. System startup, testing, and commissioning activities for automation systems (SCADA, BMS, lighting, HVAC, fire alarm, fire pump, etc.).
13. Pouring of concrete housekeeping pads for electrical equipment and testing of concrete samples.
14. Requests for special inspections.
15. Requests for inspections by authorities having jurisdiction.

- B. Delegated Design Drawings: As indicated in individual Division 26 Sections.
- C. Seismic Qualification Data: In accordance with Section 260011 "Facility Performance Requirement for Electrical" and individual Division 26 Sections.
- D. Wind-Load Performance Data: In accordance with Section 260011 "Facility Performance Requirement for Electrical" and individual Division 26 Sections.
- E. Qualification Statements: In accordance with individual Division 26 Sections.

1.10 CLOSEOUT SUBMITTALS

- A. Record Documents: Submit documentation to accurately show completed installation. Include modifications to Contract Documents (one line power diagrams, equipment elevations, panel schedules, elementary control diagrams, riser diagrams, plans, conduit and ductbank routing, etc.) along with additional drawings or sketches created to convey completed installation.
- B. Operation and Maintenance Data:
 1. Provide emergency operation, normal operation, and preventive maintenance manuals for each system, equipment, and device as specified in each Division 26 Section.

1.11 DELEGATED DESIGN / PROFESSIONAL ENGINEERING SERVICES

- A. When engineering services are specified to be provided by Contractor, retain a licensed professional engineer to perform the services. Engineer shall be licensed at the time services are performed and licensed in the state in which project is located. If the state issues discipline specific licenses, Engineer shall be licensed in the applicable discipline. Engineer shall be experienced in the type of work being performed.
- B. Engineering work shall be done according to the applicable regulations for professional engineers to include signing, sealing, and dating documents.

1.12 QUALIFICATIONS

- A. Comply with Quality Assurance Articles within each Division 26 Section.
- B. On Site Field Superintendent:
 - 1. Minimum of 10 years of experience of industrial low and medium voltage projects of comparable size and complexity.

1.13 MATERIALS AND EQUIPMENT

- A. Provide new materials and equipment unless specifically noted otherwise.
- B. NEMA enclosure types are listed on the Drawings and/or the specifications.
- C. Electrical materials and equipment must be listed by Underwriter's Laboratories, Inc. (UL) or other National Recognized Testing Laboratory (NRTL) and bear the appropriate listing or classification marking. Equipment not bearing a UL certification shall be field or factor UL certified prior to acceptance and use.
- D. Provide major electrical equipment by a single manufacturer, i.e. unit substations, switchgear, motor control centers, disconnect switches, transformers, panelboards, etc.
- E. Variable frequency controllers, when provided as a stand-alone package with the driven equipment and therefore not included in a motor control center are required to be by a single manufacturer.

1.14 HAZARDOUS AREAS

- A. Drawings may indicate and define NEC hazardous classified locations.
- B. Equipment and materials installed in hazardous areas shall be UL listed for the appropriate Class and Division and in accordance with NEC Articles 500, 501, 502, and 503 as applicable.

1.15 EQUIPMENT SIZE, HANDLING, AND STORAGE

- A. Coordinate with equipment manufacturer shipping splits to permit safe handling and passage of equipment to final installation location.
- B. Comply with manufacturer's instructions for upright equipment orientation during transportation.
- C. Protect equipment from mechanical injury, or exposure to moisture, chemicals, or corrosive gases. Do not store indoor rated electrical equipment outdoors.
- D. Provide and energize temporary space heaters if required to control moisture during storage.

1.16 SERVICE AND METERING

- A. Electric power company serving this project is Florida Power and Light (FPL). Comply with power company standards.
- B. Pay fees and charges as required for temporary / construction power for Contractor's use.
- C. Pay fees and charges as required for permanent service via a bid allowance and submit power company invoices to owner for substantiation.
- D. Power Company Work:
 - 1. Furnish conduit materials for underground service to utility transformer(s).
 - 2. Provide primary conductors (overhead and underground) to utility transformer(s).
 - 3. Provide utility transformer pad(s) and grounding.
 - 4. Provide utility transformer(s).
 - 5. Terminate underground primary cables at the utility transformer(s).
 - 6. Terminate underground secondary cables at the utility transformer(s).
 - 7. Provide metering current transformers (CT's), meter(s) and meter wiring.
- E. Contractor Work:
 - 1. Make arrangements with power company to obtain service, pay power company fees, and provide labor and materials required for electrical service.
 - 2. Install primary underground conduits.
 - 3. Provide secondary underground conduits and cable from utility transformer(s) to service entrance equipment.
 - 4. Terminate secondary underground cables at the service entrance equipment.
 - 5. Provide power company approved metering current transformer (CT) enclosure.
 - 6. Install meter base enclosure.
 - 7. Provide empty conduit with pull line from the metering CT enclosure to the meter base enclosure.

1.17 FIELD CONDITIONS

- A. Modeling, analysis, product selection, installation, and quality control for Work specified in Division 26 must comply with requirements specified in Section 260011 "Facility Performance Requirements for Electrical."
- B. Service Conditions for Electrical Power Equipment: Besides conditions specified in Section 260011 "Facility Performance Requirements for Electrical," specified electrical power equipment must be suitable for operation under service conditions specified as usual service conditions in applicable NEMA PB series, IEEE C37 series, and IEEE C57 series standards.

1.18 ELECTRICAL SYSTEM TESTING AND SETTINGS

- A. Test electrical systems and equipment in accordance with individual sections. This includes motors or other electrical equipment which are not specified in Division 26.

- B. Set and adjust controls, timers, relays, adjustable trip units, protective devices, and other electrical components in accordance with manufacturers instructions and the approved power system study. Do not energize equipment without correctly setting adjustable components.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SLEEVES AND FORMS FOR OPENINGS

- A. Provide and place sleeves for conduits and slots for electrical work prior to concrete pour.
- B. Use approved shop drawings and equipment vendor templates to determine exact locations for stub-ups and terminating concealed conduit and place before floor slab pour.
- C. Seal openings, sleeves, penetration and slots in accordance with Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.2 CUTTING AND PATCHING

- A. Cut and patch in a workmanlike manner as required to install electrical work.
- B. Modify concrete in accordance with Division 3 "Concrete."
- C. Do not cut joists, beams, girders, columns, or other structural members.
- D. Patch surfaces to restore to original integrity (waterproof or fireproof as required) and appearance.
- E. Core drill holes in concrete floors and walls as required. Prior to coring concrete, scan slab or wall using radar to locate and identify rebar and/or conduit and wiring. Locate cores to avoid cutting or drilling through rebar and/or conduits. Space conduits to not weaken structural integrity. Notify Engineer immediately if rebar is cut or upon becoming aware of discrepancies within area of work.

3.3 DEMOLITION AND DISPOSITION OF EQUIPMENT

- A. Drawings showing removal of major mechanical and electrical equipment is not intended to show all components to be demolished. Not all piping, conduits, ducts, equipment, ancillary devices, etc. are shown. Field verify existing conditions prior to bid.
- B. Unless otherwise specifically noted, remove unused exposed conduit and support systems back to source and/or point of concealment including above accessible ceiling finishes. Wiring shall be removed.
- C. Cut flush with slab, ceiling, or wall abandoned concealed conduit. Suitably plug conduits.

- D. Repair and restore adjacent construction and finishes after demolition is complete.
- E. Material and equipment indicated for removal or demolition is to become the Contractor's property upon removal, unless noted otherwise. Removed material to be properly handled and disposed.

3.4 INSTALLATION OF ELECTRICAL WORK

- A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Engineer for resolution of conflicting requirements.

3.5 FIELD QUALITY CONTROL

- A. Field testing, startup services, and system functional testing may be provided by the Contractor, and/or the manufacturer's factory-authorized service representative, and/or an independent testing agency. Provide testing and/or startup service as specified in the relevant section.
- B. Comply with Section 260800 "Commissioning of Electrical Systems".
- C. Submit Field Quality-Control Report as informational submittal within 14 days of each completed test or startup. Include within the report adjustments / as left settings.

3.6 CLEANING

- A. Remove rubbish and debris from inside and around electrical equipment and enclosures.
- B. Remove dirt, dust or concrete spatter from interior and exterior of equipment using brushes, vacuum cleaner, or clean lint-free rags. Do not use compressed air.

3.7 CLOSEOUT ACTIVITIES

- A. Provide demonstration and training as specified in each section.

END OF SECTION 260010

SECTION 260011 - FACILITY PERFORMANCE REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Field conditions and other facility performance requirements applicable to Work specified in Division 26.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 018839 "Wind Performance Requirements".

PART 2 - FIELD CONDITIONS

- A. Altitude:
 - 1. Sea level to 92 ft.
- B. Temperature Variation: Allow for thermal movements from the following differential temperatures:
 - 1. Outdoor Ambient Temperature Differential: 120 degrees F.
 - 2. Material Surface Temperature Differential: 180 degrees F.
 - 3. Ground Surface Temperature Differential to 10 foot Depth: 100 degrees F.
- C. Ground Water:
 - 1. Assume ground-water level is at grade level unless a lower water table is noted on Drawings.
 - 2. Assume ground-water level is 36 inch below ground surface unless a higher water table is indicated on Drawings.
- D. Acoustical Performance Conditions:
 - 1. Comply with local noise ordinance requirements.
- E. Hazardous and / or Corrosive Environmental Conditions: As indicated on the Drawings.

PART 3 - PRODUCTS (Not Used)

PART 4 - EXECUTION (Not Used)

END OF SECTION 260011

SECTION 260505 - SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Removal of existing electrical equipment, wiring, and conduit in areas to be remodeled; removal of designated construction; dismantling, cutting and alterations for completion of the Work.
2. Disposal of materials.
3. Storage of removed materials.
4. Identification of utilities.
5. Salvaged items.
6. Protection of items to remain as indicated on Drawings.
7. Relocate existing equipment to accommodate construction.

- B. Related Sections:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

- A. Section 013300 "Submittal Procedures": Requirements for submittals.
- B. Shop Drawings: Indicate demolition and removal sequence and location of salvageable items; location and construction of temporary work. Describe demolition removal procedures and schedule.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of capped conduits and equipment abandoned in place.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with Dunes Community Development District standard.

1.6 PRE-INSTALLATION MEETINGS

- A. Section 013100 “Project Management and Coordination”: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.7 SEQUENCING

- A. Section 011000 “Summary”: Requirements for sequencing.

1.8 SCHEDULING

- A. Section 013200 “Construction Progress Documentation”: Requirements for scheduling.
- B. Schedule work to coincide with new construction.
- C. Perform noisy, dusty, work during hours acceptable to the Owner:
 - 1. On following days: Monday - Friday.
- D. Cease operations immediately when structure appears to be in danger and notify Engineer/Engineer. Do not resume operations until directed.

1.9 COORDINATION

- A. Section 013513.24 “Special Procedure for MOPO and Construction Sequence” Requirements for coordination.
- B. Conduct demolition to minimize interference with adjacent and occupied building areas.
- C. Coordinate and sequence demolition so as not to cause shutdown of operation of surrounding areas.
- D. Equipment, building or structures scheduled for complete demolition shall be made safe from electrical shock hazard prior to demolition.
- E. Shut-down Periods:
 - 1. Arrange timing of shut-down periods of in-service panels with Owner. Do not shut down any utility without prior written approval.
 - 2. Keep shut-down period to minimum or use intermittent period as directed by the Owner.
 - 3. Maintain life-safety systems in full operation in occupied facilities or provide notice minimum 3 days in advance.

- F. Identify salvage items in cooperation with Owner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 017300 "Execution": Verification of existing conditions before starting work.
- B. Verify wiring and equipment indicated to be demolished serve only abandoned facilities.
- C. Verify termination points for demolished services.

3.2 PREPARATION

- A. Erect, and maintain temporary safeguards, including warning signs and lights, barricades, and similar measures, for protection of the public, Owner, Contractor's employees, and existing improvements to remain.
- B. Temporary egress signage and emergency lighting

3.3 REMOVAL AND DISPOSAL OF LEGALLY REGULATED MATERIALS

- A. Material and equipment indicated to be removed and disposed of will become the Contractor's property. Dispose of material and equipment offsite, unless otherwise directed by the Owner. Provide the Owner with a receipt indicating the acceptable disposal of any legally regulated materials or equipment.
- B. Assume that the ballasts in each existing lighting fixture contain PCB's, unless specifically marked with a label indicating "No PCBs." Remove ballasts from each lighting fixture and pack them in accordance with EPA PCB regulations. Ship ballasts in approved containers to an EPA approved recycling facility; pay all shipping, packaging and recycling costs.
- C. Remove, package, ship and dispose of PCBs, mercury and PCB/mercury contaminated equipment, in accordance with all State and Federal regulations. Retain the services of a firm licensed and regularly engaged in the removal of PCBs and PCB contaminated equipment. Retain a firm licensed in the State or States in which the contaminated material is handled, shipped and disposed of. Pay all fees associated with the removal of the contaminated material and equipment. Submit documentation indicating acceptable disposal.
- D. If PCB's or mercury contaminated equipment are discovered that were not identified; cease work on or about the equipment and notify the Engineer immediately.

- E. Remove the following electrical equipment to a location on the site for storage as directed by the Owner:
 - 1. RO Feed Pump (RVSS) Starters
 - 2. Circuit Breakers

3.4 DEMOLITION

- A. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Owner and Engineer before disturbing existing installation.
- B. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- C. Remove conduit, wire, boxes, and fastening devices to avoid any interference with new installation.
- D. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- E. Reconnect equipment being disturbed by renovation work and required for continue service to the nearest available panel.
- F. Disconnect or shut off service to areas where electrical work is to be removed. Remove electrical fixtures, equipment, and related switches, outlets, conduit and wiring which are not part of final project.
- G. Install temporary wiring and connections to maintain existing systems in service during construction.
- H. Perform work on energized equipment or circuits with experienced and trained personnel.
- I. Remove, relocate, and extend existing installations to accommodate new construction.
- J. Repair adjacent construction and finishes damaged during demolition and extension work.
- K. Remove exposed abandoned grounding and bonding components, fasteners and supports, and electrical identification components, including abandoned components above accessible ceiling finishes. Cut embedded support elements flush with walls and floors.
- L. Clean and repair existing equipment to to be reinstalled.
- M. Protect and retain power to existing active equipment remaining.
- N. Cap abandoned empty conduit at both ends.
- O. Perform Work in accordance with Dunes Community Development District standards.

3.5 EXISTING PANELBOARDS

- A. Ring out circuits in existing panel affected by the Work. Where additional circuits are needed, reuse circuits available for reuse. Install new breakers.
- B. Tag unused circuits as spare.
- C. Where existing circuits are indicated to be reused, use sensing measuring devices to verify circuits feeding Project area or are not in use.
- D. Remove existing wire no longer in use from panel to equipment.
- E. Provide new updated directories where more than three circuits have been modified or rewired.

3.6 SALVAGE ITEMS

- A. Remove and protect items indicated on Drawings to be salvaged and turn over to Owner.
- B. Items of salvageable value may be removed as work progresses. Transport salvaged items from site as they are removed.

3.7 REUSABLE ELECTRICAL EQUIPMENT

- A. Carefully remove equipment, materials, or fixtures which are to be reused.
- B. Disconnect, remove, or relocate existing electrical material and equipment interfering with new installation.
- C. Relocate existing lighting fixtures as indicated on Drawings. Clean fixtures and re-lamp. Test fixture to see if it is in good working condition before installation at new location.

3.8 CLEANING

- A. Remove demolished materials as work progresses. Legally dispose.
- B. Keep workplace neat.

END OF SECTION 260505

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SECTION 260510 – LIMITED ELECTRICAL FOR SMALL PROJECTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Copper power and control wire rated 600V or less.
2. Low-voltage instrumentation cable.
3. Industrial Ethernet cable.
4. Connectors, splices, and terminations.
5. Grounding and bonding components.
6. Support systems for raceways, boxes, and electrical equipment.
7. Metal conduits and fittings.
8. Nonmetallic conduit and fittings.
9. Boxes, enclosures, and cabinets.
10. Handholes and boxes for exterior underground cabling.
11. Identification requirements.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Division 26 Section 260548 "Vibration and Seismic Controls for Electrical Systems" for seismic restraints and anchors.

1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit. See also RAC.
- B. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.
- C. Duct: A single duct or multiple ducts. Duct may be installed singly or as a component of a duct bank.

- D. Duct Bank:
 - 1. Two or more ducts installed in parallel, with or without additional casing materials.
 - 2. Multiple duct banks.
- E. EMI: Electromagnetic interference.
- F. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50V or for remote-control and signaling power-limited circuits.
- G. RAC: Rigid aluminum conduit. See also ARC.
- H. RoHS: Restriction of Hazardous Substances.
- I. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.
- J. National Electrical Code (NEC) / NFPA conduit types:
 - 1. RMC – rigid metal conduit
 - 2. FMC – flexible metal conduit
 - 3. LFMC – liquidtight flexible metal conduit
 - 4. PVC – rigid polyvinyl chloride conduit
 - 5. LFNC – liquidtight flexible nonmetallic conduit
 - 6. RNC – rigid nonmetallic conduit
 - 7. EMT – Electrical metallic tubing

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product used on this project.
- B. Shop Drawings:
 - 1. Precast Handholes: Include plans, elevations, sections, and details.
- C. Installation Working Drawings: For underground conduit routing.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 ELECTRICAL MATERIALS

- A. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with associated UL Standards as applicable and listed in this specification.

2.2 WIRE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Alpha Wire Company.
 - 2. Encore Wire Corporations.
 - 3. General Cable Technologies Corporation.
 - 4. Okonite Company (The).
 - 5. Service Wire Co.
 - 6. Southwire Company.
- B. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V.
- C. Standards:
 - 1. RoHS compliant.
 - 2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- E. Size: Minimum No. 12 AWG for power circuits, minimum No. 14 AWG for control circuits.
- F. Stranding: Refer to Part 3 "Conductor Applications" Article.
- G. Conductor Insulation: Refer to Part 3 "Conductor Applications" Article.
 - 1. Type RHW-2: Comply with UL 44.
 - 2. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
 - 3. Type THHN and Type THWN-2: Comply with UL 83.
 - 4. Type XHHW-2: Comply with UL 44.

2.3 INSTRUMENTATION CABLE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Belden.
 - 2. Rockbestos.
- B. Single or Multiple Paired Cable: NEC type ITC (Instrumentation Tray Cable), UL Type TC for 4-20mA process instrumentation signals and use under NEC Article 72.
 - 1. One or Multi-pair, twisted, shielded, No. 16 AWG, stranded (19x29) tinned-copper conductors.
 - 2. XLPE insulation, 600V.
 - 3. Shield: 100 percent aluminum/polyester foil with drain wire. Pairs individually shielded.

4. PVC jacket with manufacturer's identification.
5. Standards: UL 1277 Type TC, UL 1581

2.4 INDUSTRIAL ETHERNET CABLE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Rockwell Automation 1585-C8HB-S.
- B. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 5e cable at frequencies up to 100 MHz *Ethernet/IP* compliant.
- C. Standard: UL, UL PLTC, UL AWM 2570 80C 600V, TIA 568B.
- D. Conductors: 100-ohm, No. 22 AWG solid copper.
- E. Shielding/Screening: Overall foil shield.
- F. Cable Rating: 600V.
- G. Jacket: PVC.

2.5 CONNECTORS, SPLICES, AND TERMINATIONS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. 3M Electrical Products.
 2. Ideal Industries, Inc.
 3. TE Connectivity Ltd.
 4. Thomas & Betts Corporation; A Member of the ABB Group.
- B. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 1. Material: Tin-plated copper.
 2. Type:
 - a. Locking spade with insulated sleeve for No. 10 AWG and smaller.
 - b. One hole with long barrels for No. 8 AWG to No. 4/0 AWG.
 - c. Two holes with long barrels for 250 kcmil and larger.
 3. Termination: Compression for No. 8 AWG and larger.

D. Connectors:

1. Solderless pressure type (wirenuts) for No. 10 AWG and smaller.
2. Pre-filled with silicone-based sealant for exterior, wet, or corrosive locations.
3. Split bolt type for No. 8 AWG and larger splices.

E. Motor Terminations: Mechanical compression ring type, secured with bolt, nut, and spring washer. Insulated with Raychem type RVC, roll-on stub insulator or equal.

F. Industrial Ethernet Cable Terminations: Match conductor count, RJ45 type, intended for shielded cable. Rockwell Automation Bulletin 1585J or equal.

2.6 GROUNDING AND BONDING MATERIALS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ERICO; a brand of nVent.
2. Hubbell Incorporated (Construction and Energy Group).
3. O-Z/Gedney; a brand of Emerson Industrial Automation.
4. Thomas & Betts Corporation; A Member of the ABB Group.

B. Standard: Comply with UL 467 for grounding and bonding materials and equipment.

C. Grounding Conductors:

1. Insulated conductors to match corresponding 600V phase conductor insulation requirements.
2. Bare copper conductors: tin-plated.

D. Ground rods: Copper-clad steel, sectional type; 3/4-inch diameter by 10-foot; minimum copper thickness 0.25 mm (10 mil).

E. Grounding conduit hubs: Malleable iron type, mechanical type, terminal with threaded hub, sized for the associated conduit.

F. Waterpipe ground clamps: cast bronze saddle type, sized for the associated water pipe.

G. Exothermic weld: CADWELD process, or equal. Molds and powder furnished by same manufacturer and selected for specific combination of conductors and connected items. Use low emission type, CADWELD EXOLON or equal for welds used indoors in occupied buildings or confined spaces.

2.7 SUPPORT SYSTEMS

A. Aluminum Channel:

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Channel Material: 6063-T5 aluminum alloy.
3. Fittings and Accessories Material: 5052-H32 aluminum alloy.

B. Stainless Steel Channel:

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Stainless steel, Type 316.

C. Hot-dipped Galvanized Steel Channel:

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Hot-dipped galvanized steel.

D. Nonmetallic Channel:

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Channel Material: Ultraviolet resistant FRP.
3. Fittings and Accessories Material: Stainless steel, Type 316 or compatible non-metallic.

E. Accessories: conduit clamps, straps, hangers, rods, backplates, anchors, nuts, washers, etc. shall match channel material as listed in the SUPPORT MATERIALS APPLICATION Article. Use of galvanized steel components is only allow with galvanized steel channel.

F. Threaded rod: 3/8-inch minimum diameter.

G. Expansion anchors: 3/8-inch minimum diameter.

2.8 METAL CONDUITS AND FITTINGS

A. Rigid Aluminum Conduit: Comply with ANSI C80.5 and UL 6A.

B. EMT: Comply with ANSI C80.3 and UL 797.

C. LFMC: Sealtite®, Type UA, continuously interlocked flexible steel conduit with sunlight and chemical resistant PVC jacket and complying with UL 360.

D. FMC: Comply with UL 1; zinc-coated steel.

E. Metallic Fittings: Comply with NEMA FB 1 and UL 514B.

1. Use cast aluminum fittings with RAC.
2. Use malleable iron, three-piece screw in type with LMFC.
3. Use Myers Electric Products, Inc. or equal, grounding type for conduit hubs.
4. Use die cast compression type fittings with EMT, no set-screw type.

2.9 NONMETALLIC CONDUIT AND FITTINGS

A. RNC: Schedule 40 or Schedule 80 PVC based on application; comply with NEMA TC 2 and UL 651.

B. LFNC-B: Comply with UL 1660, Type B.

C. Nonmetallic Fittings:

1. RNC: Comply with NEMA TC 3; match conduit type and material.
2. LFNC: Comply with UL 514B; dust-tight, liquid-tight, chemical resistant thermoplastic/nylon construction with tapered thread hub and neoprene O-ring gasket. Push-on fittings are prohibited.

D. Solvents and Adhesives: As recommended by conduit manufacturer.

2.10 BOXES, ENCLOSURES, AND CABINETS

A. Sheet Metal Outlet and Device Boxes: Pressed steel. Comply with NEMA OS 1 and UL 514A.

B. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

C. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

D. NEMA 1 and NEMA 12 Pull and Junction Boxes:

1. Material: Sheet steel, minimum 14 gauge, without knockouts.
2. Construction: flanged box, galvanized with continuous weld seams that are ground smooth.
3. Cover: Gasketed, hanged, fastened with quick connect door clamp.

E. NEMA 4X Pull and Junction Boxes:

1. Material: Type 316 stainless steel, minimum 14 gauge, without knockouts.
2. Construction: flanged box, continuous weld seams that are ground smooth.
3. Cover: Gasketed, hanged, fastened with quick connect door clamp.

F. Handholes and Boxes for Exterior Underground Cabling: Comply with details as indicated on the Drawings.

2.11 IDENTIFICATION

A. Factory applied insulation color for No. 8 AWG conductors and smaller. Factory applied insulation color or field applied colored electrical tape for No. 6 AWG conductors and larger:

1. Color for 208/120V Circuits:

- a. Phase A: Black.
- b. Phase B: Red.
- c. Phase C: Blue.
- d. Neutral: White.

2. Color for 240/120V Circuits (Single Phase):

- a. Phase A: Black.
- b. Phase B: Red.
- c. Neutral: White.

3. Color for 240Δ/120V Circuits (Three Phase, Four Wire, high leg, center tap):

- a. Phase A: Black.
- b. Phase B: Orange (high leg).
- c. Phase C: Blue.
- Neutral: White.

4. Color for 480/277V Circuits:

- a. Phase A: Brown.
- b. Phase B: Orange.
- c. Phase C: Yellow.
- d. Neutral: Gray.

5. Color for Equipment Grounds: Green.

6. Color of Individual Control Conductors:

- a. AC: Red.
- b. DC: Blue.

B. Nameplates and Labels:

1. Equipment Identification and Source Nameplates:

- a. Black letters on a white field.
- b. Engraved, laminated plastic, 3/16-inch-high lettering.
- c. Provide for all electrical equipment. Match Drawing designation.
- d. Include power source information, i.e., “FED FROM MCC-2” or provide separate nameplate.

2. Device Identification Labels:

- a. Black letters on a white field.
- b. Machine generated, self-adhesive, 1/4-inch-high lettering.
- c. Provide for all receptacles, wall switching, lighting fixtures, photocells, exit lights, instruments, etc.
- d. Include power source and branch circuit information, i.e., “LP-2/15” indicates panelboard LP-2, branch circuit 15.

3. Wire and Cable Labels:

- a. Black letters on a white field.
- b. Wraparound or sleeve type.

C. Detectable Underground-Line Warning Tape:

- 1. Foil-backed, detectable buried utility tape with black lettering on a bright background.
- 2. Width: 6 inches.
- 3. Overall Thickness: 5 mils.
- 4. Background Color / Description:

- a. Red / Electric: electrical power, control, or instrumentation.
- b. Orange / Fiber: fiber optic cables.

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with the applicable National Electrical Contractors Association (NECA) documents for installation requirements except where requirement on Drawings or in this specification are stricter.
 - 1. NECA 1: Standard for Good Workmanship in Electrical Construction.
 - 2. NECA 101: Standard for Installing Steel Conduits.
 - 3. NECA 102: Standard for Installing Aluminum Rigid Metal Conduit.
 - 4. NECA 111: Standard for Installing Nonmetallic Raceways.
 - 5. NECA 331: Standard for Installing Building and Service Entrance Grounding and Bonding.
 - 6. NECA / NEMA 605: Recommended Practice for Installing Underground Nonmetallic Utility Duct.

3.2 CONDUCTOR APPLICATIONS

- A. Wires and Cables: Copper, stranded, except for lighting and receptacle wiring which may be solid.
- B. Wire for lighting, receptacles, and other circuits not exceeding 150 volts to ground shall be NEC type THWN-2/THHN. Below grade and underground the wire shall be type XHHW-2.
- C. Wire for power circuits over 150 volts to ground shall be NEC type XHHW-2 for sizes No. 4/0 AWG and smaller and shall be NEC type RHW-2 for sizes 250 kcmil and larger.
- D. Equipment grounding conductors shall be the same NEC type as the phase conductors described previously, green and sized per NEC Table 250.122.
- E. Bare copper ground wire shall be stranded, tinned soft drawn annealed copper wire.
- F. Ground grid conductors shall be uninsulated unless shown otherwise on the Drawings.
- G. Wire for control, status, and alarm shall be NEC type XHHW-2.
- H. Multi-conductor control cable shall be NEC type TC (tray cable), stranded, No. 14 AWG, XHHW-2 600V insulated color coded conductors, bare stranded ground wire, with overall PVC cable jacket.

3.3 CONDUCTOR INSTALLATION

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

- B. Complete raceway installation between conductor and cable termination points prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway. Use of steel fish tapes and/or steel pulling cables in PVC conduit or raceways that terminate into energized enclosures is prohibited.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Adequately support cables.
- G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- H. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors. Do not splice service or feeder cables without prior written approval of Engineer. Instrumentation and Ethernet cables may not be spliced and shall be continuous from terminal to terminal.
- I. Wiring at Outlets:
 - 1. Install conductor at each outlet, with at least 6 inches (150 mm) of slack.
 - 2. Form solid wire into loop to fit around device terminal screw. Do not overlap wire.
- J. Identify and color-code conductors and cables.
- K. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.
- L. Identify circuit number associated with lights, receptacles, and other miscellaneous loads to panelboards. Identify phase and neutral conductors with circuit number.
- M. Install instrumentation and Ethernet cabling in separate raceway from control or power wiring.
- N. Separation from EMI Sources:
 - 1. Separation between open instrumentation cables or cables in non-metallic or non-ferrous raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Equipment or circuits rated less than 2 kVA: Minimum 5 inches.
 - b. Equipment or circuits rated between 2 and 5 kVA: Minimum 12 inches.
 - c. Equipment or circuits rated more than 5 kVA: Minimum 24 inches.

3.4 GROUNDING

- A. Comply with NEC Article 250.
- B. Install insulated green equipment grounding conductor in all power and control raceways.
- C. For instrumentation wiring, ground shield at one end only as recommended by instrument manufacturer and in accordance with Owner's standard.
- D. Install grounding conductors in conduit or sleeves when passing through floor slabs.
- E. Use exothermic welding process for all underground connections, connections to structural steel, connections to ground rods, or other connections which will become inaccessible at project completion.

3.5 SUPPORT MATERIALS APPLICATION

- A. Dry, indoor, conditioned, non-process space: Hot-dipped galvanized steel.
- B. Outdoor, process areas, or areas shown on the drawings as "DUST", "DAMP", or "WET": Aluminum and/or stainless-steel channel, depending upon load requirements.
- C. Areas shown on the drawings as "CORROSIVE": Nonmetallic.

3.6 RACEWAY APPLICATIONS

- A. Refer to Appendix Table 260510-1 for specific raceway application requirements.
- B. Minimum Raceway Size: 3/4-inch trade size.

3.7 BOX APPLICATIONS

- A. All boxes shall be metallic unless specified herein or indicated on the Drawings.
- B. Use cast malleable iron for boxes and conduit fittings for exposed switch, receptacle, and lighting outlets.
- C. Use pressed steel boxes for concealed switch, receptacles, and lighting outlets.
- D. Pull boxes, junction boxes, cabinets, etc. shall be suitable for the location and conform to the NEMA enclosure rating and material descriptions as indicated on the Drawings.
- E. Where no size is indicated for junction boxes, pull boxes, or terminal cabinets, size in accordance with NEC Article 314.

3.8 RACEWAY INSTALLATIONS

- A. Complete raceway installation before starting conductor installation.

- B. Tightly plug ends of conduits during construction to exclude dust and moisture.
- C. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- D. Arrange conduit system to allow liquids such as water, condensation, etc. will drain away from equipment served. If conduit drainage is not possible, plug conduits using conduit seals.
- E. Install no more than the equivalent of three 90-degree bends in any conduit run. Support within 12 inches of changes in direction.
- F. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- G. Support conduit within 12 inches of enclosures to which attached.
- H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- J. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits. Install Meyers grounding type hubs when conduits terminate at gasketed enclosures.
- K. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- L. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- M. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- O. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- P. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways using "Duxseal" or seal fitting at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service raceway enters a building or structure.
 3. Conduit extending from interior to exterior of building.
 4. Conduit extending into pressurized duct and equipment.
 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 6. Where otherwise required by NFPA 70.
- Q. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- R. Install expansion joint fittings where necessary to compensate for thermal expansion and contraction.
- S. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for equipment subject to vibration, noise transmission or movement; and for transformers and motors.
- T. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- U. A maximum continuous run of conduit shall not exceed 300 feet and shall be reduced by 75 feet for each 90-degree elbow.
- V. Provide a 4-inch concrete housekeeping pad at all slab and grade penetrations. Provide a 45 degree, 3/4-inch chamfer at all exposed edges.
- W. Protect metallic finish conduit installed in contact with concrete or below grade with two coats of bitumastic paint, heat shrink tubing, or approved equivalent. Extend protection on riser conduits from 12 inches below slab to 6 inches above slab.
- X. In hazardous locations, seal conduits terminating at boxes enclosing circuit opening equipment at the entrance to the enclosure with approved compound filled sealing fittings to prevent passage of explosive or combustible gases through the conduits. Similarly seal all conduits leading from or entering hazardous locations at points of exit or entrance. Seal exposed conduits passing through hazardous locations at both the entrance to and the exit from the hazardous locations.
- Y. Install conduit sealing and drain fittings in all hazardous (classified) areas designated Class 1, Division 1, and Class 1, Division 2.
- 3.9 UNDERGROUND SYSTEM INSTALLATION
- A. Coordinate final arrangement with other underground utilities, site grading, and surface features.
- B. Comply with Division 31 specifications for earthwork, excavation, trenching, backfill, and compaction.

- C. Raceway Drainage:
 - 1. Drain away from buildings.
 - 2. Drain towards manholes or handholes.
 - 3. Slope raceway not less than 3-inches per 100-feet.
- D. Restoration: Restore surface features and re-establish grade, paving, and vegetation to original unless otherwise indicated.
- E. Separate underground copper signal conduits (instrumentation and telecommunication) from power conduits by a minimum of 12 inches unless noted otherwise. Keep crossing of these conduits to a minimum; cross at 90-degree angles.
- F. Transition to Metal Conduit:
 - 1. Use fittings manufactured for RNC to metal conduit transition.
 - 2. Make transition from underground duct to metal conduit at least 10 feet outside the building wall, without reducing duct line slope away from building and without forming a trap in the line.
- G. Minimum Cover and Additional Detail: As indicated per details on Drawings.
- H. Where Drawings call for concrete encased duct bank, color concrete red.

3.10 ELECTRICAL PENETRATIONS

- A. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc.
- B. Locate all slots and concealed conduits and stub-ups for electrical work and place and form as required before concrete is poured.
- C. Make weathertight and restore finishes on exterior penetrations.
- D. Use conduit wall seals where underground conduits penetrate walls or at other locations indicated on the Drawings.
- E. Seal openings where conduits pass through walls or floors to prevent passage of flame and smoke. Maintain fire rating of walls.
- F. Patch and paint interior wall penetrations to match original.

3.11 IDENTIFICATION INSTALLATION

- A. Self-Adhesive Identification Products: Before applying identification product, prepare and clean attachment surface with manufacturer recommended product to allow for effective bond.
- B. Verify and coordinate identification names and other features.
- C. Nameplate Attachment:

1. Screw mounted for NEMA 1 enclosures.
 2. Epoxy or similar waterproof adhesive for all other enclosure types.
- D. Install identification and power source nameplates for electrical equipment. Refer to Part 2 “Identification” Article for requirements.
- E. Install circuit identification labels for cables and conductors at each termination location and within pull boxes and handholes. Refer to PART 2 “Identification” Article for color code and additional requirements.
- F. Install device identification labels for receptacles, light switches, etc. Refer to Part 2 “Identification” Article for requirements.
- G. Install underground warning tape during backfilling of trenches for underground conduits and duct banks in accordance with details on the Drawings.
- H. Panelboard Identification
1. Provide equipment and power source nameplates as previously described.
 2. Label branch circuit phase and neutral wires with associated pole number.
 3. Install typed as built circuit directory giving location and nature of load served.

3.12 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections for conductors and cables.
1. Visually inspect for correct installation.
 2. Perform continuity test.
 3. Perform insulation-resistance test for power and control conductors in accordance with NETA standards.
 4. Verify uniform resistance of parallel conductors.
- B. Cable will be considered defective if it does not pass tests and inspections.
- C. Conduct fall-of-potential grounding electrode system test in accordance with IEEE 81.
- D. Prepare test and inspection reports.

3.13 CLEANING / PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration. Repair damage as recommended by manufacturer.
- B. Remove all rubbish and construction debris from inside electrical equipment and enclosures.

3.14 APPENDICES

- A. Table 260510-1: Raceway Application Guidelines

Table 260510-1 Raceway Application Guidelines	
Raceway Type	Location / Application
Aluminum Rigid Conduit (ARC)	All indoor and outdoor applications, except where other types are listed. All exposed, non-corrosive areas. All concealed, non-corrosive areas. Under slabs in slab on grade construction. Stub-ups through slabs. Use LFMC for flexible connections. When installed underground or in contact with concrete, paint with two coats of bitumastic paint.
Electrical Metallic Tubing (EMT)	Indoor air-conditioned spaces in the Administration Building including the electrical room, mechanical room, control room, toilet areas, and office areas. Use FMC for flexible connections to light fixtures.
PVC Schedule 40	Concrete encased duct banks. Embedded in concrete slabs or structures. Use ARC elbows.
PVC Schedule 80	Direct buried. Corrosive areas. Protection of grounding electrode conductors. Protection of lightning conductors. Where exposed, use LFNC for flexible connections. Use ARC elbows for underground applications.

END OF SECTION 260510

SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Elastomeric isolation pads.
 - 2. Restraints - rigid type.
 - 3. Restraints - cable type.
 - 4. Restraint accessories.
 - 5. Post-installed concrete anchors.
 - 6. Concrete inserts.
- B. Not all components specified in this Section are necessarily utilized on this project. Verify components needed per Drawings and Specifications.
- C. Related Requirements:
 - 1. Section 018839 "Wind Performance Requirements" for submittals, performance requirements and installation.
 - 2. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definition, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 3. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads: .
 - 1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
 - 2. Size: Factory or field cut to match requirements of supported equipment.
 - 3. Pad Material: Oil and water resistant with elastomeric properties. Neoprene rubber, silicone rubber, or other elastomeric material.
 - 4. Surface Pattern: Smooth, ribbed, or waffle pattern.

2.2 RESTRAINTS - RIGID TYPE

- A. Description: Shop- or field-fabricated bracing assembly made of ANSI/AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 RESTRAINTS - CABLE TYPE

- A. Seismic- and Wind-Load-Restraint Cables: ASTM A492 stainless steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for seismic-restraining cable service; with fittings attached by means of poured socket, swaged socket, or mechanical (Flemish eye) loop.
- B. Restraint cable assembly and cable fittings must comply with ASCE/SEI 19. Cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge-type end fittings do not comply and are unacceptable.

2.4 RESTRAINT ACCESSORIES

- A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Non-metallic stiffeners are unacceptable.
- B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.
- D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.
- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.5 POST-INSTALLED CONCRETE ANCHORS

- A. Mechanical Anchor Bolts:
 - 1. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength for anchor and as tested according to ASTM E488/E488M.
- B. Adhesive Anchor Bolts:
 - 1. Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts

and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.

- C. Provide post-installed concrete anchors that have been prequalified for use in seismic and wind-load applications.
 - 1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
 - 2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.
- D. Expansion-type anchor bolts are not permitted for equipment in excess of 10 hp that is not vibration isolated.
 - 1. Undercut expansion anchors are permitted.

2.6 CONCRETE INSERTS

- A. Provide preset concrete inserts that are seismically prequalified in accordance with ICC-ES AC446 testing.
- B. Comply with MSS SP-58.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install seismic and/or wind restraint components in accordance with Division 01 requirements.

END OF SECTION 260548

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SECTION 260573 - POWER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes a computer-based study for:
 - 1. Short circuit report.
 - 2. Protective device coordination report.
 - 3. Arc flash report.
 - 4. Harmonic analysis report.
- B. Study encompasses the power distribution system of the Dunes Community Development District Water Treatment Plant. Facility is located at 101 Jungle Hut Rd, Palm Coast, FL 32137.
- C. Study includes the electric utility company's protective devices, emergency generators, service entrance equipment and low-voltage distribution equipment. All power distribution to that point whether existing or new is included. Equipment included, but not limited to:
 - 1. Substations and distribution.
 - 2. Switchgear, switchboards, and panelboards.
 - 3. Motor control centers.
 - 4. Variable frequency controllers.
 - 5. Disconnect switches.
 - 6. Transfer switches.
 - 7. 480V control panels.
- D. The local electric utility is Florida Power and Light (FPL).
- E. Obtain all data necessary to perform the study. Data included, but not limited to:
 - 1. Up to date one-line diagrams.
 - 2. Equipment data.
 - 3. Cable sizes and lengths.
 - 4. Existing protective device settings.
 - 5. Electric utility information: available fault current, protective device equipment information and settings, X/R ratios, transformer impedances and ratings.
- F. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 DEFINITIONS

- A. Boundary, Arc Flash: When an arc flash hazard exists, an approach limit from an arc source at which the incident energy equals 1.2 cal/cm^2 (5 J/cm^2).
- B. Boundary, Limited Approach: An approach limit at a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists.
- C. Boundary, Restricted Approach: An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased likelihood of electric shock, due to electrical arc-over combined with inadvertent movement.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.
- E. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- F. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- G. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- H. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- I. Preliminary Short Circuit Report: Report that includes the maximum available utility fault current, proposed equipment, and existing equipment to determine if new equipment may be released for manufacturing and existing equipment is adequate for the calculated short circuit levels.
- J. Protective Device: A device that senses when an abnormal condition or current flow exists and then removes the affected portion of the circuit from the system.
- K. SCCR: Short-circuit current rating.
- L. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

- M. Single-Line Diagram: See "One-Line Diagram."
- N. Supplier: The person, firm or corporation identified as such to provide the power system study and means the Supplier or its authorized agent. See also Power Systems Analysis Specialist.
- O. VFD: Variable frequency drive. Interchangeable with variable frequency controller.

1.4 ACTION SUBMITTALS

- A. Supplier qualifications per Quality Assurance paragraph. Submit prior to starting study. Include the following:
 - 1. Brief description of each qualifying study.
 - 2. Name of owner of installation on which study was performed with address, telephone number, and contact person.
 - 3. Date of study.
 - 4. Any other information indicating the firm's experiences and ability to perform the work and business status.
- B. Preliminary Power System Study Report. Report must be approved prior to release for manufacture of major electrical equipment including but not limited to switchgear, switchboards, distribution panels, and motor control centers. Fault data from the utility must be included and not assumed or submittal will be rejected.
- C. Final Power System Study Report. Report must be approved prior to energization of new major electrical equipment. Revise study as required for changes during construction.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
 - 1. For Power Systems Analysis Software Developer.
 - 2. For Power System Analysis Specialist.
 - 3. For Field Adjusting Agency.
- B. If requested, Product Certificates: For power system study software, certifying compliance with IEEE 399, IEEE 1584 and NFPA 70E.
- C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Final power system study updated with any changes made after equipment start-up.
- B. Digital computer files with full read-write access of the complete power system model and library.

1.7 QUALITY ASSURANCE

- A. Perform Study using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. Power System Analysis Software Qualifications:
 - 1. Design computer program to perform short-circuit studies or have a function, component, or add-on module designed to perform short-circuit studies.
 - 2. Develop computer program under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
 - 3. Complies with IEEE 399, IEEE 141, IEEE 242, IEEE 519, IEEE 1015, and IEEE 1584 as applicable to the project scope.
- E. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located and has regularly engaged in this electrical engineering study specialty for minimum of five years and has performed at least three projects of similar complexity to this project within the last three years. Perform all elements of the study under the direct supervision and control of this professional engineer.
- F. Power System Study Certification: Report shall be signed and sealed by Power Systems Analysis Specialist.
- G. Field Adjusting Agency Qualifications:
 - 1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
 - 2. A member company of NETA.
 - 3. Acceptable to authorities having jurisdiction.

1.8 POWER SYSTEM STUDY MEETINGS

- A. Supplier's professional engineer responsible for the study to attend a meeting with the Engineer and Owner at the Owner's facility up to and including three times.
- B. Purpose of the three meetings are:
 - 1. Initial meeting discusses the study's scope and the Owner's operational and maintenance requirements prior to the preliminary study submittal.
 - 2. Second meeting discusses the preliminary study and its recommendations. Based on this meeting, the Owner may request modifications to the studies' recommended protective settings to reduce the arc flash hazard or meet other operational objectives.
 - 3. Third and final meeting presents the final study and its recommendations.

- C. Provide a minimum of three-week notice to the Owner and Engineer in advance of all projected meeting dates.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

- A. Acceptable Software:
 - 1. SKM System Analysis, Inc.: Power*Tools.
 - 2. Operation Technology, Inc.: ETAP (Electrical Transient Analyzer Program).
 - 3. EasyPower, Inc.: EasyPower.
 - 4. Or equal.

2.2 POWER SYSTEM STUDY REPORT GENERAL REQUIREMENTS

- A. Except for one-line diagrams, standard 8 1/2-inch by 11-inch pages, with total pages numbered.
- B. Electronic PDF format copy with electronic bookmarks for each section.
- C. Signed and sealed by a professional engineer registered in the state in which the project is located.
- D. Organized in the following order:
 - 1. Executive Summary.
 - 2. Short Circuit Analysis.
 - 3. Short Circuit Computer Printout.
 - 4. Protective Device Coordination.
 - 5. Arc Flash Hazard Analysis.
 - 6. Harmonic Analysis.
 - 7. Utility Data.
 - 8. Modeled One Line Diagrams.
- E. Information on one-line diagrams, legible when printed at 11-inch x 17-inch. Show the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Conductor types, sizes, and lengths.
 - 3. Transformer kilovolt ampere (kVA), impedance, and voltage ratings.
 - 4. Motor and generator designations and kVA ratings.
 - 5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
 - 6. Derating factors and environmental conditions.
 - 7. Any revisions to electrical equipment required by the study.
- F. Identifiers between the one-line diagram, short circuit study, coordination study, and arc flash study to be the same.

- G. Include copies of correspondence with electric utility under utility data section of report. Correspondence to include names and contact information.

2.3 EXECUTIVE SUMMARY

- A. Include summary of distribution system, information received from electric utility, major assumptions, adequacy of equipment to safely clear or close on any fault, identify problem areas and recommendations for resolving problem areas.

2.4 SHORT CIRCUIT

- A. Comply with IEEE 399 and IEEE 551 (new 3002 series).
- B. Include normal utility powered configuration, on-site generation configuration, and alternate modes of operation (i.e. alternate utility configuration, bus ties closed).
- C. Include minimum and maximum possible fault conditions. Address three-phase bolted as well as ground fault conditions.
- D. Consider the fault contribution of all motors operating during the maximum demand condition of the motors.
- E. Calculate short-circuit momentary duties and interrupting duties based on an assumed bolted three-phase short circuit at each high and medium voltage switchgear bus and controller, low voltage switchgear bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard and other significant locations throughout the systems. Include the X/R ratios, asymmetry factors, KVA and symmetrical fault-current in the short circuit tabulations. Provide a ground fault current study for the same system areas. Include in tabulations fault impedance, X/R ratios, asymmetry factors, motor contribution, short circuit KVA, and symmetrical and asymmetrical fault-currents.
- F. Include representation of the site power system, the base quantities selected, impedance source data, calculation methods and tabulations, one-line diagrams, conclusions and recommendations.
- G. Identify available fault current at each bus and evaluate system elements including but not limited to equipment, protective devices, and cables.
- H. Base current transformers' ratio and burden calculations on a 10 percent maximum ratio error per IEEE C57.13. Identify current transformers that will not allow the protective devices to operate within acceptable IEEE error margins and recommend corrective action.
- I. List momentary, interrupting, and/or withstand rating of all key elements of the distribution system along with the maximum available fault current in tabular form and clearly indicate the adequacy of the element with PASS / FAIL designation.
- J. Short Circuit Computer Printout:
 - 1. Calculations shall be in sufficient detail for easy review.
 - 2. Back up calculations shall become part of the final report.

2.5 PROTECTIVE DEVICE COORDINATION

- A. Comply with IEEE 242 (new 3004 series).
- B. Utilize results from the short circuit study and balance the competing objectives of protection and continuity of service for the system specified, considering the basic factors of sensitivity, selectivity and speed. Include all system protective devices in the coordination analysis, not just overcurrent protective devices. This includes but is not limited to under and over voltage protective relays, frequency relays, differential relays and reverse power relays.
- C. Show graphic indication of coordination between protective devices in the form of full color time-current coordination (TCC) plots with each protective device curve in a unique color for easy review.
- D. Provide separate TCC plots for each mode of operation. Provide separate TCC plots for “normal” and “stand by” operation. Show maximum fault values in each case. Both power sources shown on one plot is unacceptable.
- E. Provide separate TCC for phase over-current and ground fault.
- F. Show no more than six devices on one TCC. Of these six curves, two (the largest upstream device and the smallest downstream device) shall repeat curves shown on other coordination plots to provide cross-reference. Designate each TCC with a unique identifier and include each TCC identifier and descriptive title in the study’s table of contents.
- G. Include in each TCC the following as applicable:
 - 1. TCC name and description.
 - 2. One-line diagram.
 - 3. Identifiers on one-line diagram and curves.
 - 4. Significant motor starting characteristics.
 - 5. Appropriate NEC protection points.
 - 6. Appropriate ANSI/IEEE protection points.
 - 7. Magnetizing inrush points of transformers.
 - 8. Transformer damage curves.
 - 9. Complete operating bands for low voltage circuit breaker trip devices and fuses.
 - 10. Relay coil taps, time-dial settings and pickup settings.
 - 11. Significant symmetrical and asymmetrical fault currents.
 - 12. Power cable withstand curves.
 - 13. Generator short circuit decrement and thermal limit curves.
- H. Terminate device characteristic curve on TCC at a point reflecting the maximum symmetrical or asymmetrical fault current to which that device is exposed, based on the short circuit study.
- I. Select each primary protective device for a delta-to-wye-connected transformer so the characteristic or operating band is within the transformer parameters; where feasible, include a parameter equivalent to 58 percent of the ANSI C37.91 withstand curve to afford protection for secondary line-to-ground faults.

- J. Separate low voltage power circuit breakers from each other and the associated primary protective device, by a 16 percent current margin for coordination and protection in the event of line-to-line faults.
- K. Separate protective relays by a 0.3-second time margin for the maximum 3 phase fault conditions to assure proper selectivity.
- L. Optimize settings for breakers and relays to provide the most effective protection practicable for all modes and power sources.
- M. Include at least all devices down to largest branch circuit and largest feeder circuit breaker in each motor control center and/or power distribution panelboard. Include all adjustable setting ground fault protective devices.
- N. Provide tabulations of recommended settings for all protective devices. Where devices are existing, highlight any changes from the existing setting to the proposed recommended setting.
- O. Provide all information required to program/set multifunction solid state relays.

2.6 ARC FLASH HAZARD

- A. Comply with IEEE 1584, NFPA 70, and NFPA 70E as applicable.
- B. Utilize short circuit and protective device coordination results to provide arc flash hazard analysis. Perform calculations in accordance with IEEE 1584 or NFPA 70E with the method identified within the report.
- C. Calculate the incident energy levels at each faulted bus for each mode of operation and for both maximum and minimum fault currents.
- D. Include calculations at line side and load side of main breakers, where applicable.
- E. Provide tabular report for all modes and conditions and include “worst case” summary. Use the “worst case” to generate the arc flash labels. Include:
 - 1. Fault location.
 - 2. Arcing fault magnitude.
 - 3. Protective device clearing time.
 - 4. Duration of the arc.
 - 5. Arc flash boundary.
 - 6. Working distance.
 - 7. Incident energy.
 - 8. Electrode configuration.
- F. Highlight any available incident energy over 40 cal/cm² and provide recommendations to mitigate the hazard.
- G. Arc Flash Labels:
 - 1. Machine printed, 4-inches x 4-inches (nominal), thermal transfer, high adhesion polyester.

2. Provide UV resistant laminate for outdoor labels.

H. Here are some examples:

**DANGER**

SHOCK and ARC FLASH HAZARD
PNL 3

480 VAC	Shock Hazard
00	Class Glove with Leather Protectors
42 in	Limited Approach (Fixed Circuit)
12 in	Restricted Approach

14 cal/cm²
82 in

Incident Energy at **18 in**
Arc Flash Boundary

ARC FLASH PPE REQUIRED
Arc-rated (AR) long sleeve shirt & AR pants or AR coverall and/or AR flash suit, AR flash suit hood, AR gloves, hard hat, safety glasses/goggles, hearing protection, leather footwear

WARNING: Power system changes will invalidate the information on this label

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Job#: SAMPLE1 **MM/DD/YYYY** **By:** ERS

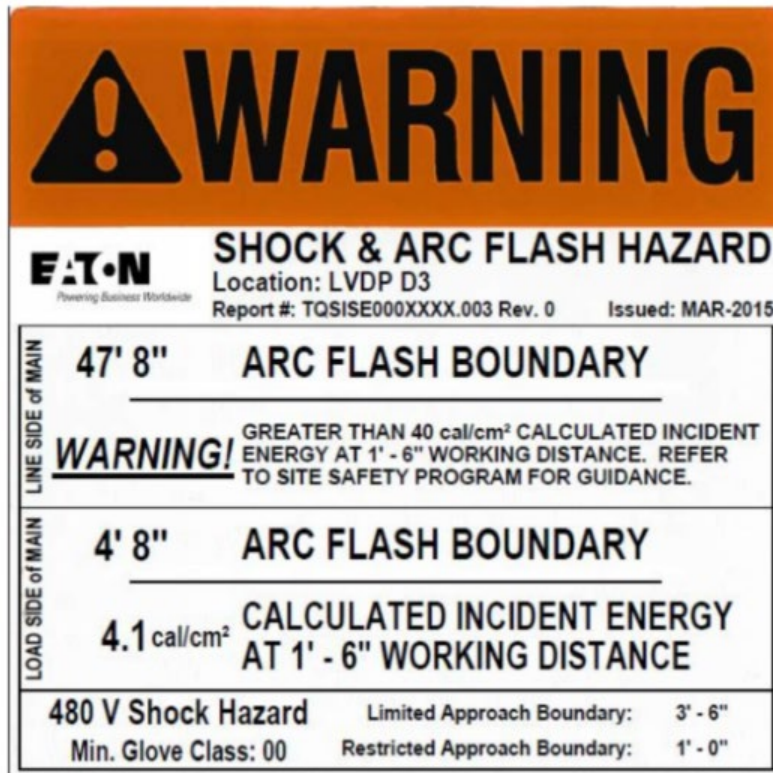
I.

 WARNING	
Arc Flash & Shock Hazard Appropriate PPE Required	
FLASH PROTECTION Arc Flash Boundary _____ Arc Flash PPE Category <u>2</u> Incident Energy (cal/cm²) <u>8</u> Corresponding Work Distance _____ _____ VAC Shock Hazard When: Minimum Arc Rating of Clothing _____ Nominal System Voltage _____ PPE: ☐ Arc-rated long sleeve shirt and long pants OR arc-rated coverall ☐ Arc-rated flash suit hood or arc-rated face shield and arc-rated balaclava ☐ Safety glasses or safety goggles ☐ Leather gloves and footwear ☐ Hard hat ☐ Hearing protection (ear canal inserts) ☐ Arc-rated hard hat liners (as needed)	SHOCK PROTECTION Limited Approach Boundary _____ Restricted Approach Boundary _____ PPE: ☐ Class _____ ☐ V-rating _____ ☐ _____ ☐ _____
Equipment ID: _____	
BRADY #121087 BRADYID.COM Y4061903 	

J.

 DANGER	
 Arc-Flash and Shock Hazards 	
<u>0' - 11.5"</u> - Arc-Flash Boundary <u>0.6 cal/cm²</u> - Incident Energy Arc-Flash Hazard at 18 inches	
Appropriate PPE Required for both Arc-Flash and Shock Hazards: Non-melting or untreated natural fiber long-sleeve shirt & long pants, or coverall; Face shield for projectile protection (AN); Class G or E hard hat (SR); Safety glasses or safety goggles (SR); Hearing protection (ear canal inserts); Heavy-duty leather gloves or Rubber insulating Class 00 Voltage gloves w/ leather protectors (AN); Rubber insulating sleeves (AN); Heavy-duty leather footwear (AN). AN = As Needed SR = Selection Required	
Shock Hazard	<u>480 Vac</u> - Shock Hazard with covers/doors open <u>3' - 6"</u> - Limited Approach Boundary <u>1' - 0"</u> - Restricted Approach Boundary Study Date: 4/2015
1806-PNL B10 Case # 1 0004 PANELBOARD B10	

K.



L. Arc Flash Label Information:

1. Equipment name.
2. Identifier LINE or LOAD where equipment has potential different energy levels.
3. Arc flash hazard information: arc flash boundary and incident energy in cal/cm².
4. Shock hazard information: limited approach and restricted approach boundaries.
5. Personal Protective Equipment (PPE) requirements.
6. Study Supplier, project number, and date.

M. Provide arc flash label sample with preliminary report.

N. Do not be print the labels until equipment is energized and protective devices set according to the approved final protective device coordination study.

2.7 HARMONIC ANALYSIS

A. Comply with IEEE 519 and IEEE 3002.8.

B. Provide a harmonic analysis for all major harmonic producing equipment to determine the harmonic currents and voltages of the electrical distribution system. Include utility and alternate power sources, if applicable. Major harmonic producing equipment includes: RO Feed Pump VFDs.

- C. Provide a harmonic current and voltage profile for the complete electrical distribution system. At a minimum, the voltage profile shall include voltage values at the utility service point, and at each switchgear/switchboard and motor control center bus.
- D. Provide calculations for all operating modes and the following conditions:
 - 1. One profile for all duty equipment running with variable frequency controllers at full speed.
 - 2. One profile for all duty equipment running with variable frequency controllers at 60% speed.
- E. Include in the analysis:
 - 1. Explanation of analysis method.
 - 2. Explanation of analysis and recommendations to meet the specified limits.
 - 3. Calculations and/or computer printouts.
 - 4. Harmonic current and voltage profiles up to the fiftieth harmonic.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the study.
 - 1. Verify completeness of data supplied on one-line diagram. Call any discrepancies to Engineer's attention.
 - 2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
 - 3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be as defined by NFPA 70E.
- B. Gather and tabulate the required input data to support the power system study.
- C. Field data gathering for existing systems shall be under direct supervision and control of the engineer in charge of performing the study and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.
- D. Data included, but are not limited to, the following:
 - 1. Product data for overcurrent protective devices and existing settings.
 - 2. Electrical power utility information. Information required may include:
 - a. Available minimum and maximum three-phase fault current and X/R ratio.
 - b. Available minimum and maximum single-line-to-ground fault current and X/R ratio.
 - c. Service transformer voltage, kVA, and impedance ratings, winding configuration, and grounding method.
 - d. Upstream protective device data.
 - 3. Power sources and ties.

4. For switchgear, switchboards, panelboards, and motor control centers, ampacity and SCCR in amperes RMS symmetrical.
5. For transformers, kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
6. For reactors, manufacturer and model designation, voltage rating, and impedance.
7. For circuit breakers, trip units, and fuses, manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
8. For generators, short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
9. For busways, manufacturer and model designation, current rating, impedance, lengths, and conductor material.
10. For motors, horsepower and NEMA MG 1 code letter designation.
11. Conductor sizes, lengths, number, conductor material, shield parameters for medium voltage cable, and conduit material (magnetic or nonmagnetic).
12. For relays, manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
13. For transfer switches, withstand and closing ratings (WCR) with time duration.
14. Derating factors.

3.2 FIELD QUALITY CONTROL

- A. Do all testing and adjustment prior to the energization of new equipment.
- B. Test existing adjustable protective devices in accordance with NETA MTS.
- C. Test new adjustable protective devices in accordance with NETA ATS.
- D. Adjust existing and new protective devices according to approved coordination study.
- E. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.
- F. After successful testing and adjustment, install calibration sticker with Field Adjusting Agency name, employee initials, and date of calibration at each relay or protective device.
- G. After energization, minor adjustments to settings may be required to commission the equipment.
- H. Submit field report and list any changes made during field adjustment or commissioning for update for record submittal of study.
- I. For adjustable breakers, install sticker listing final adjusted settings, i.e. LTPU, LTD, STPU, STD, INST, GFPU, and GFD.

3.3 ARC FLASH LABELING

- A. After the field adjustment of relays and protective devices, apply arc flash study labels.
- B. Apply arc flash labels on the front covers of the following equipment:

1. Substations and distribution transformers.
 2. Medium voltage switches.
 3. Switchgear, switchboards, and panelboards.
 4. Motor control centers.
 5. Variable frequency controllers.
 6. Disconnect switches.
 7. Transfer switches.
 8. 480V control panels.
- C. Apply arc-flash labels at each section for large equipment such as switchgear and motor control centers.
- D. Install LINE and LOAD arc-flash labels as applicable.
- E. Remove any previous arc flash study labels as applicable and install new labels under the direction of the Power System Analysis Specialist.

END OF SECTION 260573

SECTION 262419 - MOTOR CONTROL CENTER MODIFICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes low-voltage motor control centers, components, and accessories for modifications to existing MCC-1.
- B. Include spares and spaces in equipment as indicated on the Drawings.
- C. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
 - 3. Section 260573 "Power System Studies" for short circuit, coordination, and arc flash.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include descriptive bill of materials, literature, and catalog cut sheets of components and accessories.
 - 2. Include time-current characteristic curves for overcurrent protective devices.
- B. Shop Drawings: For motor control center components, and accessories.
 - 1. Include drawing index.
 - 2. Include dimensioned plans and elevations, showing dimensions, shipping sections, and weights of each assembled section. Show major components and features on elevations. Show locations for conduit entrances, anchor bolts, and leveling channels on plans.
 - 3. Include tabulation of rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories for each MCC cell.
 - 4. Include single-line diagrams.
 - 5. Include wiring and schematic control diagrams.
 - 6. Include nameplate information.

C. Specification Compliance:

1. Include a copy of this specification confirming compliance with each paragraph. For deviations, provide detailed commentary to explain the deviation.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Source quality-control reports.
- C. Field quality-control reports.
- D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For MCCs and accessories to include in emergency, operation, and maintenance manuals. Include the following as applicable:
 1. Manufacturer's written instructions for:
 - a. Testing and adjusting circuit breaker and MCP trip settings.
 - b. Setting field-adjustable overload relays.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.
 3. "As-Built" shop drawings. In addition to requirements specified in UL 845, include field modifications and field-assigned wiring identification incorporated during construction by manufacturer or Contractor.
 4. For each motor controller, a tabular listing including the following:
 - a. Motor data including name, equipment tag, and nameplate full load current.
 - b. "As-Left" settings for adjustable devices such as timers and overcurrent protective devices.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 3. Indicating Lights (lamp and lens cap): Two of each type and color installed.
 4. One dozen each of cover bolts, spring nuts and door fasteners.
- B. Touchup paint: half-pint container of paint matching the enclosure exterior finish.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with the following for delivery, storage, and handling:
 - 1. Manufacturer's instructions.
 - 2. Section 260010 "Supplementary Requirements for Electrical".
 - 3. NECA 402 "Standard for Installing and Maintaining Motor Control Centers".
 - 4. NEMA ICS 2.3 "Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600 Volts".

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace MCCs and accessories that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to equipment manufacturer restrictions listed in Section 260010 "Supplemental Requirements for Electrical", motor control center components from the following manufacturer are approved:
 - 1. Eaton – Freedom Series.
- B. Source Limitations: Obtain motor control centers from single source from single manufacturer.
- C. Modifications or Additions to Existing MCCs: Use original manufacturer for model series still in production; otherwise use original manufacturer or approved manufacturer with documented prior experience providing similar types of modifications.

2.2 GENERAL REQUIREMENTS

- A. Motor control center assembly, ANSI / NEMA rated, and UL 845 labeled for installation on low voltage electrical distribution system indicated on Drawings.

- B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
- C. Comply with the following standards as applicable:
 - 1. NEMA ICS 2, Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts.
 - 2. NEMA ICS 18, Motor Control Centers.
 - 3. UL 489, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
 - 4. UL 845, Motor Control Centers.
 - 5. UL 1066, Power Circuit Breakers up to 1000 V AC and 1500 V DC Used in Enclosures.
 - 6. UL 1008, Transfer Switch Equipment.
 - 7. UL 1449, Surge Protective Devices.
 - 8. UL 61800-5-1, Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal and Energy.
 - 9. UL 61800-5-2, Adjustable Speed Electrical Power Drive Systems – Part 5-2: Safety Requirements – Functional.
- D. Drawings indicate anticipated horsepower and loads and intended control schemes. Provide NEMA size starter, circuit breaker trip ratings, control power transformers, and accessories to match actual approved motors and equipment supplied in accordance with NEC requirements.
- E. Printed circuit boards: Conformal coated to provide environmental robustness.

2.3 SYSTEM DESCRIPTION

- A. Electrical Ratings:
 - 1. Power System: 480Y V ac, three phase, three wire, 60 Hz, solidly grounded. Service entrance requirement as indicated on Drawings.
 - 2. Overall MCC Short Circuit Rating: 65 kA, rms symmetrical at 480 V. Fully rate main and feeder circuit breakers for the specified short circuit duty. Test and UL label motor starter units for the specified short circuit duty as a combination of the branch circuit protective device and the controller.
 - 3. Ampacity: Continuous current of the main horizontal bus as indicated on Drawings. Size vertical busses based on structure load with a minimum rating of 300 A.
 - 4. Bus Bracing: Equal or exceed overall MCC short circuit rating requirement.
 - 5. Temperature: Design MCCs and devices for continuous operation at rated current with a 40 degree Celsius ambient temperature.
 - 6. Control Power: 120 V ac.
 - 7. NEMA Class and Wirings: II B.

2.4 CONSTRUCTION

A. Structure:

1. Free-standing, dead-front, metal enclosed, front accessible only, assembly of vertical sections, bolted together to form double wall construction between sections, and bolted to form a rigid assembly. Unless otherwise indicated on drawings, nominal dimensions of vertical sections are 90 inches high, 20 inches wide, and 20 inches deep. Incoming feeder location as indicated on Drawings.
2. Mount bottom channel sills at front and rear of vertical sections extending full width of each shipping split.
3. Include provisions for additional sections at the end sections for future expansion and provide full depth cover plates (rodent barriers) at each end of the MCC channel sills.
4. Provide continuous top and bottom horizontal wireways extending the full width of the line-up, isolated from the horizontal main bus. Provide a 4 inch wide, full height, vertical wireway in each section, equipped with a hinged door and cable supports. Isolate vertical wireway from the bus and device compartments. Wireways openings shall have rolled edges or protective grommets.
5. Provide individual, flange formed, pan type door with concealed hinges and quarter turn latches for each device compartment and future space. Doors shall be removable. Door removal shall not be required to withdraw starter units or feeder tap devices.
6. Design MCC for against the wall or back-to-back mounting. Access to wiring, bus joints, or other parts that require tightening or other maintenance to be from the front or top.
7. Spaces designated as SPACE or BLANK shall include blank hinged doors, empty mounting unit and vertical bus bars.
8. Provide disconnect handle extensions to meet NEC requirements when MCC is located on 4-inch high housekeeping pad.

B. Maximum Dimensions: As indicated on drawings.

C. Exterior Enclosure Finish: Factory-applied finish in manufacturer's standard color over a rust-inhibiting primer on treated metal surface.

D. Interior Enclosure Finishes:

1. Control and power cell compartment: high gloss white for easier visibility.
2. Unpainted steel parts, plated for corrosion resistance.

E. When wires or buswork passes through holes or sections, add suitable guarding or grommets for close fit and to prevent cutting or chafing of insulation.

F. Unit Compartments:

1. Provide individual compartments for each removable combination starter and feeder tap device unit. Minimum compartment height for size 1 or size 2 combination starters: 12-inches. Isolate top, bottom, and sides of each compartment from adjacent units and wireways. Connect removable units to the vertical bus in each section with tin plated, self-aligning, pressure type copper plug connectors. Align removable units in the structure on guide rails or shelves and secure with a cam latch mechanism to racking screw. Size 5 and larger starter units may be wired directly to the bus.

2. Provide individual, isolated compartments for all fixed mounted devices including circuit breakers, cable lugs, metering, relaying and control devices. Wire main and bus tie circuit breakers directly to the main horizontal bus. Fully rate bus connections.
3. Provide the following features:
 - a. Provision to padlock removable units in a partially withdrawn TEST position, with the bus stabs disengaged.
 - b. Provision to padlock unit disconnect handles in the OFF position with up to three padlocks.
 - c. Mechanical interlock with bypass to prevent opening unit door with disconnect in the ON position, or moving disconnect to the ON position while the unit door is open.
 - d. Mechanical split type terminal blocks for disconnecting external control wiring.
 - e. Auxiliary contact on unit disconnect to isolate control power when fed from an external source.
 - f. Disconnect operating handles and control devices mounted on the removable units.

G. Bus Systems:

1. Main horizontal bus: Tin plated copper, bolted joints, accessible from the front of the structure, fully rated throughout the lineup. Braced for 65,000 A rms unless otherwise noted on Drawings. Full size neutral bus for four wire systems if indicated on Drawings.
2. Vertical section bus: Tin plated copper, full height. Insulated and isolated barrier system (labyrinth design) to prevent fault propagation. Include automatic shutters to cover stab openings when units are withdrawn. Provide fish tape barriers to isolate bottom wireways from lower ends of vertical bus.
3. Vertical buses used for a tie circuit breaker or tie feeder lugs shall be rated for a continuous capacity equivalent to the main horizontal bus rating.
4. Horizontal ground bus: Provide a 1/4-inch by 2-inch (minimum) tin plated copper uninsulated ground bus in each section equipped with lugs for termination of feeder and branch circuit ground conductors. Connect to ground bus in adjacent sections with splice plates.

H. Control and Secondary Wiring:

1. Wire: Stranded copper, type MTW. Minimum size No. 14 AWG.
2. Control Wire Terminations: Insulated locking spade terminals, except where saddle type terminals are provided integral to device. Current transformer secondary leads must connect to shorting type terminal blocks before connecting to another device.

2.5 IDENTIFICATION

- A. Signs and Nameplates: Engraved, laminated plastic, stainless steel screw attachment, background color and letters as noted herein.
- B. Danger Sign: Marked "DANGER 480 VOLTS KEEP OUT". Lettering not less than 1-inch high, red background, white letters. Locate at top center of MCC lineup horizontal wireway.

- C. Master Nameplate: MCC designation, service ratings, factory order number, and date (month/year) of manufacture. Lettering not less than 3/8-inch high, black background, white letters. Locate at top of MCC section containing incoming feed.
- D. Unit Compartment Nameplates: Designation as indicated on drawings. Lettering not less than 3/8-inch high, black background, white letters.
- E. Special Nameplates: Compartments with voltages from sources outside of the compartment mark "CAUTION THIS UNIT CONTAINS A VOLTAGE FROM AN EXTERNAL SOURCE". Lettering high visibility yellow background, black letters.
- F. Identify pilot devices and operators using legend plates or nameplates.
- G. Identify internal components, corresponding to wiring diagrams.
- H. Include warning labels on terminals that are energized with the power disconnect OFF.
- I. Control Wire Identification: Typed sleeve type labels at each end, corresponding to wiring diagrams. Wiring less than six inches may be numbered at only one end. Foreign voltage control wiring shall be yellow.
- J. Laminated wiring diagrams fastened to the inside of each compartment door.
- K. Include circuit directory card and holder for compartments containing panelboards.

2.6 CIRCUIT BREAKERS

- A. Circuit breakers 800 A frame and larger: 600 V, insulated-case type, listed and labeled to UL 489, 100 percent continuous ampacity. Temperature insensitive, true RMS, integral, fully adjustable solid state electronic trip unit with the following features:
 - 1. Independently adjustable long time pick-up and delay.
 - 2. Independently adjustable short time pick-up, delay, and I²t settings.
 - 3. Adjustable instantaneous pick-up.
 - 4. Independently adjustable ground fault pick-up, delay and I²t settings.
 - 5. Trip mode targets for over load, short circuit and ground fault.
 - 6. Long time pick up light.
- B. Circuit breakers 400 A and 600 A frame: 600 V, molded-case type, listed and labeled to UL 489, 80 percent continuous ampacity rated. Temperature insensitive, true RMS, integral, fully adjustable solid state electronic trip unit with the following features:
 - 1. Independently adjustable long time pick-up and delay.
 - 2. Independently adjustable short time pick-up, delay, and I²t settings.
 - 3. Adjustable instantaneous pick-up.
 - 4. Independently adjustable ground fault pick-up, delay and I²t settings.
 - 5. Trip mode targets for overload, short circuit and ground fault.
 - 6. Long time pick up light.

- C. Circuit breakers 250 A and 400 A frame: 600 V, molded-case type, listed and labeled to UL 489, 80 percent continuous ampacity rated. Temperature insensitive, true RMS, integral, fully adjustable solid state electronic trip unit with the following features:
 - 1. Independently adjustable long time pick-up and delay.
 - 2. Adjustable instantaneous pick-up.
 - 3. Independently adjustable ground fault pick-up, delay and I^2t settings.
 - 4. Trip mode targets for over load, short circuit and ground fault.
 - 5. Long time pick up light.
- D. Circuit breakers 225 A frame and less: 600 V, molded-case type, listed and labeled to UL 489, 80 percent continuous ampacity rated. Thermal magnetic trip.

2.7 COMBINATION STARTER UNITS

- A. Description: Combination starter includes motor circuit protector (MCP) in series with a motor controller and an overload protective device. Provide MCP with adjustable magnetic trip range up to 1000 percent of rated continuous current and a trip test feature. MCP listed and labeled to UL 489.
- B. Motor Starters: Three pole, 600 V, electrically operated, of the type shown on Drawings. NEMA size as required for the horsepower shown on the Drawings, minimum NEMA 1 size starter. IEC starters are unacceptable. Starters to include 120 Vac encapsulated operating coils; individual control power transformers with primary and secondary fuses; and cadmium oxide renewable line contacts.
- C. Motor Overload Protection: Self-powered solid state overload relay, ambient temperature insensitive, manual reset, push to push, overload class (10, 20, 30) selectable, to protect motor from overloads. Submersible pumps set for Class 10 protection and other motors set for Class 20 protection. Include tamper guard over trip adjustment setting. Reset on exterior door of controller. Provide auxiliary alarm contacts where shown on Drawings. Additional requirements:
 - 1. Protection features:
 - a. Phase loss.
 - b. Ground fault.
 - c. Jam.
 - d. Current imbalance.
 - 2. Diagnostic features:
 - a. Percent full load amperes.
 - b. Percent thermal capacity utilization.
 - c. Voltage.
 - d. Power.
 - 3. Network Communications: No.

2.8 STARTER/CONTROLLER AUXILIARY DEVICES

- A. Control-Circuit and Pilot Devices: As indicated on Drawings, mounted on controller compartment door. Comply with NEMA ICS 5.
 - 1. Control Operators: Heavy duty, full size, 30 mm, oiltight, NEMA A600 contact rating.
 - 2. Indicator lights: Full size, 30 mm, oiltight, LED type with push to test function.
- B. Elapsed-Time Meters: Heavy duty with digital readout in hours; non-resettable.
- C. Auxiliary Contacts: Form C, NEMA A600 rating, number and configuration as required by control schemes shown on Drawings. In addition, provide two spare reversible contacts NC/NO per starter.
- D. Relays:
 - 1. Control relays shall be 10 amp rated contacts (minimum), 11 pin with mounting base, 3PDT (minimum) with LED indicators to show relay status.
 - 2. Timing relays shall be solid state, with pin (

2.9 NETWORK COMMUNICATIONS

- A. Include interfacing hardware, cables, connectors, software, etc. for communication with SCADA system specified in Division 40.
- B. Motor control will be via hardwired signal.

2.10 SOURCE QUALITY CONTROL

- A. Test and inspect equipment according to UL, NEMA, and manufacturer.
- B. Factory inspection and witness.
 - 1. Make completed controllers available for inspection at manufacturer's factory prior to packaging for shipment.
 - 2. Notify engineer a minimum of two weeks prior to travel requirement.
- C. Physical inspection:
 - 1. Verify compliance with drawings and specifications.
 - 2. Verify nameplates, labels, and identification.
 - 3. Verify isolation barriers are present to protect personnel and equipment.
 - 4. Verify bus and connections have proper clearance and torque.
 - 5. Verify tightness of control and power wires.
 - 6. Verify mechanical interlocks.
- D. Electrical tests:
 - 1. Perform functional and continuity checks.

2. Perform dielectric withstand test on buswork and power cable (phase-to-phase, phase-to-ground).
 3. Perform I/O check and functionality operation per diagrams.
 4. Test functionality of protective relays, meters, instruments, controls.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Upon delivery of equipment and prior to unloading, inspect equipment for damage.
- B. Examine areas and surfaces to receive MCCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
- C. Verify that ground connections are in place and that requirements in Section 260526 “Grounding and Bonding for Electrical Systems” have been met.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer’s published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturer’s published instructions, comply with the following:
 1. NECA NEIS 402 – Standard for Installing and Maintaining Motor Control Centers.
 2. NEMA ICS 2.3 – Instructions for the Handling, Installation, Operation, and Maintenance of MCCs Rated Not More Than 600 Volts.
- C. Remove temporary lifting angles, lugs, and shipping braces. Touch up damaged paint finishes.
- D. Conduit entering or leaving an MCC from underground is to be stubbed up into the bottom horizontal wireway directly below the vertical section in which the conductors are to be terminated or likewise use the top horizontal wireway when entering the MCC from above. Do not enter the MCC from the side unless approved in writing by the Engineer.
- E. Grounding and Bonding:
 1. Bond equipment ground bus to grounding electrode system as shown on Drawings.
 2. Bond all conduits including stub-ups to the equipment ground bus.
- F. Install conduits to prevent water from entering enclosure. Seal voids around conduit stub-ups.

- G. Neatly group field installed interior wiring by circuit using plastic tie wraps. Support circuit groups to avoid stress at terminations.
- H. Make wiring interconnections between shipping splits. Install bus splice plates.
- I. Tighten bolted connections and wiring connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- J. Switch operating handles located above 79 inches above operating floor to have operating arm extension.
- K. Obtain the manufacturer's services for the commissioning and startup work.

3.3 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems".
 - 1. Identify equipment by name designation and fed from source nameplates.
 - 2. Identify field-installed conductors, interconnecting wiring, and components.
 - 3. Provide as built typed panelboard directory where applicable.
- B. Install Arc Flash Labels in accordance with Section 250573 "Power System Studies".

3.4 FIELD QUALITY CONTROL

- A. Division of Responsibilities:
 - 1. Provide installation and assist with all testing and startup activities.
 - 2. Engage factory authorized service representative to assist in installation, inspection, testing, startup, and commissioning activities specified herein to active manufacturer's warranty.
- B. General Requirements:
 - 1. Perform inspection, testing, and startup activities recommended by and in accordance with manufacturer's instructions, NETA ATS, and as specified herein.
 - 2. Perform testing and test methods in compliance with NFPA 70B.
 - 3. Optional NETA ATS tests are not required unless specifically called for in this specification or the manufacturer's instructions.
 - 4. Provide materials and labor as necessary.
 - 5. Correct deficiencies, adjust, and retest until requirements are met.
 - 6. Provide written report for each field testing or service visit.
- C. Visual and Mechanical Inspection:
 - 1. Confirm equipment and devices conform to approved shop drawings.
 - 2. Inspect physical and mechanical condition.
 - 3. Inspect anchorage, alignment, and grounding. Adjust compartment doors as required.
 - 4. Verify tightness of accessible bolted electrical connections. Use calibrated torque wrench.

5. Verify unit is clean.
6. Verify smooth and correct operation of mechanical devices: interlocks, shutters, etc.

D. Electrical Tests:

1. Insulation resistance test of bus, phase to phase and phase to ground after disconnecting devices sensitive to test voltage.
2. Check polarity and continuity of metering and relaying circuits.
3. Test ground connections for continuity and resistance.
4. Test protective devices and equipment as recommended by manufacturer.
5. Verify correct input and output voltages, currents, and phase rotations.

E. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each MCC line-up.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. Perform follow-up infrared scan of equipment, at 11 months after Substantial Completion.
3. Prepare a certified report identifying equipment checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

F. MCCs will be considered defective if they do not pass tests and inspections.

3.5 STARTUP AND COMMISSIONING SERVICE

A. The following items must be complete prior to startup service:

1. Driven equipment installed and ready for loading.
2. Associated SCADA system installed and programmed.

B. Engage a factory-authorized service representative to perform startup and system commissioning service to verify complete and correct operation of sensing devices, alarms, indicating devices, and communication to plant SCADA system.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Field test hardwired discrete and analog connections and any digital communication signals connected to verify proper operation locally and at the plant SCADA system.

C. Adjust the following as applicable:

1. Protective devices in accordance with the final approved submittal of Section 260573 "Power System Studies".
2. Motor overloads based on actual motor nameplate information.
3. Set field-adjustable time-delay relays and switches as needed by the driven load and Owner requirements.

D. Clear events memory after successful startup.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to demonstrate correct operation, adjust settings, and maintain MCCs to Owner.

3.7 CLEANING

- A. Remove rubbish and debris from inside and around the equipment. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint-free rags. Do not use compressed air.

END OF SECTION 262419

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SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Cartridge fuses rated 600 V ac and less for use in the following:

- a. Enclosed switches.

- B. Related Requirements:

- 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components. Include the following for each fuse type indicated:

- 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 3. Current-limitation curves for fuses with current-limiting characteristics.
 - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in PDF format.
 - 5. Coordination charts and tables and related data.
 - 6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Ambient temperature adjustment information.
 - 2. Current-limitation curves for fuses with current-limiting characteristics.
 - 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in PDF format.
 - 4. Coordination charts and tables and related data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 FIELD CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Bussman (Eaton)
 - 2. Littlefuse
 - 3. Mersen
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 - 1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.

2. Type RK-5: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
 3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, fast acting.
 4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC, fast acting.
 5. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
 6. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.
 7. Type T: 600-V, zero- to 800-A rating, 200 kAIC, time delay.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
1. Service Entrance: Class T, fast acting.
 2. Feeders: Class RK1, time delay.
 3. Motor Branch Circuits: Class RK1, time delay
 4. Large Motor Branch (601-4000 A): Class L, time delay.
 5. Power Electronics Circuits: Class J, high speed.
 6. Other Branch Circuits: Class RK5, time delay
 7. Control Transformer Circuits: Class CC, time delay, control transformer duty.
 8. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Enclosures.

- B. Related Requirements:

- 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and field conditions applicable to Work specified in this Section.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.

5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Data: Certificates, for enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2010 m).

1.10 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2.2 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by UL or a NRTL if approved by the Owner and/or Engineer and marked for intended location and application.
- D. Comply with NFPA 70.

2.3 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Eaton
 - 2. Schneider Electric (Square D)
 - 3. ABB
- B. Type HD, Heavy Duty:
 - 1. Single throw.
 - 2. Three pole.
 - 3. 600-V ac.
 - 4. 200 A and smaller.
 - 5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
 - 6. Lockable handle with capability to accept three padlocks and interlocked with cover in closed position.
- C. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
 - 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
 - 6. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 7. Lugs: Mechanical type, suitable for number, size, and conductor material.
 - 8. Service-Rated Switches: Labeled for use as service equipment.

2.4 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Eaton
 - 2. Schneider Electric (Square D)
 - 3. ABB
- B. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

- C. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Type HD, Heavy Duty, Three Pole, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- F. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
 - 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
 - 6. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 7. Lugs: Mechanical type, suitable for number, size, and conductor material.
 - 8. Service-Rated Switches: Labeled for use as service equipment.

2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint or Owner approved color and paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1) a brush finish on Type 304 stainless steel (NEMA 250 Type 4-4X 316 stainless steel or fiberglass if approved by Owner and Engineer).
- C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.
- D. Operating Mechanism: The switch/circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- E. Enclosures designated as NEMA 250 Type 4, 4X 316 stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when

the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Owner's written permission.
 - 4. Comply with NFPA 70E.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 4X.
 - 3. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4X.
 - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.4 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

- C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in fusible devices.
- F. Comply with NFPA 70 and NECA 1.

3.5 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Perform tests and inspections.
- D. Tests and Inspections for Switches:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that the unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.
 - f. Verify that each fuse has adequate mechanical support and contact integrity.
 - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's

published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

- h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
 - i. Verify correct phase barrier installation.
 - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
 - 2. Electrical Tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
 - e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."
 - 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 4. Perform the following infrared scan tests and inspections and prepare an Initial and Follow-up report:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

END OF SECTION 262816

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SECTION 262923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of either constant or variable torque loads.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
 - 3. Section 260573 "Power System Studies" for harmonic study requirements.
 - 4. Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits" for performance requirements of VFC manufacturer provided SPDs.
 - 5. Section 432331.41 "Vertical In-Line Multistage Centrifugal Pump" for pump requirements.
- C. Supplier and Compatibility with Driven Equipment:
 - 1. Manufacturer of VFC to coordinate with the driven equipment characteristics.
 - 2. VFCs on project to be by single manufacturer.
 - 3. VFC to be provided by driven equipment supplier.

1.3 DEFINITIONS

- A. VFC: Variable-frequency motor controller. See VFD.
- B. VFD: Variable-frequency drive. Used interchangeably with the term VFC.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type and rating of VFC indicated.
 - 1. Include descriptive bill of materials, literature, and catalog cut sheets of equipment and accessories.
 - 2. Include time-current characteristic curves for overcurrent protective device (OCPD).

B. Shop Drawings: For each VFC indicated.

1. Include physical characteristics:
 - a. Dimensions, weights, and required clearances.
 - b. Views showing front elevations with designation of devices and internal layout of components.
 - c. Mounting and attachment details.
 - d. Conduit entry and size locations.
 - e. Enclosure rating and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics:
 - a. Voltage, Ampacity, and power.
 - b. Fault ratings.
 - c. Maximum heat dissipation.
 - d. Efficiencies and power factor.
3. Include diagrams for power, signal, and control wiring.

C. Specification Compliance:

1. Include a copy of this specification confirming compliance with each paragraph. For deviations, provide detailed commentary to explain the deviation.
2. Include completed coordination statement.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Seismic Qualification Data: Certificates, for each VFC, accessories, and components, from manufacturer.
 1. Certificate of compliance.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.
- C. Product Certificates: For each VFC from manufacturer.
- D. Manufacturer Harmonic Estimate Report: Provide a harmonic estimation report (analysis) prior to release for manufacturing to confirm the harmonics mitigation solutions submitted meet the performance requirements contained in the HARMONICS Article.
- E. Source quality-control reports.
- F. Field quality-control reports.
- G. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.
 - 1. Include the following as applicable:
 - a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
 - b. Manufacturer's written instructions for setting field-adjustable overload relays.
 - c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
 - d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
 - e. For each VFC, a table listing of the “as left” drive set up parameters, timing relay settings, alarm, and trip set points.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 - 3. Indicating Lights: Two of each type and color installed.

1.8 QUALITY ASSURANCE

- A. Manufacturer of VFCs must be ISO 9001 certified or have a quality management system in place comparable to the requirements of ISO 9001.
- B. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to equipment manufacturer restrictions listed in Section 260010 "Supplemental Requirements for Electrical", VFCs from the following manufacturers are approved:
 - 1. Eaton.
 - 2. Yaskawa.

2.2 SEISMIC REQUIREMENTS

- A. Seismic Performance: VFCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The designated VFCs shall be tested and certified by an NRTL as meeting the ICC-ES AC 156 test procedure requirements.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified."

2.3 HARMONICS

- A. VFC construction shall control the power distribution system harmonics by limiting the current distortion level at the unit's input terminal to the levels listed in IEEE 519. The point of common coupling (PCC) for the purposes of this specification are defined as input lugs of the drive solution. The maximum short circuit current (Isc) for the purposes of this specification is defined as the short circuit interrupting rating listed within this Section.
- B. VFCs rated 100 HP and below shall include an input line reactor as detailed in the POWER CONDITIONING Article.
- C. VFCs rated 100 HP and above shall be 18-pulse, buffered design with input phase shifting transformer as detailed in the POWER CONDITIONING Article. Active front end drives or low harmonic drive designs that achieve equivalent performance in reducing input current harmonic content and protecting against power line transients will be acceptable.
- D. All VFCs shall include as a minimum an output dV/dT filter as detailed in the POWER CONDITIONING Article.
- E. VFCs that require sinewave output filters as detailed in the POWER CONDITIONING Article shall be indicated on the Drawings.

2.4 GENERAL REQUIREMENTS

- A. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. Comply with the following standards as applicable:
1. NEMA ICS 7, Industrial and Control Systems: Adjustable-Speed Drives.
 2. UL 489, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
 3. UL 508, Industrial Control Equipment.
 4. UL 508A, Industrial Control Panels.
 5. UL 61800-5-1, Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal and Energy.
 6. UL 61800-5-2, Adjustable Speed Electrical Power Drive Systems – Part 5-2: Safety Requirements – Functional.
- C. Application and compatibility: Constant or variable torque as indicated by application. VFC to supply required full load current and torque to supplied driven equipment.
- D. VFC Description: Variable-frequency motor controller, air cooled, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of driven load motor by adjusting output voltage and frequency.
- E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs including clearance between VFCs and adjacent surfaces and other items. Comply with indicated maximum dimensions.

2.5 RATINGS

- A. Environment:
1. Elevation: Up to 3,300 feet without derating.
 2. Ambient Air Temperature: 0 to 40 degrees Celsius without derating.
 3. Relative Humidity: Less than 95 percent, non-condensing.
- B. Electrical Characteristics:
1. Nominal Input Power: 480 Volts, 3 phase, 60 Hz.
 2. Input Voltage Variation: Plus, or minus 10 percent, maximum 2 percent imbalance.
 3. Input Frequency Variation: Plus, or minus 5 percent.
 4. Overall Short Circuit Current Rating: 65 kA minimum or as noted on the Drawings.
 5. Output Rating: To power 460 Volt, three phase motor, 0.1 to 60 Hz for variable torque loads, 0.1 to 66 Hz for constant torque loads.
 6. Output Speed Regulation: Plus, or minus 0.5 percent, without encode or tachometer feedback.
 7. Overtorque: Variable torque loads 110 percent for 60 seconds, constant torque loads (heavy duty) 150 percent for 60 seconds.
 8. Output Current: Continuous output current equal to or greater than the motor full load nameplate current.

2.6 ENCLOSURES

- A. Free standing or wall mounted, front accessible only, with hinged front door. Ventilated enclosures to be front ventilated. Conduit entry location may be either from below or above.
- B. NEMA 250 Enclosure Type: As indicated on the Drawings.
- C. Internal Temperature and Moisture Control:
 - 1. Derive power for cooling fans, air conditioners, or space heaters from internal control power transformer.
 - 2. Design cooling/heating solution to maintain internal component temperature requirements and mitigate condensation when drive is shut down but main disconnect is on, providing control power.
 - 3. Include sun shields on fronts, sides, and tops of outdoor enclosures exposed to direct sunlight, factory painted white.
- D. Interior switchable LED cabinet light for each cabinet section for enclosures 90 inches high and 30 inches width or larger.
- E. Floor mounted enclosures to have 18 inch minimum clear space in bottom of the cubical for line, motor and field cable terminations. Wall mounted enclosures to have 12 inch clear space in bottom of the enclosure for line, motor and field cable terminations.

2.7 MAIN DISCONNECT

- A. Integral Input Disconnecting Means and Overcurrent Protective Device: Molded case circuit breaker, UL 489, thermal-magnetic trip, with pad-lockable, door-mounted flange-mount style handle mechanism, interlocked with door(s) to prevent access to energized components. Minimum interrupting rating 65 kA.
- B. Disconnect Location: Locate disconnect to not exceed NEC maximum height requirements when VFC enclosure is placed on four inch high housekeeping pad.

2.8 SURGE PROTECTION

- A. Integral Surge Protective Device: To protect input AC line from transients.
 - 1. By VFC manufacturer, factory installed.
 - 2. Type 2.
 - 3. SCCR: Equal to SCCR of VFC.
 - 4. Performance: Comply with Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits".

2.9 POWER CONDITIONING

- A. Input Line Reactor: Five (5) percent impedance input line reactor to reduce input current harmonic content, provide protection from power line transients such as utility power factor correction capacitor switching transients, and reduce RFI emissions or an equivalent internal

DC bus choke (reactor) to achieve the same performance as the line reactor specified. Line reactors to be UL recognized or approved. Line reactors to be installed in the VFC enclosure and come factory wired.

- B. 18-Pulse Drive: Buffered drive with phase-shifting transformer to substantially reduce input harmonic currents over 6-pulse or 12-pulse designs. Transformer to be dry type, self-ventilated, suitable for rectifier service, with high temperature alarm indication. Impedance per drive system designer. Transformer to be installed in the VFC enclosure and come factory wired.
- C. DV/DT Output Filter: Comprised of passive components to limit peak voltage at the motor terminals to 150 percent or less of the VFC DC bus voltage for motor leads up to 1000 feet. Maximum dV/dT of the waveform pulses at the motor terminal to be 200 volts per microsecond. Filter to be UL recognized or approved. Maximum insertion loss of 3 percent of rated voltage. Rated for 100 percent continuous RMS current and 150 percent for 60 seconds. Filter to be installed in the VFC enclosure and come factory wired.
- D. Sinewave Output Filter: Comprised of passive components to provide a near perfect sinewave at the motor allowing for the use of non-inverter duty rated motors, elimination of the requirement for shaft grounding rings at motors and allowing for motor leads up to 15,000 feet. Maximum harmonic voltage distortion of 5 percent at switching frequency of 2 kHz. Filter to be UL recognized or approved. Maximum insertion loss of 6 percent of rated voltage. Rated for 100 percent continuous RMS current and 150 percent for 60 seconds. Filter to be installed in the VFC enclosure and come factory wired.

2.10 ADJUSTABLE SPEED MOTOR CONTROL

- A. Motor Compatibility: Capable of controlling the process motor specified in other Sections, including general purpose motors and inverter duty motors.
- B. Loss of Load Sensing: Capable to sense loss of load (broken belt / broken coupling / dry pump) and signal loss of load condition via HMI interface or over communications network.
- C. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
- D. Power-Interruption Ride-Through: A power outage of up to 5 cycles in duration will not cause the drive to shut down.
- E. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
- F. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.
- G. Bidirectional Autospeed Search (Flying Start): Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

- H. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- I. Motor Temperature Compensation at Slow Speeds: Adjustable current fallback based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- J. Switching (Carrier) Frequency: Selectable.
- K. Skip Frequencies: Three programmable critical frequency or critical speed lockout ranges to prevent the VFC operating continuously at an undesirable speed range.
- L. Stop Modes: Programmable, multiple modes including safe torque off (STO), coast, and DC-brake.
- M. Acceleration / Deceleration: Programmable, independent, and adjustable from 0 to 600 seconds.
- N. Inverter Logic: Microprocessor based, isolated from power circuits.
- O. Galvanic Isolation: Isolation between power and control (inputs, outputs, and power supplies) circuits.
- P. Additional Protections:
 - 1. Short-circuit protection.
 - 2. Loss-of-phase protection.
 - 3. Reverse-phase protection.
 - 4. Ground-fault protection.
 - 5. DC bus protection.
 - 6. Under- and overvoltage trips.
 - 7. VFC overload and overtemperature alarm and trip.
 - 8. Motor overload and overtemperature alarm and trip.

2.11 CONTROLS AND INDICATION

- A. As a minimum, provide the following controls and indication via VFC keypad/display, pilot devices, or both when indicated on the Drawings. Refer to the Contract Drawings for additional requirements.
 - 1. POWER ON, VFD RUN, and VFD READY indication.
 - 2. VFD FAULT indication.
 - 3. Local/Remote or Hand/Off/Auto control mode selector switch.
 - 4. Push-pull maintained contact EMERGENCY STOP pushbutton.
 - 5. Manual START/STOP control.
 - 6. Manual speed adjust capability.
 - 7. Five digit, non-reset, elapsed time meter.
 - 8. Speed indication.
 - 9. Speed control through potentiometer-type dial.

- B. Pilot Devices: As indicated on Drawings, mounted on cabinet door.
 - 1. Control operators: Heavy duty, full size, 30 mm, oiltight, NEMA A600 contact rating.
 - 2. Indicator lights: Full size, 30 mm, oiltight, LED type with push to test function.
- C. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
 - 1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
 - 2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
 - a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.
- D. Digital Display Information:
 - 1. Real-time clock with current time and date.
 - 2. Running log of total power versus time.
 - 3. Total run time.
 - 4. Fault log, maintaining last eight faults with time and date stamp for each.
 - 5. Input current (three phases).
 - 6. Input voltage (three phases).
 - 7. Output current (three phases).
 - 8. Output voltage (three phases).
 - 9. Output frequency (Hz).
 - 10. Kilowatts.
 - 11. Motor speed (rpm).
 - 12. Motor torque (percent).
 - 13. Motor status (running, stop, fault).
 - 14. Fault or alarming status (code).
 - 15. Speed control signal (percent).
 - 16. DC-link voltage (V dc).
 - 17. Set point frequency (Hz).
 - 18. Drive temperature.
- E. Discrete and Analog Hardwired Control Signals:
 - 1. Inputs:
 - a. Two programmable analog inputs: 4- to 20-mA dc.
 - b. Dedicated terminal blocks to interface with remote operator and field devices.
 - c. 120 V ac control to interface with remote contacts and with two or three wire control.
 - d. Additional inputs as required by Division 40 or 43 and as shown on the Drawings.

2. Outputs:

- a. Two programmable analog outputs: 4- to 20-mA dc.
- b. Run relay with set of form C contacts.
- c. Dry contact output (N.O.) to indicate protective function trip.
- d. Dry contact output (N.O.) to indicate common alarm.
- e. Additional outputs as required by Division 40 or 43 and as shown on the Drawings.

F. Ethernet Communications Port: RJ-45.

G. SCADA System Interface:

1. Include interfacing hardware, cables, connectors, software, etc. for control and monitoring of VFC via SCADA system. Coordinate with SCADA system specified in Division 40.
2. Control will be via hardwired signal.
3. Digital communication signal will utilize copper Ethernet cable using Ethernet/IP communications protocol. Communication between individual VFCs and SCADA system will be in a star configuration.
4. Provide 24 V dc UPS / battery backup to allow ride-through control during plant generator start and transfer, up to 60 second power interruption.

2.12 ADDITIONAL CONSTRUCTION REQUIREMENTS

- A. Control Power Transformer: Two winding type, 120 VAC secondary, fused on primary and secondary, secondary grounded. Extra capacity when indicated on Drawings.
- B. Control Wiring:
 1. Wire: 600 Volt, stranded copper, 105 degree C color coded insulation, minimum size No. 14 AWG (120 VAC control power only).
 2. Terminations: Crimp type wire lugs.
- C. Relays:
 1. Control relays shall be 10 amp rated contacts (minimum), 11 pin with mounting base, 3PDT (minimum) with LED indicators to show relay status.
 2. Timing relays shall be solid state, with pin (octal) and bases.
- D. Buswork: Tin plated copper.
- E. Grounding: Ground bus or lug connectors in each structure, suitable for copper grounding conductors shown on Drawings.
- F. Provide barriers on terminals that remain energized with the main disconnect OFF.
- G. Conformal coat circuit boards, vulnerable components, and termination points to help protect them from hydrogen sulfide gases.

H. Identification:

1. Identify VFC with nameplate, 3/8-inch high letters, black letters on white background.
2. Identify pilot devices and operators using legend plates or nameplates.
3. Identify internal components, corresponding to wiring diagrams.
4. Identify control wiring at each end with typed sleeve type labels corresponding to wiring diagrams. Wiring less than 6 inches may be numbered at only one end.
5. Include warning labels on terminals that are energized with the power disconnect OFF.

- I. Accessories: Integrate pump and motor protection temperature / vibration modules as specified in Division 43.

2.13 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect VFCs according to requirements in UL 61800-5-1 or manufacturer's standards.
- B. VFCs will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and surfaces to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, conduit entry locations, and other conditions affecting performance of the Work.
- B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's published instructions. Level and anchor equipment. Remove temporary lifting angles, lugs and shipping braces. Touch up damaged paint finishes.
- B. Circuit breaker operating handles located above 79 inches above operating floor shall have operating arm extension.
- C. Maintain adequate clearance between power and signal wiring to avoid electro-magnetic interference on signal cables.

3.3 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Identify equipment by name designation and fed from source nameplates.
 - 2. Identify field-installed conductors, interconnecting wiring, and components.
- B. Install Arc Flash Labels in accordance with Section 250573 "Power System Studies".

3.4 FIELD QUALITY CONTROL

- A. Division of Responsibilities:
 - 1. Provide installation and assist with all testing and startup activities.
 - 2. Engage factory authorized service representative to assist in installation, inspection, testing, startup, and commissioning activities specified herein to active manufacturer's warranty.
 - 3. Engage a qualified testing agency as defined in this Section to perform activities defined in Section 260800 "Commissioning of Electrical Systems".
- B. Perform inspection, testing, and startup activities recommended by and in accordance with manufacturer's instructions, NETA ATS, and as specified herein. Provide materials and labor as necessary. Correct deficiencies, make adjustments, and retest until requirements are met. Provide written report for each field testing or service visit.
- C. Visual and Mechanical Inspection:
 - 1. Compare VFC and motor nameplate data and confirm compatibility.
 - 2. Inspect physical and mechanical condition.
 - 3. Inspect anchorage, alignment, and grounding.
 - 4. Verify tightness of accessible bolted electrical connections. Use calibrated torque wrench.
 - 5. Verify unit is clean and ventilation pathways clear.
- D. Electrical Tests:
 - 1. Test input circuit breaker by primary injection.
 - 2. Test protective parameters as recommended by manufacturer.
 - 3. Verify correct input and output voltages, currents, and phase rotations.
- E. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFC.
 - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
 - 2. Perform follow-up infrared scan of VFCs, at 11 months after Substantial Completion.
 - 3. Prepare a certified report identifying VFC checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

- F. VFCs will be considered defective if they do not pass tests and inspections.

3.5 STARTUP SERVICE

- A. The following items must be complete prior to startup service:
1. Driven equipment installed and ready for loading.
 2. Associated SCADA system installed and programmed.
- B. Engage a factory-authorized service representative to perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Field test hardwired discrete and analog connections and any digital communication signals connected to verify proper operation. Include as a minimum:
 - a. The drive can be started and stopped remotely.
 - b. The drive can have its speed changed remotely.
 - c. The remote equipment can read the VFC discrete status information.
 - d. The remote equipment can read the VFC speed feedback information.
 - e. Each alarm and control input/output functions correctly, in manual and automatic.
- C. Make adjustments to VFC and connected devices for manual and automatic operation of the driven equipment to operate as a system as shown on the Contract Documents. Include:
1. Trip settings in accordance with approved power system study.
 2. Programming parameters.
 3. Timing relays.
- D. Set VFC internal protection parameters as follows:
1. Loss of speed control reference signal: Run at preset speed, determined at startup.
 2. Loss of drive control signal: Run at preset speed, determined at startup.
 3. Automatic Reset:
 - a. Number of fault reset tries: 3
 - b. Time within which resets allowed: 30 seconds
 - c. Delay time before reset-retry: 5 seconds
 - d. Auto-reset for motor overcurrent: Yes
 - e. Auto-reset for DC bus overvoltage: Yes
 - f. Auto-reset for DC bus undervoltage: Yes
 - g. Auto-reset for loss of speed signal: Yes
- E. Clear VFC events memory after successful startup.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to demonstrate correct operation, adjust parameters, reprogram, and maintain VFCs to Owner.

3.7 CLEANING

- A. Remove rubbish and debris from inside and around the equipment. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint-free rags. Do not use compressed air.
- B. Replace cabinet ventilation filters upon commencement of the Contract warranty period.

3.8 APPENDICES

- A. Coordination Statement

DRIVEN EQUIPMENT AND VARIABLE FREQUENCY DRIVE COORDINATION STATEMENT

Submittal No.:

Driven Equipment Section Reference:

Contractor Name:

Driven Equipment Manufacturer:

Motor Manufacturer:

VFD Manufacturer:

Contractor certifies driven equipment and VFD submitted have been coordinated for motor characteristics (i.e. torque type, full load current, temperature winding protective devices, etc.) and the VFDs submitted properly match the driven load.

Contractor (Print)

Signature

Date

- B. VFC Schedule

END OF SECTION 262923

SECTION 264313 - SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Surge protective devices (SPDs) for power distribution systems. SPDs installed integral to electrical equipment shall meet electrical performance criteria specified herein. SPDs for telecommunications systems, antenna systems, SCADA systems and instruments are included in other Divisions.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 DEFINITIONS

- A. I_n : Nominal discharge current.
- B. Maximum Continuous Operating Voltage (MCOV): The maximum designated RMS value of the power frequency voltage that may be continuously applied to the mode of protection of an SPD.
- C. Metal-Oxide Varistor (MOV): An electronic component with a significant bidirectional, nonlinear current-voltage characteristic.
- D. Mode(s), Modes of Protection, or Protection Modes: Electrical paths where the SPD offers defense against transient overvoltages. Examples include: line to neutral (L-N), line to ground (L-G), line to line (L-L), and neutral to ground (N-G).
- E. SCCR: Short-circuit current rating.
- F. Type 1 SPDs: Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service disconnect overcurrent device.

- G. Type 2 SPDs: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.
- H. Type 3 SPDs: Point of utilization SPDs.
- I. Type 4 SPDs: Component SPDs, including discrete components, as well as assemblies.
- J. Type 5 SPDs: Discrete component surge suppressors, such as MOVs that may be mounted on a printed wiring board, connected by its leads or provided within an enclosure with mounting means and wiring terminations.
- K. Voltage Protection Rating (VPR): A rating selected from UL 1449 list of preferred values assigned to each mode of protection.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product used on project. Include physical and electrical characteristics, features, and options.
- B. Specification Compliance:
 - 1. Include a copy of this specification confirming compliance with each paragraph. For deviations, provide detailed commentary to explain the deviation.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranty.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For SPDs to include in operation and maintenance manuals.
- B. Warranty documentation.

1.7 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace SPDs for a period not less than warranty specified in PART 2 for each model described.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, ABB, Eaton, or Siemens products are acceptable.

- B. Source Limitations: Obtain devices from single source from single manufacturer.

2.2 PERFORMANCE CRITERIA

- A. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing agency recognized by authorities having jurisdiction and marked for intended location and application.
- B. Comply with the following standards as applicable:
 - 1. UL 96A, Lightning Protection System Master Label.
 - 2. UL 1283, Electromagnetic Interference Filters for EMI/RFI noise filtration.
 - 3. UL 1449, Surge Protective Devices, CCN VZCA.
- C. MCOV: Not less than 115 percent.
- D. Nominal discharge current (I_n): 20 kA, unless noted otherwise.
- E. Maximum VPR:
 - 1. 277 V (L-N), Systems: 1200 V.
 - 2. 240 V (L-L) Systems: 1200 V.
 - 3. 120 V (L-N) Systems: 700 V.
- F. Enclosure: NEMA 1 (minimum) for indoor dry locations and NEMA 4X (non-metallic) for outdoor, wet, damp, chemical or corrosive areas.
- G. Type 1 or 2, as indicated by connection point on Drawings. Include integral disconnect for Type 1 SPDs.
- H. Match voltage, phasing, and frequency of connected power system equipment to be protected.
- I. Provide all modes of protection based on the power system configuration.
- J. The SCCR rating of the SPD shall have at least the same rating of the electrical equipment being protected.
- K. Protect against surges produced by a 1.2 / 50 microsecond and 8 / 20 microsecond combination waveform generator.
- L. Provide LED indicator lights for continuous positive operational status of each protected phase. Lights to be visible without the need to open any compartments.
- M. Response Time: One nanosecond or less for any individual component and be self-restoring and fully automatic.
- N. Service entrance equipment (480 V):
 - 1. Minimum surge current ratings:
 - a. Greater than 2500 A equipment bus: 200 kA per mode, 400 kA per phase..

- b. From 1600 A to 2500 A equipment bus: 150 kA per mode, 300 kA per phase..
 - c. Up to 1200 A equipment bus: 100 kA per mode, 200 kA per phase..
- 2. Additional Features:
 - a. Suitable for use with UL Master Label lightning protection systems.
 - b. EMI / RFI noise filtration.
 - c. Include surge counter.
 - d. Include audible alarm.
 - e. Include dry Form C contacts for protection status monitoring at SCADA system.
 - f. Warranty: 10 years.
- O. Switchgear, switchboards, distribution panelboards, motor control centers, 800 A and higher equipment bus (480 V):
 - 1. Minimum surge current ratings:
 - a. Greater than 2500 A equipment bus: 200 kA per mode, 400 kA per phase.
 - b. From 1600 A to 2500 A equipment bus: 150 kA per mode, 300 kA per phase.
 - c. From 800 A to 1200 A equipment bus: 100 kA per mode, 200 kA per phase.
 - d. Warranty: 10 years.
 - 2. Additional Features:
 - a. EMI / RFI noise filtration.
 - b. Include surge counter.
 - c. Include audible alarm.
 - d. Include dry Form C contacts for protection status monitoring at SCADA system.
- P. Branch panels and control panels, up to 600 A equipment bus (480 V): Minimum surge current 100 kA per phase, nominal discharge current 10 kA, 5 year warranty.
- Q. Branch circuit panels (120/208/240 V single or three phase): Minimum surge current 50 kA per phase, nominal discharge current 10 kA..

PART 3 - EXECUTION

3.1 PREPARATION

- A. Layout disconnect and SPD locations to minimize SPD lead length to less than 24 inches and to avoid sharp bends or kinks in leads. Rearrange circuit breakers as necessary in panelboards to achieve.

3.2 INSTALLATION

- A. Install SPDs as shown on the Drawings and in accordance with manufacturer's instructions.
- B. Install SPD lead conductors as short as possible (not to exceed 24 inches), gently twist together where practicable with wire size, and route to avoid sharp bends or kinks. Do not splice or

extend SPD leads unless specifically permitted by manufacturer and approved by Engineer. Spliced extensions using wire nuts are unacceptable.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
 - 1. Compare equipment nameplate data for compliance with Drawings and Specifications.
 - 2. Inspect anchorage, alignment, grounding, and clearances.
 - 3. Verify that electrical wiring installation complies with manufacturer's installation requirements.
- B. SPDs that do not pass tests and inspections will be considered defective.
- C. Prepare test and inspection reports.

3.4 STARTUP SERVICE

- A. Complete startup checks in accordance with manufacturer's instructions.
- B. Where alarm contacts report to SCADA system, confirm correct operation.
- C. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests; reconnect them immediately after the testing is over.
- D. Energize SPDs after power system has been energized, stabilized, and tested.

END OF SECTION 264313

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SECTION 400506 - COUPLINGS, ADAPTERS, AND SPECIALS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Dismantling joint.

- B. Related Requirements:

- 1. Section 400507 “Hangers and Supports for Process Piping: Hangers, anchors, sleeves, and sealing of piping to adjacent structures.
 - 2. Section 400523 “Stainless Steel Process Pipe and Tubing”: Stainless steel piping materials and appurtenances.
 - 3. Section 400531 “Thermoplastic Process Pipe”: Plastic piping materials and appurtenances.

1.3 COORDINATION

- A. Coordinate Work of this Section with installation of piping, valves and equipment connections specified in other Sections and indicated on Drawings.

1.4 PREINSTALLATION MEETINGS

- A. Refer to Section 013513.24 Special Procedures for MOPO.

1.5 ACTION SUBMITTALS

- A. Product Data:

- 1. Submit manufacturer catalog information for each specified product, including installation instructions.
 - 2. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 3. Expansion Joints: Indicate maximum temperature, pressure rating, and expansion compensation.

B. Shop Drawings:

1. Identification:
 - a. Submit list of wording, symbols, letter size, and color coding for pipe identification.
 - b. Comply with ASME A13.1.
2. Indicate restrained joint details and materials.
3. Submit layout drawings showing piece numbers and location, indicating restrained joint locations.
4. Indicate layout of piping systems, including flexible connectors, expansion joints and compensators, loops, offsets, and swing joints.

1.6 DELEGATED DESIGN SUBMITTALS

A. Submit signed and sealed Shop Drawings with design calculations and assumptions for:

1. Flexible connectors
2. Expansion joints
3. Pipe Restraints:
 - a. Determine restrained lengths and submit joint restraint details.
 - b. Use joint restraint devices specifically designed for applications as described in manufacturer data.

1.7 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- B. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS qualification within previous 12 months.
- C. Manufacturer Instructions: Submit special procedures and setting dimensions.
- D. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- F. Qualifications Statements:
 1. Submit qualifications for manufacturer, installer, and licensed professional.
 2. Submit manufacturer's approval of installer.
 3. Welders: Qualify procedures and personnel according to AWS D1.1/D1.1M.

1.8 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of piping appurtenances.
- B. Identify and describe unexpected variations to pipe routing or discovery of uncharted utilities.

1.9 QUALITY ASSURANCE

- A. Materials in Contact with Potable Water: Certified to NSF Standards 61 and 372.
- B. Perform Work according to ASME B31.9 for installation of piping systems and according to AWS D1.1/D1.1M for welding materials and procedures.
- C. Perform Work according to ASME B31.9 for installation of piping systems.

1.10 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience.
- C. Welders: AWS qualified within previous 12 months for employed weld types.
- D. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Florida.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
- C. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
 - 3. Provide additional protection according to manufacturer instructions.

1.12 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.13 WARRANTY

- A. Furnish five-year manufacturer's warranty.

PART 2 - PRODUCTS

2.1 DISMANTLING JOINT

A. Manufacturers:

1. GE Oil & Gas (Dresser), Style 131.
2. Xylem (Smith-Blair), Type. 975
3. Romac Industries, Model DJ400.

B. Description:

1. Double ended flanged adapter that allows for longitudinal adjustment between flanges and quick removal.
2. Max. Pressure Rating: 320 psig.
3. Complies with AWWA.
4. Body & Flange: A36 steel.
5. Follower: A36 steel coupling with AISI C1012.
6. Wedge Gasket: Buna N.
7. Bolts & Nuts: High strength, low alloy steel.
8. Tie-Rods: Required.
9. Finish: As per manufacturer standards.

2.2 FINISHES

- #### A.
- Prepare piping appurtenances for field finishes as specified in Section Manufacturer's standard.

2.3 SOURCE QUALITY CONTROL

- #### A.
- Provide shop inspection and testing of completed assemblies.

B. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- #### A.
- Verify that field dimensions are as indicated on Shop Drawings.
- #### B.
- Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flanges mate properly.

- C. Verify that openings are ready to receive sleeves
- D. Verify that pipe plain ends to receive sleeve-type couplings are smooth and round for 12 inches from pipe ends.
- E. Verify that pipe outside diameter conforms to sleeve manufacturer's requirements.

3.2 PREPARATION

- A. Cleaning: Thoroughly clean end connections before installation.
- B. Close pipe and equipment openings with caps or plugs during installation.
- C. Surface Preparation: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

- A. Flexible Connections: Install flexible couplings at connections to equipment and where indicated on Shop Drawings.

3.4 FIELD QUALITY CONTROL

- A. After installation, inspect for proper supports and interferences.
- B. Repair damaged coatings with material equal to original coating.

3.5 CLEANING

- A. 017700 "Closeout Procedures": Requirements for cleaning.
- B. Keep equipment interior clean as installation progresses.

END OF SECTION 400506

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SECTION 400507 - HANGERS AND SUPPORTS FOR PROCESS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Hangers and supports for piping.
 - 2. Delegated design.
- B. Related Requirements:
 - 1. Section 033010 “Miscellaneous Cast-In-Place Concrete” for placement of concrete housekeeping pads required by this Section.
 - 2. Section 400531 “SFL - Thermoplastic Process Pipe”.
 - 3. Section 400506 “Couplings, Adapters, and Specials for Process Piping”.
 - 4. Section 400523 “Stainless Steel Process Pipe and Tubing”.

1.3 DEFINITIONS

- A. Ferrous Metal: Iron, steel, stainless steel, and alloys with iron as principal component.
- B. Wetted or submerged: Submerged, less than 1-foot above liquid surface, below top of channel or tank wall, under cover or slab of channel or tank, or in other damp locations.
- C. “Pipe” or “Piping”: Piping, piping system(s), hose, tube, fittings, joints, valves, and similar appurtenances.
- D. Supports: Wherever the word “supports” or “pipe supports” are used, pipe supports, hangers, structural connections, concrete inserts (if allowed), anchors, guides, bolts, expansion units, restraints and all restraint, hanging, supporting, allowing controlled expansion, or other means of attaching piping along with the necessary appurtenances.

1.4 COORDINATION

- A. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.5 AMERICAN IRON AND STEEL (AIS) REQUIREMENTS

- A. Products submitted under this section shall meet American Iron and Steel (AIS) requirements as described in Division 00 and 01 Specifications.

1.6 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's catalog data including load capacity.
- B. Shop Drawings: Submit scaled piping layouts for each system. Indicate flow stream, pipe size(s) material(s), schedule(s), lining(s), critical dimensions between pipes, equipment and building features. Indicate by schedule pipe hanger/support type and locations. Provide detail of each type of hangers, supports, anchors, and guides.

1.7 DELEGATED DESIGN SUBMITTALS

- A. Delegated-Design Submittal: For hangers and supports for piping; Section 014000 "Quality Requirements" for additional delegated design requirements.
 - 1. Where the Drawings show support types and/or locations, analyze them for adequacy to support loads and stresses, modify if required, install generally where shown, and integrate with the pipe support system design.
 - 2. Engage the services of an independent registered professional engineer licensed in the State of Florida ordinarily engaged in the business of pipe support systems analysis and design, to analyze system piping and service conditions, and to develop a detailed support system design, specific to the piping material, pipe joints, valves, and piping appurtenances proposed for use.
 - a. Support system engineering groups include the following:
 - 1) SAC Incorporated <https://www.sacincorporated.com/contact-us/>
 - 2) Fenny Engineering <http://www.fennyengineering.com/contact/>
 - 3) Piping Solutions and Energy Associates <https://www.pseassoc.com/request-for-service/>
 - 4) Newman Associates <https://newmanassoc.com/>
 - 3. The support system design shall include:
 - a. Criteria by piping system.
 - b. Summary of Contractor-selected related components including joints, class, valves, appurtenances, etc., and commercial supports and especially including pipe materials.
 - c. Dead weight and dynamic analysis, including system thermal effects and pressure thrusts. Computer-based software system equivalent to Bentley Systems AutoPIPE or SST Systems CAEPIPE.

- 1) Present each system in an isometric graphic and show the resolved and resultant force and moment systems, as well as all recommended hangers, supports, anchors, restraints, and expansion/flexible joints.
 - d. Submit support system design to the Engineer for review. The submittal needs to be stamped by a professional engineer registered in State where work installed.
 - e. All aspects of the analysis and design to comply with the provisions of ANSI B31.1 and the referenced standards.
- 4. Coordinate support arrangements to eliminate interference with similar systems to be installed under HVAC, Plumbing, and Electrical, to account for structural expansion joints and to maintain access for both personnel and for the removal of equipment.
- B. Manufacturers' Instructions: Submit special procedures and assembly of components.
- C. Qualifications Statement: Submit qualifications for licensed professionals.

1.8 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- B. Welders' Certificate: Submit welders' certification of compliance with ASME Section IX, verifying qualification within previous 12 months.
- C. Qualifications Statements:
 - 1. Submit qualifications for manufacturer, fabricator, installer, and licensed professional.
 - 2. Submit manufacturer's approval of installer.

1.9 DELIVERY, STORAGE AND HANDLING

- A. All supports and hangers shall be crated, delivered and uncrated so as to protect against any damage.
- B. All parts shall be properly protected so that no damage or deterioration shall occur during a prolonged delay from the time of shipment until installation is completed.
- C. Finished metal surfaces not galvanized, that are not of stainless-steel construction, or that are not coated, shall be grease coated, to prevent rust and corrosion.

1.10 QUALITY ASSURANCE

- A. Perform Work according to AWS D1.1 for welding hanger and support attachments to building structure.

1.11 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum five years' documented experience.
- B. Fabricator: Company specializing in fabricating products specified in this Section with minimum five years' documented experience.
- C. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience and approved by manufacturer.
- D. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Florida.
 - 1. Have at least 5 years of experience in the analysis and design of similar systems, including the use of commercial and custom pipe supports and in the use of commercial pipe stress software programs.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on-Site in original factory packaging, labeled with manufacturer's identification.
- B. Protect products from weather and construction traffic, dirt, water, chemical, and damage by storing in original packaging.

1.13 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

1.14 WARRANTY

- A. Furnish five -year manufacturer's warranty for pipe hangers and supports and accessories.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Support pipe and appurtenances connected to equipment to prevent any strain being imposed on the equipment. Comply with manufacturer's requirements regarding piping loads being or not being transmitted to their equipment. Submit certification stating that such requirements have been met.

- B. Support and secure all pipe and tubing in the intended position and alignment to prevent significant stresses in the pipe or tubing material, valves, fittings, and other pipe appurtenances. Design all supports to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces, and all probable external forces such as equipment, pipe, and personnel contact. Any structural steel members required to brace any piping from excessive dislocation shall conform to the applicable requirements of Section 055000 "Metal Fabrications" and shall be furnished and installed under this Section.
- C. Contractor may propose minor adjustments to the piping arrangements in order to simplify the supports, or in order to resolve minor conflicts in the work. Such an adjustment might involve minor change to a pipe centerline elevation so that a single trapeze support may be used.
- D. Where flexible sleeve, split ring, vibration, or other couplings are required at equipment, tanks, etc., the end opposite to the piece of equipment, tank, etc., shall be rigidly supported to prevent transfer of force systems to the equipment. Do not install fixed or restraining supports between a flexible coupling and the piece of equipment.
- E. Pipe Supports:
 - 1. Shall not induce point loadings but shall distribute pipe loads evenly along the pipe circumference.
 - 2. Provide supports at changes in direction and elsewhere as shown in the Drawings or as specified herein.
 - 3. No piping shall be supported from other piping or from metal stairs, ladders, and walkways, unless specifically directed or authorized by the Engineer.
 - 4. Provide pipe supports to minimize lateral forces through valves, both sides of flexible split ring type couplings and sleeve type couplings, and to minimize all pipe forces on pump housings. Pump housings shall not be utilized to support connecting pipes.
 - 5. Effects of thermal expansion and contraction of the pipe to be accounted for in the pipe support selection and installation.
- F. Insofar as is possible, floor supports shall be given preference. Where specifically indicated, concrete supports, as shown on the Drawings, may be used. Base elbow and base tees shall be supported on concrete pedestals.
- G. Restraints, flexible connections, expansion items, and related items as included in other specifications (especially Section 400506 SFL - Couplings, Adapters, and Specials for Process Piping and other individual pipe sections) and shown on the Drawings.

2.2 PERFORMANCE REQUIREMENTS/DESIGN CRITERIA

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hangers and supports for piping.
- B. All supports and appurtenances shall be standard products from approved manufacturers wherever possible and shall be adequate to maintain the supported load in proper position under all operating conditions. Any reference to a specific figure number of a specific manufacturer is for the purpose of establishing a type and quality of product and shall not be considered as

proprietary. Note that different materials required, as specified in Part 2 MATERIALS, may require different figures or model numbers than those shown.

1. The minimum working factor of safety for all items, with the exception of springs, shall be five times the ultimate tensile strength of the material, assuming 10 feet of water-filled pipe being supported and normal test pressures.
 2. Design for all loads using a safety factor of 5.
- C. All items shall be designed with strength and stiffness to support, restrain, and allow expansion of the respective pipes under the maximum combination of peak loading conditions to include pipe weight, liquid weight, liquid movement and pressure forces, thermal expansion and contraction, vibrations, and all probable externally applied forces.
- D. Support spacing shall be per ASME B31.3.
- E. Complete design details of the pipe system components shall be submitted for review and approval as specified in Part 1. No support shall be installed without approved support system Drawings.
- F. The pipe support system shall not impose loads on the supporting structures in excess of the loads for which the supporting structure is designed.

2.3 MATERIALS

A. Metallic Pipe Support:

1. Type 316 stainless steel (SS).

2.4 SUPPORT AND RESTRAINT SYSTEMS

A. Steel or Ductile Iron Piping:

1. Cast iron and ductile iron, steel, and stainless-steel piping shall be supported at a maximum support spacing of 10 feet (3 m) with a minimum of one support per pipe section at the joints.
2. Support spacing for ductile iron, steel, and stainless-steel piping 2-inch and smaller diameter shall not exceed 5 feet (1.5 m).

B. Non-Metallic Piping:

1. All uninsulated non-metallic piping such as PVC, CPVC, HDPE, PVDF, etc., shall be protected from local stress concentrations at each support point. Protection shall be provided by non-metallic protection shields or other method as approved by the Engineer.
 - a. Where pipes are bottom supported 180 degrees, arc shields shall be furnished. Where 360-degree arc support is required, such as U-bolts, protection shields shall be provided for the entire pipe circumference. All U-bolts or clamps for non-metallic pipes shall be plastic coated.

- b. Protection shields shall have an 18-gauge minimum thickness, not be less than 12 inches in length and be securely fastened to pipe with Type 316 stainless steel straps not less than 1/2 inch wide.
2. Individually supported PVC pipes shall be supported as recommended by the pipe manufacturer except that support-spacing shall be manufacturers recommendation minus 2-ft. down to 5 ft spacing recommendation, then spacing shall be 3 feet.
3. Supports for horizontal multiple PVC plastic piping:
 - a. Shall be continuous wherever possible.
 - b. Multiple, suspended, horizontal plastic PVC pipe runs, where possible, shall be supported by ladder type cable trays such as: Husky Ladder Flange Out by MPHusky; or equal.
 - c. Rung spacing shall be 12 inches. Tray width shall be approximately 6 inch for single runs and 12 inches for double runs.
 - d. Ladder type cable trays shall be furnished complete with all hanger rods, rod couplings, concrete inserts, hanger clips, etc., required for a complete support system. Individual plastic pipes shall be secured to the rungs of the cable tray by strap clamps or fasteners similar to: Globe, Series 600; Unistrut Pipe/Conduit Clamps and Hangers; or equal.
 - e. Spacing between clamps shall not exceed 9 feet. The cable trays shall provide continuous support along the length of the pipe. Individual clamps, hangers, and supports in contact with plastic PVC pipe shall provide firm support but not so firm as to prevent longitudinal movement due to thermal expansion and contraction.

2.5 ANCHOR BOLTS/SYSTEMS

- A. Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear, and pullout loads imposed by loading and spacing on each particular support. DO NOTE USE ADHESIVE ANCHOR BOLTS ON ANY PIPE SUPPORT HUNG FROM A ROOF OR CEILING, unless specifically noted otherwise.
- B. All post-installed anchors in concrete shall have current published ICC-ES Evaluation Report indicating the anchor is approved for installation in cracked concrete.
- C. The latest edition of the following specification and recommended practices shall become part of this specification as if written herein. Wherever requirements conflict, the more stringent shall govern.
 1. ACI 318, Appendix D.
 2. ACI 355.2, Mechanical Anchors “Qualification of Post-Installed Mechanical Anchors in Concrete”
 3. Anchor manufacturer’s published installation requirements.

D. Expansion Anchors:

1. The length of expansion bolts shall be sufficient to place the wedge portion of the bolt a minimum of 1 inch behind the steel reinforcement.
2. Manufacturers:
 - a. Power-Stud+ SD4 and Power-Stud+ SD6 by Powers Fasteners, Brewster, NY.
 - b. Kwik Bolt as manufactured by Hilti USA, Tulsa, Oklahoma.
 - c. Wej-it by Wej-it Expansion Products, Inc., Broomfield, Colorado.
 - d. Or approved equal (any manufacturer or product that is not listed above is considered a substitution and shall be submitted in accordance with Section 01 25 00).

E. Unless otherwise noted: use Type 316 stainless steel anchoring parts/bolts and hardware for both non-submerged supports and submerged anchors.

F. Size of anchor bolts as designed by manufacturer, 1/2 inch minimum diameter, or as shown on the Drawings.

G. Anchors to concrete in chemical areas shall be epoxy secured vinyl ester FRP all thread, insertion depth and size as required by the manufacturer for the design loads. Nuts, bolts and hardware shall all be vinyl ester FRP construction.

2.6 SINGLE PIPE SUPPORTS FROM BELOW

A. Single pipes located in a horizontal plane close to the floor shall be Pedestal type: Schedule 40 pipe stanchion, saddle, and anchoring flange.

1. Nonadjustable Saddle: MSS SP 58, Type 37 with U-Bolt.

- a. Anvil, Figure 259.
- b. Cooper B-Line, Figure B3090.

2. Adjustable Saddle: MSS SP 58, Type 38 without clamp.

- a. Anvil, Figure 264.
- b. Cooper B-Line, Figure B3093.

B. Pipes less than 3 inch in diameter:

1. Hold in position by supports fabricated from steel C channel, welded post base similar to Unistrut, Figure P2072A, where use of steel is allowed; and pipe clamps similar to Unistrut, Figures P1109 through 26.
2. Where required to assure adequate support, fabricate supports using two vertical members and post bases connected by horizontal member of sufficient load capacity to support pipe.
3. Fasten supports to nearby walls or other structural member to provide horizontal rigidity.
4. More than one pipe may be supported from a common fabricated support.

C. Pipes 3 inch in diameter and larger:

1. Support by adjustable stanchions.
 2. Provide at least 4 inch adjustment.
 3. Flange mount to floor.
- D. Use yoked saddles for piping whose centerline elevation is 18 inch or greater above the floor and for all exterior installations.
- E. Pipe roller type supports shall be used where required to accommodate thermal movement in conjunction with axial supports.

2.7 ACCESSORIES

- A. Insulation Shield: Install on insulated non-steel piping. Oversize the rollers and supports, as required. Manufacturers:
1. Anvil, Figure 167.
 2. Cooper B-Line, Series B3151.
- B. Welding Insulation Saddle: Install on insulated metal pipe. Oversize the rollers and supports, as required. Manufacturers:
1. Anvil, Figure 160.
 2. Cooper B-Line, Series B3160.
- C. Vibration Isolation Pad: Install under base flange of pedestal type pipe supports adjacent to equipment, and where required to isolate vibration.
1. Isolation pads to be neoprene, waffle type.
 2. Manufacturers:
 - a. Mason Industries, Type W.
 - b. Korfund.
- D. Dielectric Barrier:
1. Install between carbon steel members and copper or stainless-steel pipe.
 2. Install between stainless steel supports and non-stainless steel ferrous metal piping.
 3. All stainless-steel piping shall be isolated from all ferrous materials, including galvanized steel by use of neoprene sheet material and protection shields.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify field dimensions as indicated on Drawings.

3.2 INSTALLATION

- A. Obtain permission from Engineer before using powder-actuated anchors.
- B. Obtain permission from Engineer before drilling or cutting structural members.
- C. Inserts:
 - 1. Install inserts for placement in concrete forms. Before setting inserts, all drawings and figures shall be checked that have a direct bearing on the pipe location. Responsibility for the proper location of pipe supports is included under this Section.
 - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 in and larger.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- D. Pipe Hangers and Supports:
 - 1. ASME B31.1 is for power piping,
 - 2. ASME B31.3 is for process piping,
 - 3. ASME B31.5 is for Refrigeration Piping and Heat Transfer Components,
 - 4. ASME B31.9 is for Building Service Piping,
 - 5. MSS SP 58 is the ANSI Manufacturers Standardization Society for pipe hangers and supports.
 - 6. Install according to: ASME B31.3.
 - 7. Support horizontal piping as indicated on Drawings, depending upon pipe size.
 - 8. Install hangers with minimum 1/2 in space between finished covering and adjacent Work.
 - 9. Place hangers within 12 in of each horizontal elbow.
 - 10. Use hangers with 1-1/2 in minimum vertical adjustment.
 - 11. Support horizontal cast iron pipe adjacent to each hub, with 5 ft maximum spacing between hangers.
 - 12. Support vertical piping at every other floor. Support vertical cast iron pipe at each floor at hub.
 - 13. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
 - 14. Support riser piping independently of connected horizontal piping.
 - 15. Design hangers for pipe movement without disengagement of supported pipe.
 - 16. Support piping independently so that equipment is not stressed by piping weight or expansion in piping system.
 - 17. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
 - 18. Provide welded steel brackets where piping is to be run adjacent to building walls or columns.
 - 19. Use beam clamps where piping is to be suspended from building steel.
 - 20. Insulated Piping: Provide two bolted clamps designed to accommodate insulated piping.

21. Use offset clamps where pipes are indicated as offset from wall surfaces.
22. Proceed with installation of piping and supports only after any building structural work has been completed and new concrete has reached its 28-day compressive strength.
23. The installation of pipe support systems shall not interfere with the operation of any overhead bridge cranes, monorails, access hatches, etc. No piping shall be supported from stairs, other pipes, ladders, and walkways unless authorized by the Engineer.
24. Repair mounting surfaces to original condition after attachments are made.
25. Brace horizontal pipe movements by both longitudinal and lateral sway bracing.
26. Where supports are required in areas to receive chemical resistant seamless flooring, install supports prior to application of flooring system.

E. Equipment Bases and Supports:

1. Provide housekeeping pads of concrete, minimum 3 1/2 inch thick and extending 6 inch beyond supported equipment. Comply with Section 033010 – Miscellaneous Cast-In-Place Concrete .
2. Provide housekeeping pads as detailed on Drawings.
3. Using templates furnished with equipment, install anchor bolts and accessories for mounting and anchoring equipment.
4. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
5. Provide rigid anchors for pipes after vibration isolation components are installed.

F. Prime Coat:

1. Prime coat exposed steel hangers and supports.

3.3 FIELD QUALITY CONTROL

- A. All pipe support systems shall be tested after installation in conjunction with the respective piping pressure tests. If any part of the pipe support system proves to be defective or inadequate, it shall be repaired, augmented or replaced to the satisfaction of the Engineer.
- B. After the work is installed, but before it is filled for start-up and testing, the Support System Design Engineer shall inspect the work and shall certify its complete adequacy. Each system shall be inspected and certified in the same way.
- C. Submit a report, including all field modifications and including all certificates.
 1. Insert state where project is located.
 2. The report shall bear the stamp of a professional engineer registered in Florida and shall be subject to the review of the Engineer.

END OF SECTION 400507

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SECTION 400523 - STAINLESS STEEL PROCESS PIPE AND TUBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. 316L Stainless steel pipe and fittings.
 - 2. Accessories.

- B. Related Requirements:

- 1. Sections of Division 40 "Instrumentation and Controls", other than those specified herein, are specified under their respective Sections.
 - 2. Section 400506 "Couplings, Adaptors, and Specials for Process Piping" for pipe penetrations, restrained joints, flexible connections, expansion joints and loops, and sleeve-type couplings.
 - 3. Section 400507 "Hangers and Supports for Process Piping" for hangers, anchors, sleeves and sealing of piping to adjacent structures.

1.3 COORDINATION

- A. Coordinate Work of this Section with piping and equipment connections as specified in other Sections and as indicated on Drawings.

1.4 PREINSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing Work of this Section.

1.5 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer information on pipe materials, tube materials, and fittings.
- B. Shop Drawings:
 - 1. Indicate piping layouts and schedules, with dimensions, fittings, expansion joints, locations of valves and appurtenances, joint details, wall penetration details, methods, types and locations of hangers and supports, and pertinent technical specifications for piping to be furnished.

2. Include data and information required for complete piping systems. Base dimensions on actual equipment to be furnished. Show types and locations of pipe hangers and/or supports on layouts for each pipe submittal. Since not all dimensions will be checked by Engineer, nor will every detail be reviewed by Engineer, Contractor will be responsible for accurate dimensioning of piping systems.

C. Cleaning Methods:

1. Include pre-cleaning, descaling, chemicals to be used, or mechanical descaling method, post-weld cleaning to restore corrosion resistance and final cleaning/passivation/pickling.
2. Include method and schedule for drying pipe so that it is ready for service as part of proposed cleaning method.
3. Include name and qualifications of firm that will be doing cleaning.
4. Include name and qualifications of independent firm that will be doing inspection of cleaned pipe.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Welder Certificates: Submit welders' certification of compliance with AWS D1.1/D1.1M, verifying qualification within previous 12 months.

1.6 INFORMATIONAL SUBMITTALS

A. Source Quality-Control Submittals: Indicate results of shop factory tests and inspections.

B. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

C. Qualifications Statements:

1. Submit qualifications for manufacturer, installer, and licensed professional.
2. Submit manufacturer's approval of installer.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves, fittings, and appurtenances, connections, and centerline elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.8 QUALITY ASSURANCE

A. Furnish stainless steel pipe and fittings by a single manufacturer who is fully experienced, reputable, qualified and regularly engaged for the last 5 years in manufacture of materials to be furnished.

B. Permanently mark each length of pipe with manufacturer's name or trademark, and compliance with standards.

- C. Materials in Contact with Potable Water: Certified according to NSF/ANSI 61 and NSF/ANSI 372.
- D. Maintain copy of each standard affecting Work of this Section on Site.
- E. Fabricator Qualifications: Factories, including mills, foundries, factories and machine shops, which hold a current ISO 9001 Certificate of Quality System Registration. Furnish documentation necessary to verify Supplier's certification and registration.
- F. Furnish work in new and unused condition. Include products and services from Suppliers having a successful record of manufacturing and servicing Work specified herein for a minimum of 10 years prior to Effective Date of Agreement.
- G. Perform and document quality control (QC) and quality assurance (QA) procedures performed during manufacturing at factory; during loading of Work for transport at factory; during transport to Site; during unloading and storage of Work at Site; and during installation and startup at Site, all part of Work specified herein.
- H. Owner and Engineer will perform independent testing of Work, herein referred to as "QA verification", at any time during manufacturing at factory; during loading for transport at factory; during transport to Site; during unloading and storage at Site; and during installation and startup at Site. Owner will provide an industry specialist and Engineer to perform QA verification procedures. Allow unhindered access to Owner and Engineer, including access for still and video photography of Work.
- I. Owner will provide an industry specialist and Engineer to perform QA verification procedures. QA Verification will include chemical analysis, examination, and testing as specified, following QA and QC procedures performed by Supplier and Contractor. Allow unhindered access to Engineer, including access for progress photographs and video documentation of work. Remove and replace, at no increase in Contract Price or Contract Time, defective Work, verified in non-compliance with acceptance criteria specified herein.
- J. Where Defective Work is identified and rejected, based on QA verification, provide additional QA verification analyses, inspections and testing performed by Owner or Engineer on corrected Work.
- K. In addition, reimbursement for subsequent QA verification inspections includes repeat QA verification analyses, testing and/or inspection related costs, including costs associated with personnel travel expenses described above; laboratory analysis; and repeat testing or inspection report review and analysis by Owner or Engineer.
- L. Design, manufacture, deliver and install products in accordance with requirements of specified herein. Provide new and unused products specified herein from Suppliers having a successful record of manufacturing and servicing products specified herein for a minimum of 10 years.
- M. Submit to Engineer, four copies of certified mill test reports (MTRs) for chemical analysis, mechanical properties including tensile, impact, and bend test results for materials used in manufacture of products specified herein. Verify MTRs identify products, for which material will be used, and information necessary to verify compliance with requirements specified herein.

- N. If there are difficulties in operation of systems included under this Contract due to defective Work, correct defective Work and meet acceptance testing requirements.
- O. Inspection by Owner or Engineer or failure to inspect does not relieve Contractor of his responsibility to provide materials and perform Work in accordance with Contract Documents.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience and approved by manufacturer.
- C. Welders: AWS qualified within previous 12 months for employed weld types.
- D. Welding Qualifications: Qualify procedures according to AWS D1.1/D1.1M, "Structural Welding Code – Steel."
- E. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- F. Testing Agency Qualifications: Qualified according to ASTM C 1021 for testing indicated.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
- C. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Protect piping and appurtenances by storing off ground.
 - 3. Provide additional protection according to manufacturer instructions.

1.11 AMBIENT CONDITIONS

- A. Minimum Conditions: Do not store or handle uninstalled lined pipes or fittings at temperatures below zero degrees F.

1.12 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.13 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 STAINLESS STEEL PIPE AND FITTINGS

- A. General Service Piping:

1. Type:
 - a. Welded; comply with ASTM A813/A813M.
 - b. Class: SW; comply with ASTM A814/A814M.
2. Schedule: As indicated on Drawings.
3. Grade: Type 316.
4. Dimensions: Comply with ASTM A312/A312M.

- B. Seamless Stainless Steel Alloy Pipe:

1. Type: Billet-pierce and manufacture seamless (SMLS) stainless steel alloy pipe, ¼ inch to 48 inch diameter to ASME B36.19 from the following alloys ("L" suffix stands for low alloy, suitable for welding). Furnish SMLS stainless steel pipe in one of the following alloys as designated on Drawings. Specific material designation indicated on Drawings is indicated in parentheses. P-Numbers for base metal classification in ASME BPVC Section IX are also provided below:
 - a. ASTM A312, Grade TP304L (304L) austenitic stainless steel; ASME P-8.
 - b. ASTM A312, Grade TP316L (316L) austenitic stainless steel; ASME P-8.
 - c. ASTM A312, Grade S31254 (6MOLY) 254SMO super austenitic stainless steel; ASME P-8.
 - d. ASTM B690, Grade N08367 (6MOLY) AL6XN super austenitic stainless steel; ASME P-45.
 - e. ASTM B729, UNS N08020, Alloy 20 (AL20) austenitic stainless steel; ASME P-45.
 - f. ASTM A790, Grade S32205 (2205) duplex stainless steel; ASME P-10H.
2. Provide 2D factory finish on SMLS stainless steel pipe, having a wall thickness of 0.010 inch or less.
3. Provide a 2E factory finish on seamless stainless steel pipe, having a wall thickness 0.010 inch to 0.25 inch when delivered to mill.
4. Provide a 1D factory finish on seamless stainless steel pipe, having a wall thickness greater in 0.25.

C. Fittings:

1. Type:
 - a. Piping 2 inches and Smaller: Socket welding.
 - b. Piping 2-1/2 inches and Larger: Butt welding.
2. Dimensions: Comply with ASTM A312/A312M.
3. Threaded Fittings:
 - a. Comply with ASME B16.11 and ASTM A182/.
 - b. Grade: Type 316.
 - c. Threads: Comply with ASME B1.20.1.
4. Butt-Welding Fittings:
 - a. Comply with ASTM A403/A403M.
 - b. Grade: Type 316.
 - c. Class: comply with ASME B16.9.
5. Socket-Welding Fittings:
 - a. Comply with ASTM A403/A403M.
 - b. Grade: Type 304 316.
 - c. Class: comply with ASME B16.11.
6. Flanged Fittings:
 - a. Type: Socket welding Threaded.
 - b. Class: 150.
 - c. Comply with ASTM A182/A182M.
 - d. Grade: Type 316.
 - e. Facing and Drilling: Comply with ASME B16.5, with- raised face <_____>.
 - f. Backing Flanges:
 - 1) Material: Stainless steel.
 - 2) Class: [] 300_____.
 - 3) Comply with ASTM A351/A351M.
 - 4) Grade: Type <_____>.
 - 5) Type: Van stone.
 - 6) Drilling: Comply with ASME B16.1.

D. Flanged Connections: As required to connect stainless steel piping to fittings and equipment indicated on Drawings.

1. High-Pressure Stainless Steel Pipe Flanges
 - a. Drill four-bolt stainless pipe flanges in accordance with SAE J518, Code 61 (3000 psi) or Code 62 (6000 psi), with weld-neck or socket-weld pipe connections as indicated on Drawings.
 - b. Provide weld-neck pipe connections having factory machined 37.5 degree beveled ends.

- c. Provide stainless steel elastomer O-ring sealing surfaces machined to a 125 µinch Ra finish or better.
- d. Provide hydraulic flanges constructed of ASTM A240, Type 316L stainless steel.
- e. Provide Code 61 SAE O-ring flanges manufactured by one of the following:
 - 1) Tube and Fittings Division/Parker Hannifin Corporation, Columbus, Ohio.
 - 2) Main Manufacturing, Grand Blanco, Michigan.
 - 3) Anchor Fluid Power, Cincinnati, Ohio.
- f. Provide low-pressure stainless steel threaded unions meeting requirements of ASME B16.39 for dimensional, material, and pressure Class 150 in accordance with scheduled piping system pressure requirements; thread form meeting ASME B1.20.1.

2.2 ACCESSORIES

A. O-Ring Seals: Rubber EPDM.

B. Flange Gaskets:

- 1. Comply with ASME B16.5.
- 2. Nonmetallic Gaskets:
 - a. Material: Chloroprene rubber.
 - b. Comply with ASME B16.21.
- 3. Metallic Ring Joint Gaskets:
 - a. Material: As per manufacturer recommendation.
 - b. Comply with ASME B16.20.
- 4. Type:
 - a. Raised-Face Flanges: Flat ring.
 - b. Flat-Face Flanges: Full face.

C. Anti-seize Bolting Lubricants:

- 1. Install flange bolts using a nickel anti-seize lubricant capable of achieving required bolt torque and sealing stress and permitting future disassembly with minimal manual input.
- 2. Remove excess anti-seize compound by degreasing solvent prior to finish painting piping.
- 3. Anti-Seize Compound:
 - a. Never-Seez Pure Nickel Special Lubricant manufactured by Bostik, Wauwatosa, Wisconsin.
 - b. Loctite Heavy Duty Anti-Seize Lubricant Manufactured by Henkel Technologies, Rocky Hill, Connecticut.
 - c. Chesterton 772 Premium Nickel Anti-Seize Compound manufactured by Chesterton Technical Products, Stoneham, Massachusetts.

4. Flange Bolts: Adequately degreased of all corrosion inhibiting slush oil and excess anti-seize lubricant prior to field application of prime and finish coatings.

2.3 SOURCE QUALITY CONTROL

- A. Section 14000 "Quality Requirements": Requirements for testing, inspection and analysis.
- B. Provide shop inspection and testing of completed assembly.
- C. Owner Inspection:
 1. Make completed piping components available for inspection at manufacturer's factory prior to packaging for shipment.
 2. Notify Owner at least seven days before inspection is allowed.
- D. Owner Witnessing:
 1. Allow witnessing of factory inspections and test at manufacturer's test facility.
 2. Notify Owner at least seven days before inspections and tests are scheduled.
 3. Coordinate QC and QA testing of Work to be witnessed by Owner or Engineer in factory, such that they may be conducted on consecutive days and completed during a single trip. Notify the Engineer of scheduled factory QC and QA testing and inspections three (3) weeks, as a minimum, prior to first scheduled testing date.
- E. Certificate of Compliance:
 1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
 2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field dimensions are as indicated on Shop Drawings.
- B. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flange mate properly.

3.2 PREPARATION

- A. Ream pipe ends and remove burrs.
- B. Bevel plain-end pipe.
- C. Thoroughly clean pipe and fittings before installation.

3.3 INSTALLATION

- A. Comply with ASME B31.3. Install pipe, fittings and specials true to alignment and rigidly supported. Do not exceed deflection at pipe joints recommended by *Supplier*. Support all pipe and appurtenances connected to equipment to prevent any strain on equipment and valves nozzles, and adjoining pipe flanges
- B. Run piping straight along alignment as indicated on Shop Drawings, with minimum number of joints.
- C. Fittings:
 - 1. Clean gasket seats thoroughly, and wipe gaskets clean prior to installation.
 - 2. Install according to manufacturer instructions.
 - 3. Bolting:
 - a. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight.
 - b. Use torque wrench to tighten bolts to manufacturer instructions.
- D. Concrete encase pipe under concrete slabs. Wrap stainless steel pipe in a protective material, such as a petrolatum tape or coat pie as needed, prior to encasement.
- E. Provide required upstream and downstream clearances from devices as indicated on Shop Drawings.
- F. Install piping with sufficient slopes for venting or drainage of liquids and condensate to low points.
- G. Provide expansion joints as specified in Section 400506 - Couplings, Adaptors, and Specials for Process Piping to compensate for pipe expansion due to temperature differences.
- H. Dielectric Fittings: Provide between dissimilar metals.
- I. Field Cuts: According to pipe manufacturer instructions.
- J. Field welding of stainless steel is not permitted.
- K. Joining preparation and finished welds: Under no circumstances may permanent backer-rings or other consumable inserts be used for field or shop welding of steel pipe. Non-consumable refractory inserts are allowed with Engineer's approval.
- L. Prepare pipe joints by a machining process without damage to pipe exterior. Cut ends smooth and at a right angle to axis of pipe and beveled where required in accordance with approved welding procedure specifications. Deburr pipe and tube as part of preparation of all joint configurations.
- M. Rust spots and corrosion pits on new stainless steel pipe and fittings are not allowed. Verify pipe, tube and fittings are inspected by the Engineer and Contractor upon delivery and stored in a location that will prevent entry of contaminants prior to installation.

- N. Protect pipe, tube, fittings and valves, and adhere to the following mandatory requirements, and others specified in paragraphs below:
1. Protect stainless steel materials from contact with carbon steel including but not limited to hoisting and rigging equipment, steel tables, storage racks and hand tools.
 2. Do not bundle pipe and fittings using ferrous metal banding at factory or Supplier's facility.
 3. Do not allow contact between wear surfaces of tools used for carbon steel fabrication and surfaces of stainless steel pipe, tubes and fittings. These tools include abrasive grinding and cutting wheels, wheel cutters and rollers, threading taps and dies, tube bending equipment and all other bearing edge tools.
 4. Use manual or powered wire brush tools for surface repair and joint preparation manufactured from stainless steel. Brushes with carbon steel wire cannot be used for fabrication of stainless steel.
 5. Shield stainless steel pipe, tube and fittings from all on-site carbon steel pipe and structural steel cutting and blasting operations.
 6. Remove all exterior surface scratches; surface contamination by ferrous metal grinding kerf; contamination by paint markers and crayons etc.; and labels after installation.
- O. Verify engineer examines exterior surfaces of pipe, tube and fittings at Site for free iron contamination by ferroxyl test or other method. Clean all contaminated surfaces at Site by pickling using a lean spray-applied pickling cleaner suitable for large surfaces system. Follow pickling with passivation of entire treated surface by a neutralizing rinse. Provide one of the following spray-applied pickling solutions:
1. Avesta Classic Cleaner 401®, manufactured by Avesta Finishing Chemicals, Orchard Park, New York.
 2. Antox® 75E Pickling Cleaner, manufactured by Chemetall US, New Providence, New Jersey.
 3. Kytex® Brightener 123, manufactured/distributed by Harvard Chemical Research, Atlanta, Georgia.
- P. Perform field cutting of stainless steel pipe by mechanical wheel cutter or abrasive saw, leaving a smooth cut at right angles to axis of pipe. Use new abrasive cutting wheels for stainless steel pipe and tube designed to prevent iron, sulfur or chlorine contamination to surface under preparation or repair, and surfaces of adjacent piping. Deburr pipe and tube as part of preparation for all joint configurations. Abrasive cutting wheels acceptable for use on stainless steel pipe and tube as follows:
1. Charger® cutting wheels manufactured by Norton/Saint-Gobain Abrasives, Worcester, Massachusetts.
 2. Saitech Z-Tech® cutting wheels manufactured by United Abrasives/SAIT, Windham, Connecticut.
 3. pECIALIST® cutting wheels manufactured by Flexovite, Angola, New York.
- Q. Perform field grinding of stainless steel pipe and tube, including root pass and enter-pass weld grinding using new grinding wheels. Use grinding wheels designed to prevent iron, sulfur or chlorine contamination to surface under repair or surfaces of adjacent piping. Abrasive grinding wheels acceptable for use on stainless steel pipe and tube as follows:

1. Norzon Plus® grinding wheels manufactured by Norton/Saint-Gobain Abrasives, Worcester, Massachusetts.
 2. Saitech Pipeline® grinding wheels manufactured by United Abrasives/SAIT, Windham, Connecticut.
 3. Flexon® ZA24S grinding wheels manufactured by Flexovite, Angola, New York.
- R. Use wire wheels, to remove defects on pipe surface after installation, constructed of same material as pipe wall or Type 316 stainless steel for super austenitic and duplex stainless steel piping. Verify surface finish on pipe meets specified mill-applied surface finish or better.
- S. Bolting Procedure for Flanged Joints:
1. Assemble flanged pipe joints in accordance with gasket Supplier's instructions and as specified herein. Utilize calibrated bolting equipment capable of applying a measured torque to flange bolts during assembly. Submit bolting patterns, procedures and bolting equipment data to Engineer prior to pipe fitting and bolting.
 2. Use hydraulic cassette wrenches for assembly of flanged pipe joints requiring greater than 900 ft-lbs of assembly torque. Document each flanged joint assembly included in Work using "Flange Bolting Worksheet" at end of this Section. Do not use torque multipliers. Engineer reserves right to require documentation of any flange joint requiring less than 900 ft-lbs of bolt torque.
 3. Calculate clamping forces and target assembly torque for assembly of all flanged pipe joints included in Work. Verify calculations take into consideration pipe diameter, gasket Supplier's recommended assembly stress; bolt material tensile and yield stress; gasket Supplier's recommended bolt stress; pipe service, design and test pressures. Verify calculations are stamped by a professional engineer.
 4. Visually inspect and clean flange bolts, stud-bolts, nuts and washers prior to bolting. Lubricate bolts and nuts; if hardened washers are not used, lubricate flange surface around bolt holes. Remove excess lubricant on surfaces to receive protective coatings by cleaning and degreasing solvent prior to applying a coating system.
 5. Hand-tighten all nuts and bolts, then tighten them to 10 to 20% of target torque. Do not exceed 20% of target torque, for initial torque. Tightened bolts according to pattern recommended by gasket Supplier. Do not reuse nuts removed during disassembly of existing or newly assembled joints. Dispose of used nuts in presence of Engineer.
 6. Perform three rounds of bolt tightening on flanges having 4 to 8 bolts following hand tightening, first to 30 percent; then 60 percent; and finally, 100 percent of target torque calculated by Contractor.
 7. Perform four rounds of bolt tightening for flanges having 12 bolts or more, following hand tightening, first to 20 percent; then 40 percent; then 80 percent, and then 100 percent of target torque calculated by Contractor.
 8. Measure gap between flanges following application of 100 percent of target at every other bolt to confirm uniformity. Perform a final re-tightening to 100% of target torque 24-hours after 100 percent tightening at end of initial bolting sequence. Verify every bolt and stud-bolt has a minimum of three full threads exposed beyond nut following final tightening.
 9. Fill out "Flange Bolting Worksheet", located at end of this Section, for all flanged joints on project. Identify joints in accordance with designation included in approved laying schedule. Submit form to Engineer at end of each workday, after 24-hour re-tightening sequence, for filing in project records.

3.4 TOLERANCES

- A. Piping Laying Tolerance: 5/8 inch.

3.5 FIELD QUALITY CONTROL

- A. Cleaning: After installation, clean completed lines with Oakite deoxidizer or similar deoxidizer as recommended by manufacturer to remove all foreign matter, construction stains or shop markings. Rinse cleaned lines with steam or hot water. Verify all cleaning chemicals are NSF/ANSI 60 approved.
- B. Inspection:
 - 1. Inspect for damage to piping that may be detrimental as determined by Owner/Engineer.
 - 2. Repair damaged piping, or provide new, undamaged pipe.
 - 3. After installation, inspect for required supports and anchoring, interferences, and damage to pipe, tube, or fittings.
- C. Pressure Testing:
 - 1. Test Pressure: Not less than 320 psig or 50 psi in excess of maximum static pressure, whichever is greater.
 - 2. Conduct hydrostatic test for minimum two hours.
 - 3. Filling:
 - a. Fill section to be tested with water slowly and expel air from piping at high points.
 - b. Install corporation cocks at high points.
 - c. Close air vents and corporation cocks after air is expelled.
 - d. Raise pressure to specified test pressure.
 - 4. Observe joints, fittings, and valves under test.
 - 5. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage and retest.
 - 6. Leakage:
 - a. Correct visible deficiencies and continue testing at same test pressure for additional two hours to determine leakage rate.
 - b. Maintain pressure within plus or minus 5 psi of test pressure.
 - c. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.
 - d. Compute maximum allowable leakage by following formula:
 - 1) $L = SD \times \sqrt{P}/C$.
 - 2) L = testing allowance, in gallons per hour.
 - 3) S = length of pipe tested, in feet.
 - 4) D = nominal diameter of pipe, in inches.
 - 5) P = average test pressure during hydrostatic test, in psig.
 - 6) C = 148,000.
 - 7) When pipe under test contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each size.

- e. If test of pipe indicates leakage greater than allowed, locate source of leakage, make corrections, and retest until leakage is within allowable limits.
 - f. Correct visible leaks regardless of quantity of leakage.
- D. Replace pipe or fittings with mortar cracks wider than 1/16 inch.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Coordinate startup with the Owner and in accordance with the reverse osmosis process startup procedures.

3.7 ADJUSTING

- A. Adjust hardware to function smoothly and lubricate as recommended by manufacturer.

3.8 PROTECTION

- A. Remove and replace damaged reverse osmosis membranes due to containments or debris introduced by failure to flush and clean pipe and fittings prior to startup.

3.9 MAINTENANCE SERVICE

- A. Maintenance Service: Beginning at Substantial Completion; maintenance service includes six months' full maintenance by manufacturer's authorized service representative. Include semianual preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Provide manufacture's authorized replacement parts and supplies.

3.10 CLEANING

- A. Keep pipe interior clean as installation progresses.
- B. After installation, clean pipe interior of soil, grit, and other debris. Flush pipe with water prior to startup.

END OF SECTION 400523

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SECTION 400531 - THERMOPLASTIC PROCESS PIPE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. PVC pipe.
- 2. Fittings.

- B. Related Requirements:

- 1. Section 400506 "Couplings, Adapters, and Specials for Process Piping": Pipe penetrations, restrained joints, flexible connections, expansion joints and loops, and sleeve-type couplings.
- 2. Section 400507 "Hangers and Supports for Process Piping": Hangers, anchors, sleeves, and sealing of piping to adjacent structures.

1.3 SUBMITTALS

- A. Section 013300 "Submittal Procedures": Requirements for submittals.
- B. Product Data: Submit manufacturer's catalog information regarding pipe and fittings.
- C. Shop Drawings: Indicate layout of piping systems, including equipment, critical dimensions, sizes, materials lists, location of all fittings, valves, and in-line accessories.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer's recommended butt fusion welding procedures identifying all quality control checks during the fusion procedure including the minimum and maximum allowable bead formation during the heat soak process and the final weld roll back process for the various size pipes.
- F. Manufacturer to provide a sample joint for each size pipe to be supplied that is 12-in long and has two heat fusion welds that identifies the manufacturer's minimum and maximum allowable bead thicknesses. Provide documentation that the sample was pressure tested to 150 psi or the specified pressure.
- G. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for pipe sizes and sizing methods.

- H. Source Quality-Control Submittals: Indicate results of shop factory tests and inspections.
- I. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- J. Qualifications Statements:
 - 1. Submit qualifications for manufacturer, installer, and licensed professional.
 - 2. Submit manufacturer's approval of installer.

1.4 CLOSEOUT SUBMITTALS

- A. Section 017700 "Closeout Procedures": Requirements for submittals.
- B. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and invert or centerline elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

- A. Permanently mark each length of pipe with manufacturer's name or trademark and indicate conformance to standards.
- B. Materials in Contact with Potable Water: Certified according to NSF 61.
- C. Maintain copy of each standard affecting Work of this Section on Site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience and approved by manufacturer.
- C. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Florida .

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 "Product Requirements": Requirements for transporting, handling, storing, and protecting products.
- B. Inspection:
 - 1. Accept materials on Site in manufacturer's original packaging and inspect for damage.
 - 2. Manufacturer's Packaging: Comply with ASTM D3892.

- C. Storage: Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from puncture, abrasion, moisture, dust, and UV by storing in clean, dry location remote from construction operations areas.
 - 2. Protect piping and appurtenances by storing off ground.
 - 3. Provide additional protection according to manufacturer instructions.

1.8 AMBIENT CONDITIONS

- A. Section 015000 “Temporary Facilities and Controls”: Requirements for ambient condition control facilities for product storage and installation.
- B. Minimum and Maximum Temperatures: Do not install pipe when temperature is below 40 degrees F or above 90 degrees F if pipe is exposed to direct sunlight.
- C. UV Protection: Provide pipe installed above ground or outside with UV protection.

1.9 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Van Stone flanges shall not be used with pinch valves, industrial butterfly valves; elastomer bellows style expansion joints or other piping system components having an elastomer liner (rubber seat) that is used as a gasket.

2.2 PVC PIPE, TUBE, AND FITTINGS

- A. PVC Pipe and Fittings:
 - 1. Pipe:
 - a. Comply with ASTM D2241, Class 12545.
 - b. SDR-26 for maximum 160-psig working pressure rating, calculated according to ASTM D2837 for sizes up to 24” SDR-21 for maximum 200-psig working pressure rating, calculated according to ASTM D2837 for sizes up to 8”.
 - 2. Fittings: ASTM D2467, Schedule 80, socket.
 - 3. Joints: ASTM D2855, socket, solvent welded.

4. Flanges: Comply with ASME B16.5, rated for maximum 150 psig working pressure < _____ >.
 - a. Van Stone flanges shall not be used with pinch valves, industrial butterfly valves; elastomer bellows style expansion joints or other piping system components having an elastomer liner (rubber seat) that is used as a gasket.

2.3 ACCESSORIES

A. PVC Piping:

1. Flange Bolting:
 - a. Hex-Head Bolts: Stainless steel; ASTM F593 Grade 316.
 - b. Hex-Head Nuts: Stainless steel; ASTM F594 Grade 316.
2. Flange Gaskets:
 - a. Type: Full faced.
 - b. Material: EPDM.
 - c. Comply with ASME B16.21.
3. Push-On Joint Seals:
 - a. Material: EPDM .
 - b. Comply with ASTM F477.
4. Solvent Cement:
 - a. Comply with ASTM D2564.
 - b. Formulated for use with sodium hypochlorite and other caustic solutions.
 - c. manufactured by the solvent weld cement manufacturer.

2.4 SOURCE QUALITY CONTROL

- A. Section 014000 "Quality Requirements": Requirements for testing, inspection, and analysis.
- B. Provide shop inspection and testing of completed pipe sections.
- C. Owner Inspection:
 1. Make completed pipe sections available for inspection at manufacturer's factory prior to packaging for shipment.
 2. Notify Owner at least seven days before inspection is allowed.
- D. Owner Witnessing:
 1. Allow witnessing of factory inspections and test at manufacturer's test facility.
 2. Notify Owner at least seven days before inspections and tests are scheduled.

E. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 017300 "Execution": Requirements for installation examination.
- B. Verify that field dimensions are as indicated on Shop Drawings.
- C. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flange mate properly.

3.2 PREPARATION

- A. Section 017300 "Execution": Requirements for installation preparation.
- B. Ream pipe ends, remove burrs, and bevel plain-end pipe.
- C. Thoroughly clean pipe and fittings before installation.
- D. Cleaning: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

- A. Comply with ASME B31.3 and B31.9.
- B. Run piping straight along alignment as indicated on Shop Drawings, with minimum number of joints.
- C. Fittings:
 1. According to manufacturer instructions.
 2. Gaskets:
 - a. Clean seats thoroughly.
 - b. Wipe gaskets clean prior to installation.
 3. Tighten bolts progressively, drawing up bolts on opposite sides until bolts are uniformly tight; use torque wrench to tighten bolts to manufacturer instructions.
- D. Provide required upstream and downstream clearances from devices as indicated.

- E. Install piping with sufficient slopes for venting or drainage of liquids and condensate to low points.
- F. Support exposed piping as specified in Section 400507 “Hangers and Supports for Process Piping”.
- G. Provide expansion joints as specified in Section 400506 “Couplings, Adapters, and Specials for Process Piping”, and provide pipe guides as specified in Section 400507 “Hangers and Supports for Process Piping”, to compensate for pipe expansion due to temperature differences.
- H. Field Cuts: According to pipe manufacturer instructions.
- I. Joining:
 - 1. Heat Joining: Comply with ASTM D2657.
 - a. Butt-fusion joints to be done by a factory-qualified joining technician as designated by the pipe manufacturer.
 - b. Field Samples: join two sample welds on each size of pipe to be installed using the same fusion welding equipment that will be used for completion of the entire work. These sample welds will be compared to the manufacturer’s sample previously submitted in accordance with Part 1.
 - c. Pipe joints with beads in excess of 3/16-in will not be approved by the Engineer.
 - 2. Electrofusion: Comply with ASTM F1290.
 - 3. Primers and Cleaners: Comply with ASTM F402.
 - 4. PVC Solvent-Cemented Joints: Comply with ASTM D2855.
- J. Insulation: As indicated on Drawings.

3.4 TOLERANCES

- A. Section 014000 “Quality Requirements”: Requirements for tolerances.
- B. Laying Tolerances: As specified in Section 331116 “Site Water Utility Distribution Piping”.

3.5 FIELD QUALITY CONTROL

- A. Section 014000 “Quality Requirements”: Requirements for inspecting and testing.
- B. Inspection:
 - 1. Inspect for piping defects that may be detrimental as determined by the Engineer.
 - 2. Repair damaged piping, or provide new, undamaged pipe.
 - 3. After installation, inspect for proper supports and interferences.
- C. Pressure Testing:
 - 1. Test Pressure: Not less than 150 psig or 1.5 times the system’s working pressure, whichever is greater.

2. Conduct hydrostatic test for minimum two hours.
3. Filling:
 - a. Fill section to be tested with water slowly and expel air from piping at high points.
 - b. Install corporation cocks at high points.
 - c. Close air vents and corporation cocks after air is expelled.
 - d. Raise pressure to specified test pressure.
4. Observe joints, fittings, and valves under test.
5. Remove and renew cracked pipe, joints, fittings, and valves showing visible leakage and retest.
6. Leakage:
 - a. Correct visible deficiencies and continue testing at same test pressure for additional two hours to determine leakage rate.
 - b. Maintain pressure within plus or minus 5 psi of test pressure.
 - c. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of test.
 - d. Correct visible leaks and repeat test to verify no leaks at the required test pressures.

3.6 CLEANING

- A. Sections 017300 "Execution" and 017700 "Closeout Procedures": Requirements for cleaning.
- B. Keep pipe interior clean as installation progresses.
- C. Clean pipe interior of soil, grit, shavings, and other debris after pipe installation.

END OF SECTION 400531

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SECTION 400563 - BALL VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Thermoplastic ball valves.
 - 2. Stainless Steel ball valves
- B. Related Requirements:

1.3 SUBMITTALS

1.4 QUALITY ASSURANCE

- A. Test valves in accordance with AWWA C504, API 598, MSS SP61 as applicable for types listed herein.
- B. Provide testing and inspection certificates.

PART 2 - PRODUCTS

2.1 THERMOPLASTIC BALL VALVES

- A. Manufacturers:
 - 1. ASAHI
- B. Description:
 - 1. Minimum Working Pressure: 300 psig at 200 deg. F.
 - 2. Maximum Process Fluid Temperature: 200 deg. F.
 - 3. Ports: Full size.
 - 4. End Connections:
 - a. Flanged: Comply with ASME B16.5.
 - b. Union.

C. Operator: Hand lever

D. Materials:

1. Body and Ball: PVC SCH 80, ASTM D1784.
2. Seats: PTFE.

2.2 Seals: EPDM STAINLESS STEEL BALL VALVES TAG TYPE

A. Manufacturers:

1. Apollo.
2. Worcester Controls.
3. DeZurik
4. Bray
5. Or approved equal

B. Description:

1. Comply with MSS SP 72, ANSI B16.10, B16.34, B16.5, ASTM A380.
2. Cleaned, tested, and passivated per ASTM A380.
3. Minimum Working Pressure: 300 psi.
4. Body: Two-piece, bolted.
5. Ball: Full port, floating, self-adjusting.
6. Seats: Resilient and replaceable.
7. Stem: Blow out proof, O ring sealed.
8. End Connections:
 - a. Smaller than 3-inch: Threaded with flange adapters.
 - b. 3-inch and greater: ANSI Class 150 Flange.

C. Actuator:

1. Lever or as shown on Drawings.

D. Materials:

1. Body: ASTM A351 CF8M Type 316 SS.
2. Ball: ASTM A276 Type 316 SS.
3. Seats: PTFE.
4. Stem: Type 316 SS.
5. Stem Seal: PTFE.
6. Actuator lever: 300 series stainless steel with vinyl grip

2.3 SOURCE QUALITY CONTROL

A. Section 014000 "Quality Requirements": Requirements for testing, inspection, and analysis.

B. Testing: Test ball valves according to AWWA C507.

PART 3 - EXECUTION

3.1 INSPECTION

3.2 INSTALLATION

- A. According to AWWA C507.

END OF SECTION 400563

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SECTION 400565.35 – GLOBE BODY SILENT CHECK VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: Globe body silent check valves, 2.5 through 42 inches in size.
- B. Related Requirements:

1.3 COORDINATION

- A. Coordinate Work of this Section with piping and equipment connections as specified in other Sections and as indicated on Drawings.

1.4 ACTION SUBMITTALS

- A. Product Data: Submit catalog information, indicating materials of construction and compliance with indicated standards.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 INFORMATIONAL SUBMITTALS

- A. Source Quality-Control Submittals: Indicate results of factory tests and provide required certifications.
- B. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- C. Qualifications Statement:
 - 1. Submit qualifications for manufacturer.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and invert elevations.

1.7 QUALITY ASSURANCE

- A. Comply with AWWA C518.
- B. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.
- C. Provide testing and inspection certificates.
- D. Maintain a copy of each standard affecting Work of this Section on Site.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
- C. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Protect valves and appurtenances by storing off ground.
 - 3. Cover flange faces with ¾-inch plywood blinds.
 - 4. Provide additional protection according to manufacturer instructions.

1.10 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

- A. Furnish five-year manufacturer's warranty for globe body silent check valves.

PART 2 - PRODUCTS

2.1 GLOBE BODY SILENT CHECK VALVES – Tag Type SGCV

A. Manufacturers:

1. GA Figure 280
2. Cla-Val Figure 581
3. DeZurik/APCO, Series 600
4. Val-Matic Silent Check Series 1800

B. Description:

1. Clean Water Service – Tag Type SGCV
 - a. Type: Globe body, double guided, spring-loaded, poppet check valves.
 - b. Size: 2.5 through 42 inches.
 - c. Style: Flanged.
 - d. Body: Type CF8M stainless steel.
 - e. Disk: concave Type CF8M stainless steel.
 - f. Seats: Buna-N.
 - g. Disc Pin: Type 316 stainless steel
 - h. Spring: Type 316 stainless steel.

C. Working Pressure Rating:

1. Valves 2.5 through 12 Inches: 300 psig at 150 deg. F.

2.2 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements”: Requirements for testing, inspection, and analysis.

B. Testing:

1. Hydrostatically test check valves at twice rated pressure according to AWWA C518.
2. Permitted Leakage at Indicated Working Pressure: None.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field dimensions are as indicated on Shop Drawings.
- B. Inspect existing flanges for nonstandard bolt-hole configurations or design and verify that new valve and flange mate properly.

3.2 PREPARATION

- A. Thoroughly clean valves before installation.
- B. Surface Preparation:
 - 1. Touch up shop-primed surfaces with primer as specified in Section Manufacturer's standard "".
 - 2. Solvent-clean surfaces that are not shop primed.
 - 3. Clean surfaces to remove loose rust, mill scale, and other foreign substances by commercial sand blasting; SSPC SP 6.
 - 4. Prime surfaces as specified in Section Manufacturer's standard "".

3.3 INSTALLATION

- A. According to AWWA C518 and manufacturer instructions.
- B. Dielectric Fittings: Provide between dissimilar metals.

3.4 FIELD QUALITY CONTROL

- A. Inspection:
 - 1. Inspect for damage to valve lining or coating and for other defects that may be detrimental as determined by Engineer.
 - 2. Repair damaged valve or provide new, undamaged valve.
 - 3. After installation, inspect for proper supports and interferences.
- B. Pressure test valves with piping.

3.5 CLEANING

- A. Keep valve interior clean as installation progresses.

END OF SECTION 400565.35

SECTION 400593.23 – LOW-VOLTAGE MOTOR REQUIREMENTS FOR PROCESS EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Single- and three-phase motors for application on process equipment provided under other Sections.
- B. Manufacturer of the driven equipment to provide the associated motor.
- C. Related Requirements:
 - 1. Section 260510 “Limited Electrical for Small Projects”.

1.3 DEFINITIONS

- A. NETA ATS: Acceptance Testing Specification.
- B. VFC: Variable-frequency motor controller. See VFD.
- C. VFD: Variable-frequency drive. Used interchangeably with the term VFC.

1.4 SUBMITTALS

- A. Product Data: For each type and rating of motor indicated.
 - 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
 - 2. Include nameplate data, compliance with specified standards, electrical ratings and characteristics, physical dimensions, frame size, weights, mechanical performance data, support points and the following:
 - a. Descriptive bulletins, including full description of insulation system.
 - b. Bearing design data.
 - c. Efficiency at $\frac{1}{2}$, $\frac{3}{4}$ and full load.
 - d. Power factor at $\frac{1}{2}$, $\frac{3}{4}$ and full load.
 - e. Conduit entry points and sizes.
 - f. Special features and accessories (i.e. space heaters, temperature detectors, etc.).
 - g. Power factor correction capacitor rating and type (when required).

- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Qualifications Statements:
 - 1. Submit qualifications for manufacturer and testing agency.

1.5 QUALITY ASSURANCE

- A. Provide identical electric motors driving identical equipment.
- B. Motors: Listed under UL recognized component file as applicable.
- C. Motor manufacturer to maintain a documented ISO 9001 quality assurance program implementing suitable procedures and controls to monitor all aspects of production and testing.
- D. When electrically driven equipment differs from that indicated, adjust the motor size, wiring and conduit systems, disconnect devices, and circuit protection to accommodate the equipment actually installed.
- E. Testing Agency Qualifications: Member company of NETA or NICET.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Ship motor fully assembled, capable of being lifted in one piece. Comply with Section 016000, "Product Requirements" for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on site in manufacturer's original packaging and inspect for damage.
- C. Storage:
 - 1. Store materials according to manufacturer instructions.
 - 2. Energize motors furnished with space heaters to prevent condensation throughout the storage and construction period. Perform periodic motor insulation resistance tests per manufacturer's storage recommendations.
 - 3. For extended outdoor storage, remove motors from equipment and store separately.
 - 4. Maintain bearings during storage and construction period, and periodically rotate the motor shaft per manufacturer's storage recommendations.
 - 5. Lubricate per manufacturer's recommendations and inspect purged grease for water, rust, or other contaminants.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of motors that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Three year(s) from date of Substantial Completion for inverter duty motors.
 - 2. Warranty Period: Five year(s) from date of Substantial Completion for constant speed severe-duty motors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Nidec (US Motors)
 - 2. ABB (Baldor-Reliance)
 - 3. TECO-Westinghouse
 - 4. Toshiba
 - 5. WEG
 - 6. General Electric
 - 7. Or equal

2.2 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.
- B. Comply with the latest revision of the following as applicable:
 - 1. NEMA MG 1, "Motors and Generators".
 - 2. IEEE 841 for TEFC motors where driven equipment specification indicates equipment requires motors to be severe-duty, chemical duty, or mill duty.
- C. Motors
 - 1. Horsepower: Below ½, 115/230 Volt, single phase, 60 Hertz.
 - 2. Horsepower: ½ through 100, 230/460 Volt, three-phase, 60 Hertz.
 - 3. Horsepower: 125 and above, 460 Volt, three-phase, 60 Hertz.
- D. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.
- E. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

- F. Horsepower rating: Size for operation within the full load nameplate rating without applying the service factor, throughout the full range of mechanical or hydraulic operating condition.
- G. Specific motor application data such as Hp, rpm, enclosure type, accessories, etc., are specified under the detailed driven mechanical equipment specification.
- H. Nameplates: Engrave or emboss on Type 316 stainless steel fastened to the motor frame with stainless steel screws or drive pins with information per NEMA MG 1.
- I. Space heater: Include 120-volt space heater for moisture control on all motors rated 50 horsepower and larger.
- J. Service Factor: 1.15 service factor on sine wave power and 1.0 service factor on VFD power in a 40 degrees C ambient, unless otherwise noted.
- K. Motors and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- L. Enclosures: Conform to one of the NEMA standard enclosure designs as specified under the detailed driven mechanical equipment specification. If no enclosure type is specified, provide TEFC (Totally Enclosed Fan Cooled) enclosures.
- M. Motors connected to VFCs: Inverter rated duty, complying with NEMA MG 1, Part 31. First or second torsional critical speed shall be outside the operating speed range for all VFC controlled motors.
- N. Three-phase motors:
 - 1. Description: NEMA MG 1, Design B, medium induction motor.
 - 2. Efficiency: Meet or exceed requirements for NEMA MG 1, Part 12 for Premium Efficient motors 1 HP and larger.
 - 3. Service Factor: 1.15.
 - 4. Multispeed Motors: Variable torque.
 - a. For motors with 2:1 speed ratio, consequent pole, single winding.
 - b. For motors with other than 2:1 speed ratio, separate winding for each speed.
 - 5. Rotor: Random-wound, squirrel cage.
 - 6. Code Letter Designation:
 - a. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - b. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
 - 7. Accessories: Where specified herein, or under process mechanical specification.

2.3 THREE PHASE MOTOR CONSTRUCTION

- A. Enclosure and Frame:
 - 1. NEMA enclosure type as specified in the process equipment specification.
 - 2. NEMA frame for the associated horsepower.

3. Motor frames: Cast iron or welded heavy plate steel construction, stiff enough to withstand the rotating forces and torques generated and designed to limit or avoid any undesirable harmonic resonances.
4. Provide a threaded, forged steel, shouldered eyebolt blind tapped into the motor frame for lifting on all frames 254T and larger.
5. Condensate drain openings: Locate drain holes at the low points in the end brackets to allow removal of accumulated moisture from enclosures. Provide corrosion resistant, breather drain plugs for severe-duty motors.
6. Hardware: Hex head, SAE Grade 5 or better, plated for corrosion protection.
7. Nameplates: Engraved or embossed stainless steel plates fastened to the motor frame with stainless steel screws or drive pins. Clearly indicate all items of information listed in the applicable part of NEMA MG 1.
8. Main terminal box: Fabricated steel or cast iron, sized per the NEC for number and size of conduit connections and conductor bending and terminations as indicated on the Drawings. Split box top to bottom with capability to rotate entry point to any quadrant. Provide gaskets between the box and motor frame and between box and its cover. Include ground lug for equipment grounding conductor termination.
9. Bearing housings: Provide machined surfaces for attaching a magnet mounted accelerometer to monitor the motor vibration in the vertical, horizontal, and axial directions at each bearing housing.
10. Frame grounding: provide motor frame grounding pad or threaded stud where supplemental grounding to frame is indicated on the drawings.

B. Windings:

1. Copper
2. Insulation rating: Class F.
3. Temperature rise: Class B at 1.0 SF, Class F at 1.15 SF.
4. Insulation: Non-hygroscopic, epoxy encapsulated windings for enclosure types WP I and WP II. Provide upgraded insulation by additional dips and bakes to increase moisture resistance for totally enclosed designs. Provide vacuum pressure impregnated (VPI) epoxy insulation for moisture resistance for outdoor motors.
5. Provide chemical and humidity resistance insulation system when IEEE 841 motors are specified.
6. Provide winding surge withstand capability per NEMA 1, Part 31 for VFC driven motors.
7. Provide specified temperature sensing devices for VFC driven equipment. If not specified, provide a winding temperature detector per the accessories paragraph.

C. Motor leads: Non-wicking type, minimum Class F temperature rating and permanently numbered for identification.

D. Stator: Built up core using high grade, low loss silicon steel laminations keyed or dovetailed to the stator frame and securely held in place at each end.

E. Rotor:

1. Forged or rolled steel shaft, machined, smooth finished, with sufficient strength for operation including 25 percent overspeed condition.
2. Shaft end coordinated with driven equipment coupling.
3. Entire assembly coated with protective coating.

4. Inpro seals on both ends of the shaft to prevent grease leakage and entrance of foreign materials, such as water and dirt, into the bearing area while running, coasting, or at rest. Severe duty motors to have improved sealing per IEEE 841.
 5. Vertical Motor Shafts:
 - a. Provide hollow shaft and P flange mounting to allow driven shaft to extend through provide for vertical pump applications.
 - b. Coupling for connecting the motor shaft to the driven shaft is located in the top of the motor.
 - c. Where solid shaft is provided couple the driven shaft below the P flange face.
 6. Rotor Core:
 - a. Solid, built-up stack of fully processed and coated, high-grade, low-loss silicon steel laminations.
 - b. Die cast aluminum or fabricated copper bars or their respective alloys.
 - c. Rotors on frames 213T and above to be keyed to shaft and rotating assembly dynamically balanced.
 7. Rotor Assembly:
 - a. Coated with corrosion resistant epoxy insulating varnish or other protective coating, thermally stable, statically and dynamically balanced.
 - b. Balance weights securely attached to the rotor resistance ring by welding or similar permanent method.
- F. Horizontal Bearings: roller type, grease lubricated.
1. Bearings: Anti-friction open or single-shield, vacuum-degassed steel ball or roller bearings, electric motor quality, designed for 45 degrees C maximum temperature rise. Metric size bearings are not acceptable.
 2. Life: L 10 life of 100,000 hours for direct coupled applications and 26,000 hours for belted applications based. IEEE 841 motors, L 10 life increased to 150,000 and 50,000 hours respectively.
 3. Shaft Seals: Provide to prevent grease leakage and the entrance of foreign materials, such as water and dirt, into the bearing area while running, coasting, or at rest.
 4. Shaft Currents: Provide mitigation accessory per process equipment specification.
 5. Comply with ABMA and refer to process equipment specification for stricter or additional requirements.
- G. Vertical Bearings: per manufacturer, thrust type.
1. Bearings: Manufacturer's standard design, constructed with thrust bearings on top to allow inspection and/or replacement without requiring complete disassembly of motor, of type and size to satisfy thrust loading requirements.
 2. Life: Rated for an in-service L 10 life of 100,000 hours, designed to support the weight of the rotor plus, if required, the weight of the rotating driven equipment parts and the hydraulic thrust created by the driven equipment, with a 40 degrees C maximum temperature rise. Metric bearings are not acceptable.
 3. Shaft seals: Provide to prevent grease leakage and the entrance of foreign materials, such as water and dirt, into the bearing area while running, coasting, or at rest.

4. Shaft currents: Provide mitigation accessory per process equipment specification.
5. Comply with ABMA and refer to process equipment specification for stricter or additional requirements.

2.4 THREE PHASE MOTOR ACCESSORIES

- A. Space heaters: Silicone rubber strip type, accessible for inspection, rated 120 Volt, single phase, designed to prevent condensation inside the enclosure when the motor is idle, with leads brought out to a separate terminal box. Emboss the heater wattage and voltage on the motor nameplate.
- B. Winding Temperature Switch: Three embedded bi-metallic temperature thermostat switches with normally closed contacts and leads terminating in the main conduit box.
- C. Winding Temperature Relay: Three embedded PTC thermistors with epoxy-encapsulated 115 VAC, single-phase, solid-state control relay with dual Form C contacts. Wire thermistor leads brought out to separate terminal box on the motor frame.
- D. Motor Shaft Currents: Insulate the ODE bearing and provide a shaft grounding strap. Insulate bearing probes to prevent shorting out bearing insulation.
- E. Shaft Grounding Rings: Maintenance free, circumferential micro fiber type, AEGIS™ SGR by electro Static Technology or equal to discharge shaft currents to ground.
- F. Anti-Backspin Device: Provide shaft mounted, mechanical non-reverse ratchet rated at 100 percent of motor full load torque for immediate protection against reversing due to phase reversals or from backspin at shutdown.
- G. Encoder for vector drive motors: Provide encoder on opposite drive end to sense rotor speed and provide closed loop feedback (quadrature signal with line driver output) to a control device. Provide sufficient length of encoder cable to connect encoder to variable frequency controller.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp: shall be one of the following, to suit starting torque and requirements of specific motor application:
 1. Permanent-split capacitor.
 2. Split phase.
 3. Capacitor start, inductor run.
 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Motors 1/20 HP and Smaller: Shaded-pole type.
- D. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

- E. Insulation: Class F or better, with Class B temperature rise of 80 degrees C above ambient, 1.15 service factor. Locked rotor current to be no greater than specified in NEMA MG 1, Design "N".
- F. Standard enclosure: Fully gasketed, totally-enclosed air over or fan cooled in conformance with NEMA MG 1.
- G. Washdown Duty Enclosure: Where motor is installed in wet or corrosive areas routinely exposed to washdowns, high humidity or caustic chemicals, provide stainless steel, paint free washdown motors with Inpro bearing isolators, stainless steel T-type condensation drains, nitrile conduit box gasket, and corrosion resistant fans.
- H. Bearings: Sealed ball bearings permanently lubricated for 10 years normal use, furnished with shaft slinger.
- I. Class 1, Division 1 and 2 locations: Explosion proof, marked with a T3B temperature code label, and UL listed for use in Class 1, Division 1, Groups C & D, and Class II, Groups E, F, & G hazardous location. The temperature code marking to appear on the nameplate.

2.6 SOURCE QUALITY CONTROL

- A. Factory Testing: Prior to shipment perform manufacturer's standard tests in accordance with NEMA MG 1 and IEEE 112.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Upon delivery of motor and prior to unloading, inspect equipment for damage.
- B. Comply with DELIVERY, STORAGE, AND HANDLING article within this specification.

3.2 INSTALLATION

- A. Prepare rigid foundation or mounting surface to minimize vibration and maintain alignment between motor and load shaft.
- B. Install the motors per manufacturer's installation instructions.
- C. Anchor motor base to load bearing surface with grade 5 steel bolts or better.
- D. Align the motor shaft with driven equipment according to manufacturer's written instructions. Adjust axial position of motor frame with respect to load shaft.
- E. Accurately adjust flexible couplings for direct drive according to machine manufacturer's guidelines. Check alignment to minimize vibrations. Coupling spacing according to coupling manufacturer guidelines.

- F. Install motor branch circuit conduits and conductors in accordance with NEC and local code requirements. Connect motors to rigid conduit system by a short section of liquid-tight flexible conduit to isolate the conduit system from motor vibration. Where motors are installed outdoors, bring conduit into bottom of motor terminal box to avoid standing water at connection point.
- G. Terminate the motor leads as shown on the connection diagrams using products intended for vibration applications.
- H. Ground equipment according to Section 26056, "Grounding and Bonding for Electrical Systems."
- I. Tighten electrical connections and terminals according to manufacturers' published torque values.
- J. Install conduit and wiring between motor auxiliary devices and associated indicators, controllers and protective devices in accordance to installation drawings.
- K. Connect devices sensitive to electromagnetic interferes such as RTD's, thermistors, thermal protector switches, vibration sensors with shielded instrumentation wiring per installation drawings.
- L. Comply with NECA 1.
- M. Seismic Bracing: Comply with requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

3.3 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553, "Identification for Electrical Systems." Identify field-installed conductors, interconnecting wiring, and components.

3.4 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until motors are ready to be energized and placed into service.
- B. Lubrication and Shaft Rotation: Lubricate parts and rotate shaft periodically according to manufacturer's written instructions until motors are ready to be energized and placed into service.

3.5 FIELD QUALITY CONTROL

- A. Perform inspections and tests Inspect and test according to the Inspection and Test Procedures for Rotating Machinery state in NETA Acceptance Testing Specification paragraph 7.15.1. Options tests are not required unless called for within the process equipment specification.

- B. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Motors will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies the motor and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP AND ADJUSTMENT

- A. Complete installation and startup checks according to manufacturer's written instructions. Confirm motor is structurally, mechanically, and electrically ready for start-up. Checks include support system, vibration isolation, alignment, lubrication system, and cleanliness.
- B. Start-up motor in accordance with process equipment specification.
- C. Verify correct phase rotation at motor with driven equipment uncoupled. Correction for phase rotation to be made in the motor terminal box.
- D. Prepare inspection and test reports.

3.7 DEMONSTRATION / SYSTEM FUNCTION TESTS

- A. Run motor for system testing as required in motor controller and driven equipment specifications.
- B. Confirm correct operation of all protective and metering devices.
- C. Measure voltage and motor running current and evaluate relative to load conditions and nameplate full load amperes. Corrective action is required for any current imbalance 10 percent or greater.
- D. Prepare driven equipment system testing report. Include results of all tests and check made, meter readings and recordings, and summary adjustments made. Clearly identify any discrepancies and concerns.

END OF SECTION 400593.23

SECTION 406100 - PROCESS CONTROL AND ENTERPRISE MANAGEMENT SYSTEMS GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes procurement of the services of a Process Control System Supplier (PCSS) to provide all materials, equipment, labor, and services required to achieve a fully integrated and operational system as specified herein, in “Related Requirements” under this Article, and in related drawings, except for those services and materials specifically noted.
- B. Under this contract, PCSS will also serve as the Applications Engineer System Supplier (AESS).
- C. Include auxiliary and accessory devices necessary for system operation or performance, such as transducers, relays, signal amplifiers, intrinsic safety barriers, signal isolators, software, and drivers to interface with existing equipment or equipment provided by others under other Sections of these specifications, whether indicated on the Drawings or not.
- D. All equipment and installations to satisfy applicable Federal, State and local codes. Refer to Electrical drawings for area classifications for Class and /Division ratings.
- E. Use the equipment, instrument, and loop numbering scheme indicated on the Drawings and in the specifications in the development of the submittals. Do not deviate from or modify the numbering scheme.
- F. Related Requirements:
 - 1. Section 406121.20 “Process Control System Testing.”
 - 2. Section 406733 “Panel Wiring.”
 - 3. Section 406863 “Configuration of HMI Software.”
 - 4. Section 406866 “Configuration of Controller Software.”
 - 5. Section 407000 “Instrumentation for Process Systems.”
 - 6. Section 407313 “Pressure and Differential Pressure Gauges.”
 - 7. Section 407336 “Pressure and Differential Pressure Switches.”

1.3 DEFINITIONS

- A. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

- B. Applications Engineering System Supplier (AESS): The entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

1.4 PREINSTALLATION MEETINGS

- A. Refer to related sections:

- 1. Section 406863 “Configuration of HMI Software”

1.5 ACTION SUBMITTALS

- A. Project Plan, Deviation List, and Schedule Submittal:

- 1. Submit, within 45 calendar days after Notice to Proceed, a Project plan. Submit for approval the Project Plan before further submittals are accepted. The Project Plan to contain the following:
 - a. Overview of the proposed control system describing the understanding of the project work, a preliminary system architecture drawing, interfaces to other systems, schedule, startup, and coordination. Include a general discussion of startup, replacement of existing equipment with new, approach to testing and training, and other tasks as required by these specifications.
 - b. Preliminary list of HMI software, PLC software, and PLC hardware, to be modified, including version numbers, solely to determine compliance with the requirements of the Contract Documents prior to beginning development of system programming. The review and approval of software and hardware systems as part of this Project Plan stage does not relieve the PCSS of meeting all the functional and performance requirements of the system as specified herein. Substitution of manufacturer or model of these systems after the submittal is approved is not allowed without Engineer’s approval.
 - c. Project personnel and organization including the PCSS project manager, project engineer, and lead project technicians. Include resumes of each of these individuals and specify in writing their commitment to this project. These do not need to be submitted again if already submitted in the Qualification submittal.
 - d. Sample formats of the shop drawings to be submitted and in conformance with the requirements of the Specifications. At a minimum include samples of control system architecture and I/O wiring diagrams.
 - 2. Define Exceptions to the Specifications or Drawings in a Deviation List consisting of a paragraph-by-paragraph review of the Specifications indicating acceptance or any proposed deviations, the reason for exception, the exact nature of the exception and the proposed substitution so that an evaluation may be made by the Engineer. Specifically state if no exceptions are taken to the specifications or drawings. If there is no statement by the PCSS, then it is acknowledged that no exceptions are taken.

3. The PCSS must coordinate their work with the General Contractor's overall schedule. PCSS schedule incorporates all PCSS milestones including but not limited to the following:
 - a. Schedule for all subsequent project submittals. Include the time required for Contractor's submittal preparation, Engineer's review time, and a minimum of two complete review cycles.
 - b. Proposed dates for all project coordination meetings.
 - c. Hardware purchasing, fabrication, and assembly (following approval of related submittals).
 - d. Software purchasing and configuration (following approval of related submittals).
 - e. Shipment of instrument and control system equipment.
 - f. Installation of instrument and control system equipment.
 - g. Testing: Schedule for all testing.
 - h. Schedule for system cutover, startup, and/or going on-line for each major system. At a minimum include the schedule for each process controller and HMI server/workstation provided under this Contract.
 - i. Schedule for all training including submittal and approval of O&M manuals, factory training, and site training.
 - j. Listing of all major graphics and PLC programs intended to be created or modified for this project. Indicate if graphics or programming are new or existing.
4. Component and Wiring Identification and Tagging Plan:
 - a. All components provided by PCSS require a tag, label, or nameplate. Review specifications and provide a table indicating the tagging and labeling scheme used by the PCSS:
 - 1) Instruments.
 - 2) Network Rack Components.
 - 3) Panel Hardware.
 - 4) Standalone hardware or communication equipment.
 - 5) Wires and communication cables.
 - 6) Other.
 - b. Provide detailed information so Engineer can review the following characteristics for each type of tag, label, or nameplate for the different types of components provided above:
 - 1) Size or range of size of the tag, label or nameplate.
 - 2) Font style.
 - 3) Material.
 - 4) Color(s).

B. Input/Output (I/O) List Submittal:

1. Submit, within 60 days after Notice to Proceed, a complete system Input/Output (I/O) address list for equipment connected to the control system under this Contract.
2. Base the I/O list on the P&ID's, the Drawings, the design I/O list (if included), and requirements in the Specifications.

3. Submit the I/O list in both a Microsoft Excel readable electronic file format and an 8-1/2 inch by 11-inch hard copy.
4. Reflect all active and spare I/O points on the I/O list. Add points to accommodate spare I/O's as required in the specifications.
5. Arrange the I/O list so that each control panel has a dedicated worksheet, which includes the following information:
 - a. TAG NUMBER(S): As indicated on the Drawings, the identifier assigned to a device that performs a function in the control system. As part of this information, break out the tag loop number to allow for sorting by loop.
 - b. DESCRIPTION: A description of the function of the device (text that includes signal source, control function, etc.) Include the text "Spare Points" for all I/O module points that are not connected to equipment.
 - c. PHYSICAL LOCATION: The Control Panel designation of where the I/O point is wired to.
 - d. PHYSICAL POINT ADDRESS: Rack, Slot, and Point (or Channel) assignment for each I/O point.
 - e. I/O TYPE: use DO - Discrete Output, DI - Discrete Input, AO - Analog Output, AI - Analog Input, PI - Pulse Input, or PO - Pulse Output.
 - f. RANGE/STATE: The range in engineering units corresponding to an analog 4-20 mA signal, or, the state at which the value of the discrete points is "1."
 - g. ENGINEERING UNITS: The engineering units associated with the Analog I/O.
 - h. ALARM LIMITS: Include alarm limits based on the control descriptions and the Drawings.
 - i. P&ID - the P&ID or drawing where the I/O point appears on. Mark as "NA" (Not Applicable) if the I/O point is derived from a specification requirement and is not on the P&IDs.
 - j. LOGICAL POINT ADDRESS: I/O address of each point.
6. Sort the I/O list in order by:
 - a. Physical location.
 - b. I/O Type.
 - c. Loop Number.
 - d. Device Tag.
7. Once the I/O list is approved, the PLC I/O addresses are not to be modified without approval by the Engineer.

C. Field Instruments Submittal:

1. Refer to Section 407000 for submittal requirements.

D. Control System Architecture and Hardware Submittal:

1. For each controller, digital, or network hardware component specified in the sections above, submit a cover page that lists date, specification number, product name, manufacturer, model number, location(s), and power required. Preferred format for the

- cover page is ISA-TR20.00.01-2007, general data sheet; however, other formats will be acceptable provided they contain all required information.
2. Complete system architecture drawing(s) showing in schematic form the interconnections between major SCADA hardware components within the scope of supply, including control panels, computers, networking equipment, control panels with PLC systems and I/O modules, local operator interfaces, process equipment vendor panels with PLCs, and networked peripherals such as power monitors, security cameras, etc.
 3. Develop the system architecture drawing(s) in accordance with the following information and guidelines:
 - a. Show power connections to each piece of equipment or grouping of equipment with voltage and power sources noted such as 120VAC UPS battery, 24VDC battery, or 120VAC from LP (lighting panel). Indicate specific UPS number or circuit number whenever possible.
 - b. All communication cable types should be uniquely identified with a specific line type and cable characteristics clearly indicated in a key or legend located on drawing(s). For example, 50/125-micron multimode mode fiber, or CAT6 Ethernet copper cabling. Any multiconductor communication cables will be clearly labeled above each individual communication with a note added to drawing that states if no quantity exists above a line type, there is only one communication cable between devices. If a multi-conductor cable has multiple colors, legend to clearly indicate which colors are used for which networks (i.e., a multi-pair fiber optic cable used for dedicated networks such as SCADA, Electrical, Security, HVAC, etc.)
 - c. All communication cables need to be assigned a unique cable identification label and shown in either a table or above the communication line.
 - d. Identify network protocols for each communication path or for system indicated in a key or legend as appropriate. Examples are Allen-Bradley EtherNet/IP, Modbus TCP/IP, or DNP3.
 - e. Indicate which port or connection number the communication cable is terminating at any device that has multiple ports or connection points. For multiple devices, this could be shown once in a key or legend and noted on architecture as appropriate.
 - f. For each PLC control panel or network communication enclosure provided by PCSS, the architecture drawing clearly references other drawings provided by the PCSS for detailed panel wiring diagrams with a note near that PLC panel or communication enclosure indicating referenced drawing numbers. A placeholder is acceptable at the time of submission if these drawings are to be submitted at a later date.
 - g. Use symbology and/or icons whenever possible to represent a device and differentiate between devices that are different form factors (i.e. tower computer vs. desktop computer vs. rack mounted). Vendor CAD libraries are preferred for symbols.
 - h. Develop a diagram that will allow a qualified technician to interconnect all equipment without having to refer to additional manuals or literature.
 - i. Use a minimum sheet size of 11"x17" and use of more than one sheet is acceptable with a logical breakout between sheets (i.e., head end on one sheet and plant control system on another). Clearly identify line continuations between drawings.

E. Panel Layout Drawings and Wiring Diagrams Submittal:

1. Panel Layout Drawings: Submit drawings for all panel modifications. Draw to scale panel assembly and elevation drawings and detail all equipment in or on the panel. Use 11"x17" sheet size for panel drawings and include the following:
 - a. Clearly indicate a legend sheet with all symbols used on drawings and with voltage, color and size of each wire and in accordance with requirements of Section 406733 "Panel Wiring."
 - b. Interior and exterior panel elevation drawings to scale.
 - c. Nameplate schedule.
 - d. Conduit access locations.
 - e. Panel construction details.
 - f. Cabinet assembly and layout drawings to scale. Include a bill of material on the assembly drawing with each panel component clearly defined. Cross-reference the bill of material to the assembly drawing so that a non-technical person can readily identify all components of the assembly by manufacturer and model number.
 - g. Fabrication and painting specifications including color (or color samples).
2. Wiring Diagrams Submittal:
 - a. Submit drawings for all panel modifications showing all wiring connections in the I/O system where direct hardwired interfaces exist between the PCSS control panels and vendor provided control panels furnished under other Divisions. This includes but is not limited to terminal block numbering, relay contact information, instruments, equipment, and control panel names. Include drawings in Final O&M submittal. Leaving this information blank on Final Documentation drawings is not acceptable.
 - b. Panel wiring diagrams depicting wiring within and on the panel as well as connections to external devices. Panel wiring diagrams include power and signal connections, UPS and normal power sources, all panel ancillary equipment, protective devices, wiring and wire numbers, and terminal blocks and numbering. Field device wiring includes the device ISA-tag and a unique numeric identifier. Diagrams identify all device terminal points that the system connects to, including terminal points where I/O wiring lands on equipment not supplied by the PCSS. Wiring labeling used on the drawings match that shown on the Contract Documents or as developed by the PCSS and approved by the Engineer. I/O wiring numbered with rack number, slot number, and point number. Two-wire and four-wire equipment to be clearly identified, and power sources noted. Submit final wire numbering scheme. Provide panel drawings that are 11-inch x 17-inch in size.

F. Human Machine/Operator Interface Submittals:

1. Refer to Section 406863 "Configuration of HMI Software" for specific submittal requirements.

G. Controller Program Submittal:

1. Refer to Section 406866 "Configuration of Controller Software" for specific submittal requirements.

H. Testing Plan Submittals:

1. Refer to Section 406121.20 "Process Control System Testing" for specific testing submittal requirements.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For all PCSS supplied hardware to include in operation and maintenance manuals.

1. Submit in accordance with Section 017823 "Operation and Maintenance Data."
2. Include the following information on the operations and maintenance manuals:
 - a. Table of Contents:
 - 1) Provide a Table of Contents for the entire manual with the specific contents of each volume clearly listed. Include the complete Table of Contents in each volume.
 - b. Instrument and Equipment Lists:
 - 1) Develop the following lists in Microsoft Excel format:
 - a) An instrument list or spreadsheet for all instruments supplied including tag number, description, specification section and paragraph number, manufacturer, model number, calibrated range, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
 - b) An equipment list or spreadsheet for all non-instrument devices supplied listing description, specification section and paragraph number, manufacturer, model number, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.
 - 2) Provide the record documentation of the completed test forms with sign-offs as specified in Section 406121.20 "Process Control System Testing."
 - 3) Include instrument/equipment calibration and configuration forms.
 - c. As-Built Drawings:
 - 1) Complete as-built drawings, including all drawings and diagrams specified in this section under the "Submittals" section. Include on the drawings all termination points on all equipment the system is connected to, including terminal points of equipment not supplied by the PCSS. Provide electronic files for all drawings produced. Provide drawings in Adobe Acrobat format.
 - 2) Include on as-built documentation information from submittals, as described in this Specification, updated to reflect the as-built system. Incorporate errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests.

B. Electronic O&M Information:

1. In addition to the hard copy of O&M data, provide an electronic version of all equipment manuals and data sheets, along with any software back-up of configuration files, on DVD or USB thumb drive. Supply electronic documents in Adobe Acrobat format.
2. Provide electronic files for all custom-developed manuals including training manuals. Supply text in Microsoft Office and Adobe Acrobat formats.
3. Provide electronic files for all drawings produced. Supply drawings in AutoCAD ".dwg" and in Adobe Acrobat formats. Provide drawings using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.
4. Back up each computer system hardware device onto DVD or USB thumb drive after Substantial Completion and turn over to the Owner.
5. If specified in the training section, provide digital copies of all training videos. Format videos so they are readable by standard DVD players and by standard PC DVD drives, a minimum of 800 by 600 pixels, and include sound.

C. Include information as specified in Section 017823 "Operation and Maintenance Data" on the cover and edge of each volume.

1.7 MAINTENANCE MATERIAL SUBMITTAL

- A. Furnish extra materials from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Refer to individual specification sections in Division 40 for spare equipment requirements and provide one comprehensive spare parts submittal for project.
- B. Pack all spare parts in individual cartons and label with indelible markings clearly indicating component(s) inside. Supply with the required spare parts complete ordering information paperwork including manufacturer's contact information (address and phone number), part name, part number, equipment name and tag number(s) for which the part is to be used (if applicable). Deliver and store the spare parts in a location directed by the Owner or Engineer.

1.8 QUALITY ASSURANCE

- A. The Process Control System Supplier (PCSS) to be a "systems integrator" regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. For the purposes of this Specification Section, a "systems integrator" means an organization that complies with all of the following criteria:
1. Employs personnel on this project who have successfully completed ISA or manufacturer's training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project. Key personnel to hold ISA CCST Level 1 certification or have a minimum of 10 years of verifiable plant startup experience. Key personnel includes, as a minimum, the lead field technician.

2. Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion is defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSS. Potential references for projects where the PCSS's contract was of similar size to this project.
 3. Has been actively engaged in the type of work specified in this Section for a minimum of five years.
- B. Maintain a permanent, fully staffed and equipped service facility with full-time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. Respond to on-site problems within 12 hours of notice.
- C. The PCSS shall be as listed below:
1. McKim & Creed (M&C), Dana Musumeci, DMusumeci@mckimcreed.com, (561-305-6222).
- D. Being listed in this specification does not relieve any potential PCSS from meeting the qualifications specified in this Section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 016000 "Product Requirements" for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

- A. Environmental Requirements: Refer to Electrical Drawings for specific environmental and hazardous area classifications.
- B. Elevation: Design equipment to operate at the project ground elevation.
- C. Temperature:
1. Outdoor area equipment to operate between -4 to 122 degrees F (-20 to 50 degrees C) ambient.
 2. Equipment in indoor locations operate between 50 to 95 degrees F (10 to 35 degrees C) degrees ambient minimum.
 3. Storage temperatures range from 32 to 122 degrees F (0 to 50 degrees C) degrees ambient minimum.
 4. Furnish additional cooling or heating if required by the equipment specified herein.
 5. Relative Humidity. Air-conditioned area equipment operates between 20 to 95 percent relative, non-condensing humidity. All other equipment operates between 5 to 100 percent relative, condensing humidity.

1.11 WARRANTY

- A. Warranty Period: 1 year from date of Substantial Completion unless noted otherwise in individual specification sections.

PART 2 - PRODUCTS

2.1 GENERAL

A. Electrical Requirements for Control System:

1. Operate equipment on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. Regulators and power supplies required for compliance with the above to be provided between power supply and interconnected instrument loop. Supply constant voltage transformers where equipment requires voltage regulation.
2. With the exception for field device network connected devices, all electronic instrumentation utilizes linear transmission signals of isolated 4 to 20 mA DC (milliampere direct current) capable of driving a load up to 750 ohms, unless specified otherwise. However, signals between instruments within the same panel or cabinet may be 1-5 VDC (volts direct current).
3. Outputs of equipment that are not of the standard signals to have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero-based signals will be allowed.
4. All switches have double-pole, double-throw (DPDT) contacts rated at a minimum of 600 VA, unless noted otherwise.
5. Materials and equipment UL approved whenever such approved equipment and materials are available.
6. All equipment furnished, designed and constructed so that in the event of power interruption, the systems specified go through an orderly shutdown with no loss of memory and resume normal operation without manual resetting when power is restored, unless otherwise noted.
7. Surge protection requirements for control system power, signal, and communication lines are specified in Section 407856 "Isolators, Intrinsically Safe Barriers, and Surge Suppressors."

PART 3 - EXECUTION

3.1 PROCESS CONTROL DESCRIPTIONS

A. Existing conditions related to Instrumentation & Controls:

1. The following Process Control Descriptions citing current conditions and control of the existing RO Skids is included for reference only.
 - a. All four RO skids are controlled and monitored through PLC-1/MCP-1 in the electrical room. Wiring for skid-mounted controls is routed through terminal cabinets. PLC-1/MCP-1 is Allen-Bradley CompactLogix 5380 series.
 - b. There are two types of set points; fixed set points hardcoded into the PLC such as water quality operation limits, timers, and clearwell alarm levels; or operation setpoints requiring more frequent changes such as chemical dose rates and RO skid setpoints. Current RO Skid setpoints are as follows:

- 1) Permeate Flow – Q_p
 - 2) Concentrate Flow – Q_c
 - 3) Overall Recover Rate – Y expressed as a percent of Q_p relative to total feed rate ($Q_p + Q_c$)
 - 4) Fulshing Runtime
- c. Automatic Startup Control Sequence: The control system will take the following steps automatically during the startup of the first RO Skid.
- 1) Check the Feed Pump to make sure it is in Remote at the pump and not Interlocked.
 - 2) Check the Feed Valve to make sure it is Remote at the valve, not Out-Of-Service, and is closed (Valve Position less than 3 percent).
 - 3) Check the Concentrate Valve to make sure it is in Remote at the valve, not Out-Of-Service, and is closed (Valve Position less than 3 percent).
 - 4) If this is the first train being started, check the Sulfuric Acid feed to make sure it is not Interlocked or Out-Of-Service.
 - 5) If this is the first train being started, check the Scale Inhibitor feed to make sure it is not Interlocked or Out-Of-Service.
 - 6) If this is the first train being started, check the Corrosion Inhibitor feed to make sure it is not Interlocked or Out-Of-Service.
 - 7) If this is the first train being started, check the Sodium Hydroxide feed to make sure it is not Interlocked or Out-Of-Service.
 - 8) If this is the first train being started, check the Bypass to Waste Valve to make sure it is in Remote at the valve and not Out-Of-Service. Place the valve in Manual control and set a setpoint of 40%. Move on when the valve position goes above 20%.
 - 9) If this is the first train being started, call for the Lead Well and wait until it is running.
 - 10) If this is the first train being started, wait until the Well Flow is above 250 gpm. When it reaches 250 gpm, place the Startup Bypass Valve in Automatic Control.
 - 11) If this is the first train being started, start the Sulfuric Acid feed. Wait until it is running.
 - 12) If this is the first train being started, Start the Scale Inhibitor. Wait until it is running.
 - 13) If this is the first train being started, wait until the deviation of Raw pH from the setpoint is within 0.25 for 5 minutes.
 - 14) If this is the first train being started, wait until the Raw Water Conductivity is between 2,000 and 16,000 $\mu\text{S}/\text{cm}$.
 - 15) Place the Feed Valve control into Manual with a 50 percent valve position setpoint and the Concentrate Valve into Manual with a 75 percent valve position setpoint. Wait until the Feed Valve is more than 47 percent and the Concentrate Valve is more than 73 percent.
 - 16) Wait for a period of time to allow the membrane to fill.
 - 17) If the Flush Required Flag is set, flush for the number of minutes specified on the Train Screen.
 - 18) Start the Feed Pump and wait for 30 seconds after running status.
 - 19) Place the Feed and Concentrate valves into Automatic. Open the Blend Valve solenoid. Declare the train as running.

- d. Normal Operation: During normal operation the Feed and Concentrate Valves are throttled to maintain desired set points for Permeate Flow and Concentrate Flow targeting the overall recovery percent operator set point while monitoring feed water quality and maintaining system operating parameters such as feed pressure, differential pressure, permeate flux, salt passage, recovery rate, salt rejection, permeate pressure and permeate total dissolved solids (TDS).
- e. Shutdown and Automatic Flushing: Operator selects the STOP button on the corresponding individual RO Skid screen. Upon automatic shutdown the train will automatically flush using residual pressure from the raw water wells flowing through the Cartridge Filter and the non-operating Feed Pump. The Feed Valve is preset to a fixed 50-percent position to limit flow to the RO skid. The Concentrate Valve should remain fully open to allow flow through the second stage membranes and to prevent pressurizing the membranes. Per the RO Skid manufacturer, the desired minimum flushing fluid flow rate is five gallons per minute per the number of first stage membranes; more flow is better, but target permeate flow during flushing operations should recover less than 10 percent of the feed rate; this is achieved by flowing flushing water at low pressure (15 psi to 30 psi per the membrane manufacturer).

All four RO skids are controlled and monitored through PLC-1/MCP-1 in the electrical room. Wiring for skid-mounted controls is routed through terminal cabinets. PLC-1/MCP-1 is Allen-Bradley CompactLogix 5380 series.

B. Instrumentation & Controls modifications shall be as follows:

1. Valves being added or modified in this part:
 - a. Feed Valve(s) in this part refers to the following valves depicted in the drawings:
 - 1) RO Skid No. 1 Feed Valve – Tag # BV-22-1-1
 - 2) RO Skid No. 2 Feed Valve – Tag # BV-22-2-1
 - 3) RO Skid No. 3 Feed Valve – Tag # BV-22-3-1
 - 4) RO Skid No. 4 Feed Valve – Tag # BV-22-4-1
 - b. Flushing Bypass Valve(s) in this part refers to the following valves depicted in the drawings:
 - 1) RO Skid No. 1 Flushing Bypass Valve – Tag # BV-22-1-3
 - 2) RO Skid No. 2 Flushing Bypass Valve – Tag # BV-22-2-3
 - 3) RO Skid No. 3 Flushing Bypass Valve – Tag # BV-22-3-3
 - 4) RO Skid No. 4 Flushing Bypass Valve – Tag # BV-22-4-3
2. Feed Flow Control: The new RO Pumps will be driven by variable speed drives (VFD), which will eliminate the need for modulating feed flow control valves. These will be replaced with motor actuated valves. The new Feed Valves will operate open or close; remaining open during pump operation and closed when the pump is off; the Feed Valve motor actuator will have modulating capability but will be wired for open or close operation. In addition, a new modulating valve to control flushing will be added to the

new pump bypass piping to control flow during flushing operations. This new valve is referred to as the “Flushing Bypass Valve” in this part. Feed flow control during normal operation will essentially remain the same, but with the VFD controlling the feed flow rate by modulating the Pump Motor speed between pump manufacturer recommended low and high Pump Motor speed settings. This change will require minimal PLC and human-machine interface (HMI) reconfiguration. However, the following Automatic Startup Control Sequence will need to change as follows:

- a. The Automatic Startup Control Sequence will change as follows (steps in bold indicate an addition or modification to the Automatic Startup Control Sequence):
 - 1) Check the Feed Pump to make sure it is in remote at the pump and not Interlocked.
 - 2) Check the Feed Valve to make sure it is remote at the valve, not Out-Of-Service, and is closed (Valve Position less than 3 percent).
 - 3) Check the Concentrate Valve to make sure it is in remote at the valve, not Out-Of-Service, and is closed (Valve Position less than 3 percent).
 - 4) **Check the Flushing Bypass Valve to make sure it is in Remote at the valve, not Out-of-Service and closed.**
 - 5) If this is the first train being started, check the Sulfuric Acid feed to make sure it is not Interlocked or Out-Of-Service.
 - 6) If this is the first train being started, check the Scale Inhibitor feed to make sure it is not Interlocked or Out-Of-Service.
 - 7) If this is the first train being started, check the Corrosion Inhibitor feed to make sure it is not Interlocked or Out-Of-Service.
 - 8) If this is the first train being started, check the Sodium Hydroxide feed to make sure it is not Interlocked or Out-Of-Service.
 - 9) If this is the first train being started, check the Bypass to Waste Valve to make sure it is in Remote at the valve and not Out-Of-Service. Place the valve in Manual control and set a setpoint of 40%. Move on when the valve position goes above 20%.
 - 10) If this is the first train being started, call for the Lead Well and wait until it is running.
 - 11) If this is the first train being started, wait until the Well Flow is above 250 gpm. When it reaches 250 gpm, place the Startup Bypass Valve in Automatic Control.
 - 12) If this is the first train being started, start the Sulfuric Acid feed. Wait until it is running.
 - 13) If this is the first train being started, Start the Scale Inhibitor. Wait until it is running.
 - 14) If this is the first train being started, wait until the deviation of Raw pH from the setpoint is within 0.25 for 5 minutes.
 - 15) If this is the first train being started, wait until the Raw Water Conductivity is between 2,000 and 16,000 $\mu\text{S}/\text{cm}$.
 - 16) **Place the Flushing Bypass Valve into Manual and open the Flushing Bypass Valve to the desired operator set point.**
 - 17) **Place the Concentrate Valve into Manual with a 75 percent valve position setpoint.**
 - 18) Wait for a period of time to allow the membrane to fill.

- 19) **Check that the flow alarm is off and that flow is greater than 25 gpm for RO Skids 1 or 2 and 30 gpm for RO skids 3 or 4. Increase the Flushing Bypass Valve set point to increase flow.**
 - 20) **Check that the high-pressure alarm is off and that membrane pressure is less than 30 psi and check that permeate flow is less than 10 percent of the feed rate. Adjust the Flushing Bypass Valve set point to reduce membrane pressure. If adjusting the Flushing Bypass Valve does not relieve pressure check other conditions such as the well pressure, Feed Valve position, and/or Concentrate Valve position.**
 - 21) If the Flush Required Flag is set, flush for the number of minutes specified on the Train Screen.
 - 22) **Once the flushing sequence is completed, close the Flushing Bypass Valve and wait until the valve position is 0 percent.**
 - 23) **Place the Feed Valve control into Manual, open the Feed Valve and check that the Concentrate Valve is open to the 75 percent valve position setpoint. Wait until the Feed Valve is open and the Concentrate Valve is more than 73 percent.**
 - 24) Start the Feed Pump and wait for 30 seconds after running status.
 - 25) **Place the Pump Motor Speed and Concentrate Valve in Automatic. Open the Blend Valve solenoid. Declare the train as running.*****
- b. The shutdown and automatic flushing sequence will be modified, and a new Flushing Bypass Valve Position Set Point must be added to SCADA for each RO Skid.
- c. The Shutdown and Automatic Flushing sequence, Item A.1.e, of this section, will need to be modified as follows: The operator should maintain the pump bypass manual isolation valves open unless maintenance is performed on the system requiring these valves to be closed. The operator will select the STOP button on the corresponding individual RO Skid screen. The automatic shutdown sequence initiates and will check that the RO feed pump is off and the Feed Valve is closed and the Concentrate Valve is open to a position greater than 75 percent. The Flushing Bypass Valve will open to the operator preset Flushing Bypass Valve position set point.
- d. Automatic Flushing Operation: Upon automatic shutdown the train will automatically flush using residual pressure from the raw water wells flowing through the Cartridge Filter and the pump bypass piping. The Feed Valve should remain closed and the Concentrate Valve should remain fully open to allow flow through the second stage membranes and to prevent pressurizing the system. The Flushing Bypass Valve will open to the operator preset Flushing Bypass Valve Position set point. Per the RO Skid manufacturer, the desired minimum flushing fluid flow rate is five gallons per minute per the number of first stage membranes; more flow is better, but target permeate flow during flushing operations should recover less than 10 percent of the feed rate; this is achieved by flowing flushing water at low pressure (15 psi to 30 psi per the membrane manufacturer). Add a low flow alarm to alert the operator if the flushing flow rate is below 25 gpm on RO Skids 1 and 2 and 30 gpm on RO Skids 3 and 4. Add a high-pressure alarm to alert the operator if membrane pressure is greater than 30 psi during flushing operations. The operator can then manually adjust the preset valve position set point to adjust for desired flushing flow and pressure.

- e. Manual flushing operation when other skids are running will be as follows:
 - 1) Check that other RO skids are running.
 - 2) Check that the Feed Pump is off.
 - 3) Check that the Feed Valve is closed.
 - 4) Then follow steps 2.a.16. through 2.a.22.
 - f. Manual flushing operation if no skids are running. Follow steps 2.a.2 through 2.a.22 of this part.
3. Control wiring from the new VFDs will be hardwired into existing I/O channels in PLC-1/MCP-1. Analog I/O from the feed flow control valves will be repurposed for the new VFD speed control and speed reference I/O. The following I/O modules will be added to PLC-1/MCP-1 for the additional control valves and additional spares:
- a. (2) 16-Point Digital Input cards (Allen Bradley: 5069-IA16)
 - b. (1) 16-Point Digital Output card (Allen Bradley: 5069-OA16)
 - c. (1) 8-Point Analog Input card (Allen Bradley: 5069-IF8)
 - d. (1) 8-Point Analog Output card (Allen Bradley: 5069-OF8)
4. In addition to the I/O modules needed to accommodate the new motor actuated valves, the PCSS shall provide all other components and equipment required for a complete system to operate per design intent, matching existing installation and programming as close as possible. This shall include, but not be limited to
- a. I/O terminals and/or termination blocks
 - b. Surge protectors
 - c. Circuit breakers and/or fuses
 - d. Field power distribution blocks or modules
 - e. Power supplies
5. The following new devices and instruments shall be provided for each pump and hardwired to the corresponding VFD for pump protection and shutdown:
- a. High Motor Winding Temperature (TS)
 - b. Low Suction Pressure (PSL)
 - c. High Discharge Pressure (PSH)
6. P&ID drawings depicting the work are provided as part of the design documents.

3.2 GENERAL INSTALLATION

- A. The shield on each process instrumentation cable to be continuous from source to destination and be grounded at only one ground point for each shield.

3.3 IDENTIFICATION

- A. Provide identification system for all PCSS provided hardware, instrumentation, and communication cabling. Provide details as specified in “Project Plan”.

3.4 FIELD QUALITY CONTROL

- A. Refer to individual hardware and instrument specification sections.

3.5 STARTUP SERVICE

- A. Refer to Section 406121.20 “Process Control System Testing.”

END OF SECTION 406100

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SECTION 406121.20 - PROCESS CONTROL SYSTEM TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes process control system testing, where the Applications Engineering services are performed by the Contractor.
- B. Related Requirements:
 - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions."
 - 2. Section 019113 "General Commissioning Requirements."
- C. Furnish all labor, materials, equipment and incidentals required to complete the testing of all devices and systems furnished and installed as detailed on Drawings, and as specified herein.

1.3 DEFINITIONS

- A. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.
- B. Applications Engineering System Supplier (AESS): The entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.
- C. Human Machine Interface (HMI): A software-based user interface with supervisory level control and of machine level equipment.
- D. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.
- E. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.
- F. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.
- G. Uninterruptible Power Supply (UPS): A device capable of providing emergency battery power when the main power source fails.

1.4 ACTION SUBMITTALS

- A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."
- B. Testing Submittals - Submit, in one submittal, the following testing related documents:
 - 1. Status signoff forms:
 - a. Develop and submit project specific I/O Status and Automatic Control Strategy signoff forms to be used during factory and field testing to organize and track each loop's inspection, adjustment, calibration, configuration, and testing status and sign off. Include sign-off forms for each testing phase showing all loops.
 - 1) Example forms are shown in the Appendices.
 - 2) Separate forms for factory and field testing can be used, or they can be combined, at the discretion of the PCSS.
 - 3) Submit testing forms prior to start of testing.
 - 2. Testing Procedures:
 - a. Submit detailed procedures proposed to be followed for each of the tests specified herein. The test procedures serve as the basis for the execution of the required tests to demonstrate that the system meets and functions as specified. At a minimum, provide the following test procedures:
 - 1) Network and Communications Testing.
 - 2) I/O Testing.
 - 3) UPS.
 - 4) Control panel power, indicators, and hardwired logic tests.
 - b. Structure documents in an orderly and easy to follow manner to facilitate an efficient and comprehensive test.
 - c. Indicate in test procedures all pre-testing setup requirements, all required test equipment, and simulation techniques to be used.
 - d. Structure test procedures in a cause-and-effect manner where the inputs are indicated, and the outputs are recorded.
 - e. Include in test procedures the demonstration and validation under normal operating conditions and under various failure scenarios as specified in Contract Documents.
 - f. Do not start testing until all Testing Submittals have been approved.
- C. Test Documentation:
 - 1. Upon completion of each required test, document the test by submitting a copy of the signed off Testing Status forms. Testing is not considered complete until the signed-off forms have been submitted and approved. Submittals of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.

1.5 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.6 COST OF TRAVEL

- A. Scheduled tests will only be attended once by Engineer /Owner. If test is not successful, all subsequent tests will be performed at Contractor's expense. Reimburse Owner for all costs, including labor and expenses, invoiced by Engineer and incurred by Owner for subsequent retests.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TESTING - GENERAL

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”
- B. Track results of all testing on a project specific status sign-off form or similar document. The PCSS is responsible for maintaining the sheet. Appendix of this Section has an example template for this sheet.
- C. Tests the PCSS is required to perform are as follows:
 - 1. Field Testing:
 - a. Operational Readiness Test (ORT).
 - b. Functional Demonstration Test (FDT).
 - c. Site Acceptance Test (SAT).
- D. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide all special testing materials and equipment required for a suitable means of simulation.
- E. PCSS to coordinate all required testing with Contractor, affected Subcontractors, Engineer, and Owner.
- F. Do not ship equipment to jobsite until Engineer or Owner has received all Factory Testing results and approved the system as ready for shipment.
- G. The Engineer reserves the right to test or re-test any functions.

H. Correction of Deficiencies:

1. Correct deficiencies in workmanship and/or items not meeting specified testing requirements to meet specification requirements at no additional cost to Owner.
2. Repeat testing, as specified herein, after correction of deficiencies is made until specified requirements are met. Perform work at no additional cost to Owner.

3.2 FIELD TESTING - OPERATIONAL READINESS TEST (ORT)

- A. Purpose of ORT is to check that process equipment, instrument installation, instrument calibration, instrument configuration, field wiring, control panels, and all other related system components are ready to monitor and control the processes. This test determines if equipment is ready for operation.
- B. This test to take place prior to FDT and startup. Prior to starting this test, install relevant process equipment and mechanically test instruments installed, control panels installed, and field wiring complete.
- C. Required Documents for Test:
1. Master copy of the PCSS developed field testing sign-off forms.
 2. Testing procedures.
 3. Calibration forms.
- D. These inspections, calibrations, and tests do not require witnessing. However, Engineer may review and spot-check testing process periodically. All deficiencies found to be corrected by PCSS prior to commencement of Functional Demonstration Test.
- E. PCSS to maintain Sign-off forms and Calibration forms at job site and make them available to Engineer/Owner at any time.
- F. Perform the following tests as part of ORT:
1. Instrument calibration, configuration, and set-up.
 2. Input/Output (I/O) Testing to HMI and OITs.
 3. Testing of control strategies.
- G. Instrument calibration, configuration, and set-up:
1. Calibrate, configure, and set-up all components and instruments to perform specified functions.
 2. Calibration form:
 - a. For any component or instrument requiring dip switch settings, calibration, or custom configuration, maintain a calibration form in field documenting this information. These forms provide a summary of the actual settings used in the field to allow an Instrument technician to replace the device entirely and configure it to function as it did before.

- b. Add this information to Instrument data sheet and to a copy of manufacturer's standard "Configuration Sheet" or create a separate form.
 - 1) If a separate form, list Project Name, Loop Number, ISA Tag Number, I/O Module Address, Manufacturer, Model Number/Serial Number, Output Range and Calibrated Value.
- c. Some examples of required information are:
 - 1) For Discrete Devices: Actual trip points and reset points.
 - 2) For Instruments: Any configuration or calibration settings entered into instrument
 - 3) For Controllers: Mode settings (PID).
 - 4) For I/O Modules: Dip switch settings, module configuration (if not documented in native programming documentation).
- d. Maintain a copy of these forms in field during testing and make them available for inspection at any time.
- e. For any device that allows a software back-up of configuration files to a laptop, make configuration files available to Engineer/Owner for inspection. Submit as part of Final System Documentation as specified in Section 406100 "Process Control and Enterprise Management Systems General Provisions."

H. I/O Testing:

- 1. Purpose of I/O testing is to check that process equipment, instrument installation, calibration, configuration, field wiring, and control panels are set-up correctly to monitor and control the processes. This test is commonly referred to as a "loop test" or an I/O checkout.
- 2. PCSS in conjunction with Contractor to test signals under process conditions. Preferred test methods will always be to execute test wherever possible to end elements. For example, preferred test will prove valve open/close limit switches by operating valve, not by installing a jumper on limit switch contacts. However, if equipment or process is not available to test a signal over its entire calibrated range, PCSS may test using a simulation method and make a note on sign-off form.
- 3. Perform the following I/O tests:
 - a. Discrete Input: At device or instrument, change signal condition from inactive to active state. Observe results on all indicators within loop such as HMI screens, OIT screens, pilot lights, horns, beacons, etc.
 - b. Analog Input: Test analog signal over entire engineering range at various intervals including 0, 50%, and 100% as well as on increasing and decreasing range. Observe results on all indicators within loop such as HMI screens, OIT screens, recorders, digital indicators, etc.
 - c. Test discrete output signals by switching equipment to manual control at the HMI and OIT nodes and turning output on or using other means to turn output on. Then verify equipment responds accordingly.
 - d. Test analog output signals by switching equipment to manual control at HMI and OIT nodes and turning output on or other means to turn output on. Then verify equipment responds accordingly.

- I. Testing of Automatic Control Strategies:
 - 1. Verify all automatic control strategies using actual process equipment and instruments, or other means, to verify logic performs as expected. Verify faults and logical failure scenarios for control strategies such as instrument failures, equipment failures, loss of communication between HMI Server and PLC, loss of peer-to-peer communication, out of range testing for analog inputs, loss of power, and all other strategies specified in control strategy document.
- J. Repeat all systems tests specified under factory testing.
- K. Upon successful completion of ORT, PCSS to submit a record copy of test results as specified in PART 1 and request scheduling of FDT.

3.3 FIELD TESTING - FUNCTIONAL DEMONSTRATION TEST (FDT)

- A. After facility is started up and running treatment process in automatic control to extent possible, perform a Functional Demonstration Test. Purpose of FDT is to allow Engineer or Owner representatives to witness actual functionality, performance, and stability of system while connected to process equipment.
- B. Required Documents for Test:
 - 1. Set of panel drawings and wiring diagrams from ORT with corrections noted.
 - 2. Set of Contract Documents - all drawings and specifications.
 - 3. All design-change related documentation.
 - 4. Signed-off master copy of the PCSS developed field testing signoff forms.
 - 5. Testing procedures.
 - 6. Copy of completed calibration forms.
 - 7. One copy of all O & M Manuals for PCSS supplied equipment.
- C. Perform a witnessed FDT on each process area. To extent possible, repeat testing performed during ORT.
- D. Follow specified daily schedule during factory tests and FDT.
- E. After coordinating with Operations, perform a "Black Start" of the plant to confirm plant operation recovers as specified in Contract Documents. Black start means shutting off power to the plant and turning it back on. Perform separate tests by recovering the plant while on generator (if a generator is specified) and while on utility power.
- F. Document punch list items and resolutions noted during test on Punch list/Resolution form. In event of rejection of any part or function test procedure, PCSS to perform repairs, replacement, and/or retest within 10 days.
- G. Upon successful completion of the FDT, PCSS to submit a record copy of test results as specified in PART 1.

3.4 FIELD TESTING - SITE ACCEPTANCE TEST (SAT)

- A. After completion of FDT, and system is started up and running treatment process in automatic control to extent possible, perform a test on the system as defined in Section 019113 "General Commissioning Requirements."
- B. While this test is proceeding, Engineer and Owner have full use of system. Only allow plant operating personnel to operate equipment associated with live plant processes. Plant operations remain the responsibility of Owner and decision of plant operators regarding plant operations are final.
- C. During this test, PCSS personnel to be present as required to address any potential issues that would impact system operation. PCSS is expected to provide personnel for this test who have an intimate knowledge of hardware and software of system. When PCSS personnel are not on-site, PCSS to provide cell phone/pager numbers that Owner personnel can use to ensure that support staff is available by phone and/or on-site within four hours of a request by operations staff.
- D. PCSS to analyze and correct any malfunctions during test. In event of rejection of any part or function, PCSS to perform repairs or replacement within 5 days.
- E. Throughout duration of SAT, do not make software or hardware modifications to the system without prior approval from Owner or Engineer.

3.5 SUPPLEMENT TO FIELD TESTING REQUIREMENTS

- A. Prior to leaving the site, use the Owner's programming computer to monitor all PLC processors online, make on-line changes, upload and download the processor to ensure programming software version compatibility.
- B. Loop Tuning – Tune all PID control loops (single or cascade) following device installation but prior to commencement of the Functional Demonstration Test.
 - 1. Achieve optimal loop tuning either by auto-tuning software or manually by trial and error, Ziegler-Nichols step-response method, or other documented process tuning method.
 - 2. Determine and configure optimal tuning parameters to assure stable, steady state operation of final control elements running under the control PID. Adjust each control loop that includes anti-reset windup features to provide optimum response following startup from an integral action saturation condition.
 - 3. Tune all PID control loops to eliminate excessive oscillating final control elements. Adjust loop parameters to achieve a decay ratio of 1/4 or better. In addition, achieve loop steady state at least as fast as the loop response time associated with critical damping.
 - 4. Verify loop performance and stability by step changes to setpoint in the field.
 - 5. Submit loop tuning documentation as specified in Part 1 of this Section.

END OF SECTION 406121.20

APPENDIX 40 61 21-A: EXAMPLE INPUT/OUTPUT (I/O) STATUS SIGN OFF FORM

An example template for I/O Status signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific I/O Status signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

APPENDIX 40 61 21-B: EXAMPLE AUTOMATIC CONTROL STRATEGIES SIGN OFF FORM

An example template for Automatic Control Strategies signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific Automatic Control Strategies signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

[Project Name] Appendix A - Input/Output (I/O) Status Sign-Off Form

4-Jun-14

All Sections below are required to be filled out by PCSS as part of Field Testing.															
Instrument Alarm Setpoint - Setpoint for any alarms set by PCSS															
Wiring Complete - Signal wired from field device to PLC															
I/O Tested - Signal tested from field device to SPADA HMI															
PLC	Signal Tag	Description	Range or Active State when closed	P&ID	Signal at Rack	Slot	Channel	Instru-ment config., Alarm and Wiring complete	PCSS I/O testing	Date	I/O Testing to the HMI	Date	Notes		
PLC-SC	UT-4000-1	Secondary Clarifier No. 1 Sludge Level	0-10 ft	8	AI	2	1	0							
PLC-SC	UT-4000-3	Secondary Clarifier No. 3 Sludge Level	0-10 ft	8	AI	2	1	1							
PLC-SC	SI-4100-1	RAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	2							
PLC-SC	SI-4100-4	RAS Pump No. 4 Speed Feedback	0-100%	15	AI	2	1	3							
PLC-SC	FI-4102-1	RAS Flow Pump 1-3	0-1900 GPM	14	AI	2	1	4							
PLC-SC	SI-4110-1	WAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	5							
PLC-SC	N/A	Spare Slot	N/A	N/A	Spare	2	5	N/A							
PLC-SC	SC-4100-1	RAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	0							
PLC-SC	SC-4100-2	RAS Pump No. 2 Speed Setpoint	0-100%	14	AO	2	7	1							
PLC-SC	SC-4100-3	RAS Pump No. 3 Speed Setpoint	0-100%	14	AO	2	7	2							
PLC-SC	SC-4110-1	WAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	3							
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	4							
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	5							
PLC-SC	TSH-4000-1	Secondary Clarifier No. 1 High Temp	Normal	8	DI	3	1	0							
PLC-SC	XA-4000-1	Secondary Clarifier No. 1 Motor Overload	Normal	8	DI	3	1	1							
PLC-SC	WAH-4000-1	Secondary Clarifier No. 1 High Torque	Normal	8	DI	3	1	2							
PLC-SC	WAHH-4000-1	Secondary Clarifier No. 1 High High Torque	Normal	8	DI	3	1	3							
PLC-SC	YRI-4000-1	Secondary Clarifier No. 1 On/Off	On	8	DI	3	1	4							
PLC-SC	YCI-4000-1	Secondary Clarifier No. 1 In Remote	In Remote	8	DI	3	1	5							
PLC-SC	YFI-4100-1	RAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	6							
PLC-SC	FAL-4100-1	RAS Pump No. 1 Low Flow	Normal	14	DI	3	1	7	50 GPM	RJM	12/18/2011	JAS	12/22/2011		
PLC-SC	Spare	Spare	Normal	14	DI	3	1	8					Example completed line		
PLC-SC	YRI-4100-1	RAS Pump No. 1 Running	Running	14	DI	3	1	9							
PLC-SC	YFI-4110-1	WAS Pump No. 1 In Remote	In Remote	14	DI	3	1	10							
PLC-SC	YFI-4110-1	WAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	11							
PLC-SC	FAL-4110-1	WAS Pump No. 1 Low Flow	Normal	14	DI	3	1	12							
PLC-SC	Spare	Spare	Normal	14	DI	3	1	13							
PLC-SC	YRI-4110-1	WAS Pump No. 1 Running	Running	14	DI	3	1	14							
PLC-SC	YCI-4110-1	WAS Pump No. 1 In Remote	In Remote	14	DI	3	1	15							
PLC-SC	HSS-4000-2	Secondary Clarifier No. 2 Start Command	Start	8	DO	4	6	0							
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	1							
PLC-SC	HSS-4100-2	RAS Pump No. 2 Start Command	Start	14	DO	4	6	2							
PLC-SC	HSS-7000-2	Sludge Holding Tank Blower No. 2 Start Command	Start	17	DO	4	6	3							
PLC-SC	HSS-4100-5	RAS Pump No. 5 Start Command	Start	15	DO	4	6	4							
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	5							
PLC-SC	HSS-4105-1	Secondary Sludge Pump No. 2 Start/Stop	Start	15	DO	4	6	6							
PLC-SC	HSS-4110-2	WAS Pump No. 2 Start/Stop Command	Start	15	DO	4	6	7							
PLC-SC	7160-FQI-1	Sludge Loadout LCP Pumping Indicator	Pumping	17	DO	4	6	8							
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	9							
PLC-SC	HSS-7115-2	Sludge Holding Tank Mixer No. 2 Start	Start	17	DO	4	6	10							
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	11							
PLC-SC	HSS-7117-2	Sludge Holding Tank Discharge Valve No. 2 Open CMD	Open	17	DO	4	6	12							
PLC-SC	HSS-7117-2	Sludge Holding Tank Discharge Valve No. 2 Close CMD	Close	17	DO	4	6	13							
PLC-SC	HSS-7120-2	TS Transfer Pump No. 2 Start Command	Start	17	DO	4	6	14							
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	15							

4-Jun-14 [Project Name] Appendix B - Automatic Control Strategies Sign-Off Form

All Sections below are required to be filled out by PCSS as part of Testing

Auto. Control Strategies - Loop operational in Automatic as defined in Control Strategies

Control Strategies Loop #	Control Strategy Description	P&ID	Auto. Control Strategy	Date	Notes
LOOP 281 - 284	LOW FLOW PUMPS	8			
LOOP 290	LOW EQ CHANNEL FLOW NO.4	8			
LOOP 300	MICROFILTRATION AIR SUPPLY LOW PRESSURE	10			
LOOP 351, 352	SITE LIFT STATION PUMP NO.1 AND NO. 2	12			
LOOP 355	SITE LIFT STATION HIGH AND LOW LEVEL CONTROL	12			
LOOP 371, 372	SLUDGE HOLDING TANK NO.1 AND NO. 2 LEVEL	14			
LOOP 381, 382	SLUDGE TRANSFER PUMPS	14			
LOOP 385	SLUDGE TRANSFER PUMPS REMOTE START/STOP COMMAND	14			
LOOP 700	EFFLUENT PUMPING STATION LEVEL	14			
LOOP 701, 702, 703	EFFLUENT PUMP NO.1	14			
LOOP 840	POST AERATION CHANNEL AIR FLOW CONTROL	15			
LOOP 900	SLUDGE TRANSFER PUMPS DISCHARGE FLOW	8			
LOOP 971	CENTRIFUGE SLUDGE FEED PUMP NO.1	8			
LOOP 1001	CENTRIFUGE NO.1 SLUDGE FEED FLOW CONTROL	8			
LOOP 1411, 1412	SODIUM HYPOCHLORITE STORAGE TANKS LEVEL	8			
LOOP 1421, 1422	SODIUM HYPOCHLORITE PUMPS	8			
LOOP 1430	SODIUM HYPOCHLORITE STORAGE TANKS				
LOOP 2051, 2052, 2053	CONTAINMENT AREA HIGH LEVEL DETECTION	14			
LOOP 2055	DIESEL ENGINE GENERATOR STATUS	14			
LOOP 2060	TRANSFER SWITCH STATUS	14			
	GENERATOR KILOWATTS MONITORING	14			
APPENDIX ONE	EQUIPMENT RESTART DURING A POWER LOSS WITH THE GENERATOR RUNNING	14			
APPENDIX TWO	EQUIPMENT RESTART WITH POWER RESTORED AFTER A POWER LOSS	14			
N/A	SELF-HEALING CAPABILITIES OF NETWORK	N/A			
N/A	REDUNDANT SCADA SERVER FAILOVER AND RECOVERY	N/A			

SECTION 406733 - PANEL WIRING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for internal wiring of control panels and consoles.
- B. Related Requirements:
 - 1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.

1.3 DEFINITIONS

- A. American Wire Gage (AWG): Measurement of the cross-sectional area of a conductor.
- B. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.
- C. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.
- D. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.6 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. None Required.

1.8 QUALITY ASSURANCE

- A. Perform work in accordance with UL 508A.
- B. Provide components compatible with functions required to form complete working system.
- C. Maintain one copy of modified panel drawings on site.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 016000 "Product Requirements" for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

- A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

1.11 WARRANTY

- A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

PART 2 - PRODUCTS

2.1 CONTROL PANEL - INTERNAL CONSTRUCTION

- A. Internal Electrical Wiring:
 - 1. Provide stranded, type MTW interconnecting wiring:
 - a. Use 600-volt insulation rated for not less than 90 degrees Celsius.
 - b. Segregate wiring for systems operating at voltages in excess of 120 VAC from other panel wiring
 - 1) Locate either in a separate section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier.
 - c. Develop panel layout such that technicians have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.
 - 2. For power distribution wiring on the line side of fuses or breakers:

- a. Use 12 AWG minimum.
- b. For control wiring on the secondary side of fuses:
 - 1) Use 16 AWG minimum.
 - 2) Utilize 18 AWG shielded, twisted pair cable insulated for not less than 600 volts for electronic analog circuits.
3. Cover power distribution blocks with protective guards to meet “finger-safe” requirements of IP20.
4. Route power and low voltage DC wiring systems in separate wireways.
 - a. Cross different system wires at right angles.
 - b. Separate different system wires routed parallel to each other by at least 6-inches.
 - c. Terminate different wiring systems on separate terminal blocks.
 - d. Do not fill wiring troughs to more than 60 percent visible fill.
 - e. For wireways with intrinsically safe conductors, utilize light blue wireways.
5. Terminations:
 - a. Terminate wiring onto single tier terminal blocks:
 - 1) Uniquely and sequentially number each terminal block.
 - 2) Direct wiring between field equipment and panel components is not acceptable.
 - 3) Multi-level terminal blocks or strips are not acceptable.
 - b. Arrange terminal blocks in vertical rows and separated into groups (power, AC control, DC signal).
 - 1) Provide each group of terminal blocks with a minimum of 25 percent spares.
 - c. Use compression type, fused, unfused, or switched terminal blocks.
 - 1) Use two terminals per point for discrete inputs and outputs (DI and DO) with adjacent terminal assignments.
 - 2) Wire all active and spare PLC and controller points to terminal blocks.
 - d. Use three terminals per point for analog inputs and outputs (AI and AO) per shielded pair connection with adjacent terminal assignments for each point.
 - 1) The third terminal is for shielded ground connection for cable pairs.
 - a) Ground the shielded signal cable at the PLC cabinet.
 - b) Wire all active and spare PLC and controller points to terminal blocks.
 - e. Use sleeve-type wire and tube markers with heat impressed letters and numbers.
 - f. Use only one side of a terminal block row for internal wiring.
 - 1) Field wiring side of the terminal not to be within 6-inches of the side panel or adjacent terminal or within 8-inches of the bottom of free-standing panels, or within 3-inches of stanchion mounted panels, or 3-inches of adjacent wireway.

- g. Isolate circuit power from the SCADA cabinet to field devices (switches, dry contacts etc.) that are used as discrete inputs to the PLC input cards with an isolating switch terminal block with flip cover that is supplied with a dummy fuse.
 - 1) Use Allen Bradley Model 1492-H7 or equal.
 - 2) One isolating switch terminal block per loop numbered piece of equipment and one per spare I/O point is acceptable.
 - h. Isolate all PLC discrete outputs to the field with an isolating fuse switch terminal block with a flip cover and a neon blown fuse indicator.
 - 1) Use Allen Bradley 1492-H4 or equal.
- 6. Clearly identify wiring to hand switches and other devices, which are live circuits independent of the panel's normal circuit breaker protection as such.
- 7. Clearly tag and color code wiring.
 - a. Tag numbers and color coding to correspond to panel wiring diagrams and loop drawings prepared by the PCSS.
 - b. Power wiring, control wiring, grounding, and DC wiring to utilize different color insulation for each wiring system used.
 - c. Color coding scheme to be in accordance with UL 508a.
- 8. Provide surge protectors on all incoming power supply lines at each panel per requirements of Section 407856 "Isolators, Intrinsic Safety Barriers, and Surge Suppressors."
- 9. Each field instrument furnished under Division 40 and shown on the Drawings as deriving input power from the control panel(s) to have a separate power distribution circuit with a circuit breaker or fuse and blown fuse indication.
 - a. Power instruments requiring 120VAC power as shown on the drawings.
- 10. Wiring trough for supporting internal wiring:
 - a. Plastic type with snap-on covers.
 - b. Side walls to be open top type to permit wire changing without disconnecting.
 - c. Trough to be supported to the subpanel by stainless steel screws.
 - d. Do not bond trough to the panel with glue or adhesives.
- 11. Provide each panel with a single tube, LED light fixture, 20 Watt in size (minimum)
 - a. Mounted internally to the ceiling of the panel.
 - b. Light fixture to be switched and be complete with the lamp.
- 12. Each panel to have a specification grade duplex convenience receptacle with ground fault interrupter:
 - a. Mount internally within a stamped steel device box with appropriate cover.
 - b. Convenience receptacle is not powered from a UPS.
 - c. Protect by a dedicated fuse or circuit breaker.

13. Each panel to be provided with an isolated copper grounding bus for all signal and shield ground connections.
 - a. Shield grounding to be in accordance with the instrumentation manufacturer's recommendations.
 14. Provide each panel with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.
 15. Each panel to have control, signal, and communication line surge suppression in accordance with Section 407856 "Isolators, Intrinsic Safety Barriers, and Surge Suppressors."
 16. Microprocessor-based electronic devices in the panel that are powered by 120VAC to be powered by the UPS.
 17. Provide each panel with a circuit breaker to interrupt incoming power.
 18. Additional electrical components including transformers, motor starters, switches, circuit breakers, etc. to be in compliance with the requirements of Division 26.
- B. Relays not provided under Division 26 and required for properly completing the control function specified in Division 40, Division 26 or shown on the Drawings to be provided under this Section.
- C. Orientation of devices including PLC and I/O when installed to be per the manufacturer's recommendations.
1. No vertical orientation of PLC racks are allowed unless specifically indicated by the manufacturer as an acceptable mounting alternative and approved by the Engineer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.2 CONNECTIONS

- A. Refer to Section 260526 "Grounding and Bonding for Electrical Systems."

END OF SECTION 406733

SECTION 406863 - CONFIGURATION OF HMI SOFTWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. If referred to anywhere else in the project manual, AE or AESS services include, but are not limited to, those services specified in this Section.
- B. Provide all modifications of programming, configuration, and related services required to achieve a fully integrated and operational system. Control of all equipment to be in conformity with the Contract Drawings, process control descriptions, specifications, engineering data, instructions, and recommendations of the equipment manufacturer. Coordinate the control system for proper operation with related equipment and materials furnished by other suppliers under other Sections of these specifications and with related existing equipment. Include the following information:
 - 1. Modification of existing HMI System Software configuration. Use all existing HMI standards and conventions.
 - 2. Modification of existing Historian Software configuration.
 - 3. Modification of existing system reports configuration using the Reporting Software provided.
 - 4. Modification of existing communications and functionality data between all connected devices (such as PLCs) and the HMI software packages, including devices supplied by others, as depicted on the system architecture drawings to provide a comprehensive working system of data collection, storage and reporting.
- C. Coordinate all work with plant operating personnel to minimize impacts on daily operation.
- D. Related Requirements:
 - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions" for submittal requirements.
 - 2. Section 406863 "Configuration of HMI Software."
 - 3. Section 406866 "Configuration of Controller Software."
- E. Existing PLC Hardware, Firmware, and HMI Software are as follows:
 - 1. PLC Hardware: Compact Logix 5380
 - 2. CPU: 5069-L320ER
 - 3. Ethernet Adapter: 5069-AENTR
 - 4. AC Inputs: 5069IA16
 - 5. AC Outputs: 5069-OA16

6. Analog Inputs: 5069-IY4
7. Analog Outputs: 5069-OF4
8. Field Potential Module: 5069-FPD
9. PLC Firmware: To be confirmed by Contractor/PCSS
10. HMI Software: VTScada Version 12.1.44

1.3 DEFINITIONS

- A. Applications Engineering System Supplier (AESS): The entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.
- B. Human Machine Interface (HMI): A software-based user interface with supervisory level control and of machine level equipment.
- C. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.
- D. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.
- E. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.
- F. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

1.4 PREINSTALLATION MEETINGS

- A. Schedule and conduct workshop to review the standards, conventions, and methodologies that will be used to program and develop the programs (i.e., HMI and PLC databases, HMI graphics, and PLC programming, etc.); standards for storage and management of historical data; format of daily, monthly, and yearly reports; development of data entry templates; report formats and layouts; and user interface displays for accessing and generating reports.

1.5 ACTION SUBMITTALS

- A. Provide all required submittals in accordance with Section 013300 "Submittal Procedures."
- B. Provide the submittals listed below at a minimum:
 1. Operator Interface.
 2. Controller Program.
 3. Reports.
 4. Historical Data Management.

C. Operator Interface

1. Submit all proposed graphic displays, examples of each type of pop-up (faceplate) displays, and examples of trends. For those graphics which will be duplicated more than once for similar type of equipment, submit graphics for the first equipment only.
2. Submitted graphic displays and trends are to be no less than 8.5 inches by 11 inches and in full color.

D. Historical Data Management

1. Following the Historical Workshop, submit all aspects of the historical data management system and include as a minimum the following:
 - a. A complete listing of all signals to be collected and stored, including data sampling rate and duration for which the data will be immediately accessible.
 - b. Data reduction methods, rates, and the duration data will be immediately accessible.
 - c. Storage space requirements and supporting calculations.
 - d. Historical database design description, including data flow diagram, table definitions, procedures and queries used; and description of method of accumulating and displaying run times and flow totals. Define the method of interfacing to the reporting system, methods of handling Data Quality Flags, and methods of storing and displaying trending information.
 - e. Description of methodology for restoring data collected locally during times when the historical data management system is not available. Description of database failure and recovery, including data correction.
 - f. Description of selecting only the active real-time data source for systems that are utilizing redundant data acquisition nodes.
 - g. List of data source interfaces to be used with the system (for example, OPC, file collection, historian-historian collector, HMI applications, etc.)

E. Reports

1. Following the Historical Workshop, submit all aspects of the reports generation system and include as a minimum the following:
 - a. A complete list of all reports to be modified to accommodate the process changes.
 - b. Complete listing of all new signals to be reported, including calculated values.
 - c. Description of reporting data storage design, including method data is polled and stored.
 - d. Description of methodology for entering manual data and interfaced used.
 - e. Procedures for recall, generation and printing of reports
 - f. Printout of each report to be provided with details of each cell, where data comes from, and calculation of raw data.

1.6 INFORMATIONAL SUBMITTALS

- A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

1.7 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

- A. The system performs the following generalized functions:
 - 1. Allows the operator to control equipment such as pumps and valves as shown on the Drawings and as defined in Section 406100-3.1 “Process Control Descriptions.”
 - 2. Perform real-time process control, including proportional integral derivative control action, sequencing, and process calculations.
 - 3. Collect, calculate, and store accurate, reliable operating information for present and future uses.
 - 4. Assist remote site operating personnel by noting and communicating of normal operating conditions and equipment failures.
 - 5. Accumulate and store equipment running times for use in preventative maintenance.
 - 6. Provide color graphic displays and reports for use by the system operating and supervisory personnel.
 - 7. Provide trending for analog values.
 - 8. Provide control system diagnostics.
 - 9. Perform process control functions including PID, calculations, sequencing, timing, in the process controller. The HMI software performs the real-time database, report generation, graphic screens, program development, set point modification, data archiving, etc.
 - 10. Allow the operator to manually control (by keyboard entry and mouse type pointing device) the status of pumps, valves, e.g., on/off, open/close, setpoint value,) when viewing the appropriate graphic screen on the HMI.

3.2 GRAPHIC DISPLAYS

- A. The HMI screens that shall be modified under this contract shall include (but not limited to, as required):
 - 1. Pretreatment
 - 2. Membrane Train Overview Screen
 - 3. Membrane Train 1
 - 4. Membrane Train 2
 - 5. Membrane Train 3
 - 6. Membrane Train 4

- B. Ensure displays contain and continuously update the displayed process variables, date and time of day, with process values showing in engineering units. Incorporate on displays:
 - 1. References to both instrumentation tag numbers and plant equipment numbers.
 - 2. Process variables on their associated display(s) with correct engineering units.
 - 3. Process variables with their associated data quality flags.
- C. Operator commands related to controlling field devices or system attributes require multiple keystrokes or mouse actions to protect against inadvertent operations. Confirmation to the operator for the selected point to be controlled is provided, at which time a cancellation of the control can be affected.
- D. Process graphic displays are depicted from the P&ID's, site plan drawings, mechanical drawings and electrical drawings included in these Contract Documents. The graphic displays include process flow streams, process structures, and all major items of process equipment and control devices in a schematic format.
- E. Include on main graphical screens a title bar, main graphic area, navigational buttons, and alarm summary bar.
 - 1. Title bar displayed on the top of each screen and include display name, description and time/date.
 - 2. Main graphical area contains primary screen data in graphical format.
 - 3. Navigational buttons include a minimum of main menu, trends, main alarm summary, and security log in.
 - 4. Alarm summary bar displays the last three valid alarms on the bottom of each screen.
- F. Provide animation to mimic level changes in tanks or vessels, and to mimic rotation of rotating equipment when running. Valve colors to change when opened and closed.
- G. Adjust from the operator interface timers, setpoints, alarm actuation levels, unless specifically noted.
- H. Ensure the system show field conditions with text that can alternate (i.e., OPEN/CLOSE, START/STOP, HIGH/LOW) and change color correspondingly. Field devices that are tri-state must be represented in three conditions.
- I. Ensure conditions in the field designated as alarm conditions report to the operator workstation, actuate an audible alarm, and provide a visual blinking image on the associated graphic page. Display alarms and events on the screen and archived.
- J. Identify interlocks that affect equipment operation both by alarm and by HMI indication.
- K. Check analog inputs for out of range (via high and low limit checks) and alarmed.
- L. Label process flow streams and color-code using the project color schedule in Division 09. Identify structures and equipment by name and appropriate equipment and loop tags.
- M. Color coding for equipment status and alarms is to follow existing standard.
- N. Automatically record alarm and events should any of the following sequences or events occur:

1. Date/Time entry.
2. Limit changes.
3. Commanded or un-commanded change of any point.
4. Alarm conditions.
5. PLC activation or deactivation.
6. Operator login or logout activity.

3.3 HISTORICAL DATA MANAGEMENT

- A. The existing Historical Data Management System is VTScada Historian by Trihedral. Provide the following features for processing and storage of system historical data:
1. Each system point (analog or digital, real or pseudo) has the capability of being historically logged. A point can be deleted from historical log at any time. Points can be added or deleted from the system using minimal keystrokes.
 2. Sample and store all process analogs and all flow totals and run time indications of all primary process equipment motors in the historical data management system.
 3. Data Processing: Store the real time instantaneous values in a historical log file on the hard disk at defined sampling rates.
 4. Data Correction: Manually modify historical data by personnel with appropriate security levels. Differentiate such data from actual monitored values on reports, in the database and in trends.
 5. Data Quality: Propagate data Quality flags to the next higher level of the history based on user selectable percentage determining tolerance levels for averages and totals. If the percentage of suspect data exceeds the tolerance level, the suspect data flag propagates to the next higher level. Maximums and minimums are taken from good data.
 6. Manual Input Data Handling: This data consists of additional values not obtainable by the system such as laboratory analysis for use in reports. Enter and store all manually entered data in the appropriate engineering units. Display all data entered for confirmation on the display prior to incorporation to the database.

3.4 REPORTS

- A. Determine quantity and format of reports at the workshop, including all new tags will need to be linked and recorded in Historian.
- B. General Requirements For Reports:
1. The system generates reports from on-line historical data files or prompt the user for the appropriate archived data files.
 2. Initiate reports automatically based upon time of day or manually upon operator's request.
 3. Develop user-interface displays for report generation with easy recall of reports by entering time:day:year target values.
 4. User interface displays allows the operator to define the destination of the report (e.g., display, printer, computer file, etc.) and when to print (e.g., immediately, on demand, or automatically at a specified time).
 5. Print quality tags alongside the value.

6. Identify values for which there are no data with a special character. Thus, print only values which are actually zero.
7. Operational Report Types. Provide the following operational report types with the system:
 - a. Shift Operation Summary Report:
 - 1) Summarize plant operation from the start and finish time of operation on an operator-adjustable time interval shift operation report.
 - 2) Consist of the following: correct date, plant name, report name, page number, group headings, subheadings, point identification, and engineering units.
 - b. Daily Operation Summary Report
 - 1) Summarize plant operation for the previous day on the daily operation report. Printed information is stored values (not averages) including scanned, lab, and manually entered data.
 - 2) The report format consists of the following: correct date, plant name, report name, page number, group headings, subheadings, point identifications, and engineering units.
 - 3) Also calculate the daily minimum, average, maximum, and total where applicable and print and store for each point.
 - c. Monthly Operation Summary Report:
 - 1) Summarize plant operation for the previous calendar month on the monthly operation summary report.
 - 2) Arrange the report format so that the first several pages conform to the requirements of the state regulatory agencies and separate from the rest of the monthly operation report for transmittal to the regulatory agency.
 - 3) Report format similar to the daily operation summary report, consisting of the following: month and year, plant name, report name, page number, group headings, sub-headings, point identifications, and engineering units.
 - 4) Print monthly minimum, average, maximum, and totals, where applicable, for each column of points printed.
 - d. Annual Operation Summary Report:
 - 1) Summarize plant operation for the previous calendar year on the annual operation summary report. Report consists of scanned data, lab data, and manually entered data.
 - 2) Format of the report is identical with the monthly operation summary report except for replacing month with year in the heading and replacing date with calendar month.

3.5 TRAINING

- A. Furnish training as shown on the table below. Operator Training shall include, but not be limited to:
 1. Demonstration of the operation of the modified system with newly installed VFDs.
 2. How the VFDs control the feed pressure of the RO Trains.

3. What to view/monitor to ensure the RO Trains are working properly.
4. How to operate the VFDs manually.
5. User interface of the new VFDs.
6. How to use any applicable modifications to HMI/SCADA screens.

Description	Minimum Course Duration (hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audience
Onsite Training				
Control System Overview Seminar	2	12	1	Management
Operator Training	2	12	1	Operations
System Reports and Historian	2	2	1	Maintenance

B. Control System Overview Seminar:

1. Provide Control System Overview seminar for the Owner's personnel at the Owner's facility. The objective of this seminar is to provide personnel with an overview understanding of the Control System. Target the seminar material to the Owner's management, engineering, and other non-operations personnel. The seminar includes, but not limited to, the following:
 - a. An overview of the Control system explaining how the hardware and software supplied under this Contract is used for the operation and control of the facilities.
 - b. A block diagram presentation of the Control system showing how and what information flow within the system and what each functional unit does.
 - c. An explanation of the operator interfaces including a demonstration of how to use an operator's workstation to monitor, control, navigate, display trends, and all other operational features of the system. Address outside of this course a discussion of process control of individual processes.
 - d. A walkthrough of the installed system explaining each of the items covered in the functional units' discussion. Discuss the features and functions of operator controls and interfaces.

C. Operator Control System Training (pre- or post start-up):

1. Cover during operator training plant operation with the control system and use of the HMI display screens, including at a minimum all the following items:
 - a. Basics of HMI control and navigation.
 - b. Alarming and Interlocks.
 - c. Auto functionality of automated processes and HMI control.
 - d. Failure modes of equipment and operator responses.
2. Hold a minimum of two operator-training sessions (Pre-Startup) for operators one week before system startup. Use the Simulator specified in this project for the pre-startup training. Hold additional one or two operator-training sessions (Post-Startup) for operators one week after system startup.

3. Hold operator training at the convenience of the Owner. Hold this training during the day, late at night, or very early in the morning to accommodate the Owner's shift schedule.
4. Operator training is introductory in nature during pre-startup training and more in-depth and detailed during post-startup training.
5. At a minimum, provide the following teaching aids for distribution during Operator training sessions:
 - a. Preliminary O&M Manuals (pre-startup); Final O&M Manuals (post-startup).
 - b. P&IDs.
 - c. Daily syllabus.
6. Fifty percent of the Operator training is "hands on" utilizing the installed Control System to the fullest extent possible. Confirm the operability of the Control System before commencing training. Training performed using a non-functioning Control System is not permitted.

D. Software Maintenance:

1. Provide training of how to back-up PLCs, HMIs, OITs, and any other software in this system.
2. Provide training on all aspects covered in the O&M Software Maintenance Manuals.
3. Provide training on PLC program structure, HMI configuration structure, tips in how to edit programming code, and other items which will supplement the maintenance staff's ability to edit and maintain the programs.

E. Historian and System Reports:

1. Provide training of how to run the reports, how to manually enter data, and how to print and reprint the reports.
2. Provide training on how to execute data queries that are outside of those defined in the reports.
3. Provide training on Historian configuration, report configuration, database maintenance and backup, and repair of failed reports.

END OF SECTION 406863

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SECTION 406866 - CONFIGURATION OF CONTROLLER SOFTWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. If referred to anywhere else in the project manual, AE or AESS services include, but are not limited to, those services specified in this Section.
- B. Provide all modifications to programming, configuration, and related services required to achieve a fully integrated and operational system. Control all equipment in full conformity with the Contract Drawings, process control descriptions, specifications, engineering data, instructions, and recommendations of the equipment manufacturer. Coordinate the control system for proper operation with related equipment and materials furnished by other suppliers under other Sections of these specifications and with related existing equipment.
 - 1. Provide modifications to configuration of the PLC provided for all equipment shown on the drawings, except for controls equipment shown being provided as part of a vendor package system.
- C. Coordinate all work with plant operating personnel to minimize impacts on daily operation. Note delays caused for any reason and formally submitted to the Engineer and the Owner in the form of a letter.
- D. Related Requirements:
 - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions" for submittal requirements.
 - 2. Section 406863 "Configuration of HMI Software."

1.3 DEFINITIONS

- A. Applications Engineering System Supplier (AESS): The entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.
- B. Human Machine Interface (HMI): A software-based user interface with supervisory level control and of machine level equipment.
- C. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

- D. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.
- E. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.
- F. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

1.4 ACTION SUBMITTALS

A. Controller Program Submittal

1. For each controller, submit the following using the controller manufacturers built in printing functions. Electronic submission of Adobe Portable Document Format ("pdf") files in lieu of paper submittals is acceptable. Review will be for general program organization, level of documentation, and overall programming standards (basic pump and valve control, for example). The review will not attempt to confirm the logic works correctly for every loop.
 - a. PLC programs showing modifications to ladder logic, function block, high level language or another controller language used. Include individual rung, network, and/or command descriptions with abundant comments to clearly identify function and intent of each code segment. Clearly present each logic segment, describe the function of each timer, label and define the purpose of each subroutine call, etc. Ensure that program documentation is sufficiently clear to allow determination of compliance with the process control requirements included in the control descriptions and with the Drawings. The submittal demonstrates that all logic provided under this project follows the same structure and format and reflects a common programming approach.
 - b. Submit a memory usage report for the controller. Indicate total memory capacity and unused memory capacity.
 - c. Submit cross reference index of I/O allocation and controller memory address. Include every physical I/O point as well calculated or virtual I/O required for the implementation of the process scheme.
2. Submit details of modifications to control system communication. Submit a "memory map" or other means showing which signals are exchanged between PLCs. Also submit an HMI tag database showing all signals exchanged between the PLCs and HMI. Define any specific communication block memory addresses.

- B. Submit all electronic files associated with the controller such that the Owner and Engineer can open a complete copy of the controller program using the controllers native programming package.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONTROLLER PROGRAMS

- A. Modify all application programs in a structured manner and follow an intuitive arrangement so that an instrumentation technician with basic programming knowledge will be able to understand. Utilize standard program templates or subroutines for repetitive logic such as equipment control, flow total calculations, equipment runtime calculations.
- B. Make changes to the application programs and software configuration, based on comments during the submittals, the factory tests, the field tests, and during the commissioning process to meet the design intent, at no additional cost to the Owner.

3.2 PROGRAMMING STANDARDS

- A. All modifications to existing programming configurations shall follow and match existing standards. Use of other standards and conventions will not be allowed

END OF SECTION 406866

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SECTION 407000 - INSTRUMENTATION FOR PROCESS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes the general requirements to furnishing, installing, and servicing PCSS provided instruments.
- B. Related Requirements:
 - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions" for submittal requirements.
 - 2. Section 407313 "Pressure and Differential Pressure Gauges"
 - 3. Section 407336 "Pressure and Differential Pressure Switches"

1.3 DEFINITIONS

- A. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

1.4 ACTION SUBMITTALS

- A. Submit complete documentation for all field instruments in one comprehensive submittal. Use ISA-TR20.00.01-2007 data sheet format as a cover sheet for each instrument prior to data sheets. Submit a complete Bill of Materials (BOM) or Index that lists all instrumentation equipment, sorted by Loop Number.
- B. Submit separate data sheets for each instrument type:
 - 1. Plant Equipment Number and ISA tag number per the Drawings.
 - 2. Product (item) name used herein and on the Drawings.
 - 3. Manufacturer's complete model number.
 - 4. Location of the device.
 - 5. Input - output characteristics.
 - 6. Range, size, and graduations in engineering units.

- C. Submit the following information for each instrument type:
1. Include construction details, material descriptions, dimensions of individual components and profiles.
 2. Sizing calculations where applicable.
 3. Indicate which instruments will be provided with certified calibration data (i.e., all flow metering devices) as part of O&M manual.
 4. Include rated capacities, operating characteristics, electrical characteristics and furnished specialties and accessories.
 5. Two-wire or four-wire device type as applicable.
 6. Indicate which instruments will be provided with manufacturer's maintenance services if specified.
 7. Indicate instruments that are located in hazardous areas based on the Area Classification table and plans.
 8. Where instruments are located in hazardous areas, indicate the classification (e.g., Class I, Division 1) and protection technique utilized for the instrument as required by the NEC (NFPA 70 Art. 500.7) (e.g., explosionproof equipment, intrinsic safety, etc.)
- D. Instrument Vendor Shop Drawings:
1. Include plans, elevations, sections, and mounting details.
 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Detail fabrication and assembly of instrument.
 4. Include diagrams for power, signal, and control wiring.
- E. Submit catalog cuts for all instruments. Submit descriptive literature for each hardware component, which fully describes the units being provided.

1.5 INFORMATIONAL SUBMITTALS

- A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

1.6 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Refer to individual instrument specifications for spare parts requirements.
- B. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions" for PCSS requirements regarding submission of maintenance materials.

1.8 QUALITY ASSURANCE

- A. Refer to individual instrument specifications for quality assurance requirements as well as which specific instruments require manufacturer's start-up and training services.
- B. Provide components compatible with functions required to form complete working system.
- C. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions" for overall quality assurance requirements for PCSS scope of work.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 016000 "Product Requirements" for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

- A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

1.11 WARRANTY

- A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

PART 2 - PRODUCTS

2.1 INSTRUMENT TAGS

- A. Permanent stainless steel or other non-corrosive material tag firmly attached and indelibly marked with the instrument tag number, as indicated in the Drawings. Tag equipment before shipping to the site.
- B. Provide 1/8-in by 3/8-in, Type 316 stainless-steel button head machine screws.
- C. All supplied instrument transmitters and instrument transmitter elements require a stainless-steel identification tag. Attach tag via stainless steel chain or stainless-steel wire (24-gauge min) to a non-removable part of the device. Stamp the ISA alphanumeric instrument number as indicated on the P&ID, loop, or detail drawings into the tag. Minimum tag size is 1" H x 3" W with 3/16" high alphanumeric characters.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. See installation requirements in individual specification sections.
- B. Mount instrumentation on instrumentation racks or stands, unless otherwise indicated. Provide shutoff and drain valves on all instrumentation connections.

3.2 FIELD INSTRUMENT SCHEDULE

- A. The field instrument schedule Section 407000 APPENDIX A itemizes field instruments being provided by the PCSS (Division 40) or manufacturers of vendor provided equipment.
- B. Each column of the field instrument schedule is defined as follows:
 - 1. DRAWING NO.: The P&ID or drawing where the I/O point appears on.
 - 2. ISA TAG NAME AND LOOP NO.: The identifier assigned to the field instrument.
 - 3. LOOP SUFFIX: Used to distinguish instruments that share an ISA tag and loop number.
 - 4. TYPE: The type of instrument to be provided. For example, if the instrument is a pressure, this will specify whether it is a differential pressure transmitter, gauge pressure transmitter, etc. Specific criteria will also be included in this column, such as if a diaphragm seal is required.
 - 5. RANGE: Required measurement span of the instrument.
 - 6. UNITS: Engineering units being measured
 - 7. LOCATION AND DESCRIPTION: The process being measured.
 - 8. PROVIDE BY: The entity responsible for providing the instrument
 - 9. SPEC: The specification section number where the instrument details can be found.
 - 10. INSTALLATION DETAIL: Detail on the drawings showing specific installation requirements.

END OF SECTION 407000

SECTION 407000 APPENDIX-A: FIELD INSTRUMENT SCHEDULE

Drawing No.	ISA tag name and loop No.	Type	Range /Setpoint	Units	Location & Description	Provided by	Spec.	Installation Detail (I drawing unless otherwise stated)
I-4	PI-22-1-1	PRESSURE GAUGE	0-160 psi	PSI	RO FEED PUMP NO. 1 SUCTION PRESSURE	40	407313	A
I-4	PSL-22-1-1	PRESSURE SWITCH	20 psi	PSI	RO FEED PUMP NO. 1 SUCTION PRESSURE LOW	40	407336	A
I-4	PI-22-1-2	PRESSURE GAUGE	0-500 psi	PSI	RO FEED PUMP NO. 1 DISCHARGE PRESSURE	40	407313	A
I-4	PSH-22-1-2	PRESSURE SWITCH	310 psi	PSI	RO FEED PUMP NO. 1 DISCHARGE PRESSURE HIGH	40	407336	A
I-4	PI-22-2-1	PRESSURE GAUGE	0-160 psi	PSI	RO FEED PUMP NO. 2 SUCTION PRESSURE	40	407313	A
I-4	PSL-22-2-1	PRESSURE SWITCH	20 psi	PSI	RO FEED PUMP NO. 2 SUCTION PRESSURE LOW	40	407336	A
I-4	PI-22-2-2	PRESSURE GAUGE	0-500 psi	PSI	RO FEED PUMP NO. 2 DISCHARGE PRESSURE	40	407313	A
I-4	PSH-22-2-2	PRESSURE SWITCH	310 psi	PSI	RO FEED PUMP NO. 2 DISCHARGE PRESSURE HIGH	40	407336	A
I-5	PI-22-3-1	PRESSURE GAUGE	0-160 psi	PSI	RO FEED PUMP NO. 3 SUCTION PRESSURE	40	407313	A
I-5	PSL-22-3-1	PRESSURE SWITCH	20 psi	PSI	RO FEED PUMP NO. 3 SUCTION PRESSURE LOW	40	407336	A
I-5	PI-22-3-2	PRESSURE GAUGE	0-500 psi	PSI	RO FEED PUMP NO. 3 DISCHARGE PRESSURE	40	407313	A
I-5	PSH-22-3-2	PRESSURE SWITCH	310 psi	PSI	RO FEED PUMP NO. 3 DISCHARGE PRESSURE HIGH	40	407336	A
I-5	PI-22-4-1	PRESSURE GAUGE	0-160 psi	PSI	RO FEED PUMP NO. 4 SUCTION PRESSURE	40	407313	A
I-5	PSL-22-4-1	PRESSURE SWITCH	20 psi	PSI	RO FEED PUMP NO. 4 SUCTION PRESSURE LOW	40	407336	A
I-5	PI-22-4-2	PRESSURE GAUGE	0-500 psi	PSI	RO FEED PUMP NO. 4 DISCHARGE PRESSURE	40	407313	A
I-5	PSH-22-4-2	PRESSURE SWITCH	310 psi	PSI	RO FEED PUMP NO. 4 DISCHARGE PRESSURE HIGH	40	407336	A

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SECTION 407313 - PRESSURE AND DIFFERENTIAL PRESSURE GAUGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes pressure and differential pressure gauges.
- B. Related Requirements:
 - 1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
 - 2. Section 407000 “Instrumentation for Process Systems.”

1.3 DEFINITIONS

- A. Not used.

1.4 ACTION SUBMITTALS

- A. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Provide (1) spare of each instrument type and range provided.

1.8 QUALITY ASSURANCE

- A. Provide components compatible with functions required to form complete working system.
- B. Ensure that materials of construction of wetted parts are compatible with process liquid.
- C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.11 WARRANTY

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 PRESSURE GAGES

- A. Manufacturers:
 - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
 - a. Ametek US Gauge.
 - b. Ashcroft.
 - c. Omega Engineering, Inc.
 - d. Weksler.
 - e. Or equal.
- B. Type:
 - 1. Bourdon tube actuated dial face pressure gauge.
- C. Function/Performance:
 - 1. Accuracy: Plus or minus 1.0 percent of full-scale range.
 - 2. Provide for zero-reading adjustment.
 - 3. Adjusting Screws: Accessible from rear of case without need for disassembly.

4. Comply with ASME B40.100.

D. Physical:

1. Dial:

- a. Nominal Diameter: 4-1/2 inches.
- b. Face: White, laminated plastic dials with black graduations.
- c. Scale: Extend over arc not less than 200 and not more than 270 degrees.
- d. Ranges and Graduation Units: As indicated on instrument schedule.

2. Cases:

- a. Liquid filled.
- b. Material: Type 316 stainless-steel.
- c. Provide removable rear plate.
- d. For gauge pressure, vented case for temperature/atmospheric compensation
- e. Windows:
 - 1) Material: Clear acrylic or shatterproof glass.
 - 2) Thickness: 1/8 inch.
 - 3) Provide gasket.

3. Bourdon Tubes:

- a. Material: Stainless steel, to brass socket.
- b. Provide welded, stress-relieved joints.

4. Connection:

- a. Location: Bottom.
- b. Socket:
 - 1) 1/2-inch NPT male thread.
 - 2) Material: Brass forging.
 - 3) Extend minimum 1-1/4 inches below gage cases.
 - 4) Provide wrench flats.
- c. Mounting: Stem or surface.

E. Required Accessories:

1. Provide isolation valve.
2. Shutoff Cocks: Furnished by gauge manufacturer.
3. Special scales: Engineer reserves the right to require special scales and/or calibration if the manufacturer's standard is not suitable for the application.
4. Liquid fill gauges at the factory.
5. For each differential pressure switch, provide a three-valve manifold. Manifold to be Type 316 stainless steel. Manifolds to be D/A Manufacturing or Anderson Greenwood.

PART 3 - EXECUTION

3.1 IDENTIFICATION

- A. Refer to drawings for tagging designations.

3.2 FIELD QUALITY CONTROL

- A. Refer to Section 406121.20.

3.3 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Works with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system's operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.
- B. While starting up the instruments, the manufacturer to provide training to the Owner's instrumentation technicians as follows:
 - 1. How to calibrate, install, troubleshoot, read the diagnostics, and maintain the gauge.

END OF SECTION 407313

SECTION 407336 - PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes pressure and differential pressure switches.
- B. Related Requirements:
 - 1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
 - 2. Section 407000 “Instrumentation for Process Systems.”

1.3 ACTION SUBMITTALS

- A. Refer to Section 407000 “Instrumentation for Process Systems.”

1.4 INFORMATIONAL SUBMITTALS

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.5 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Provide (1) spare of each type of instrument and range provided.

1.7 QUALITY ASSURANCE

- A. Provide components compatible with functions required to form complete working system.
- B. Ensure that materials of construction of wetted parts are compatible with process liquid.

- C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.9 FIELD CONDITIONS

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 PRESSURE SWITCHES

- A. Manufacturers:
 - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
 - a. Ashcroft.
 - b. Mercoid.
 - c. Static-O-Ring (SOR).
 - d. Dwyer Instruments, Inc.
 - e. Omega Engineering, Inc.
 - f. Or equal
- B. Type:
 - 1. Pressure: Diaphragm actuated.
- C. Function/Performance:
 - 1. Accuracy:
 - a. Pressure: Plus or minus 5 percent of operating range.
 - 2. Range:
 - a. Pressure: Refer to instrument schedule in Section 407000.

3. Type of Switch: SPDT snap action.
4. Switch Rating: 10A at 230VAC.
5. Repeatability: Better than 1 percent of full scale.
6. Dead band: Adjustable to 60 percent of full scale.
7. Set Points: Adjustable between 20 and 80 percent of adjustable range.
8. Automatic reset type.
9. Over Range Protection: Provide positive over range protection to 150 percent of the maximum pressure of the system being monitored.

D. Physical:

1. Hermetically sealed switches.
2. Enclosures shall meet the area classification of the location where the device is being installed.
3. Materials:
 - a. Diaphragm: Stainless steel.
 - b. Wetted parts: 316L Stainless Steel.
 - c. Seals: Viton.
 - d. Connection port: 316 Stainless Steel.
4. Connection:
 - a. Location: Bottom.
 - b. Size: 1/4 inch.
 - c. Furnish taps for sensing lines.

E. Required Accessories:

1. Pressure: Provide Type 316 stainless-steel shutoff valve. Provide manifold by D/A Manufacturing, Anderson Greenwood, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1.

3.2 CONNECTIONS

- A. Refer to Section 260526 "Grounding and Bonding for Electrical Systems."

3.3 IDENTIFICATION

- A. Refer to drawings for tagging designations.

3.4 FIELD QUALITY CONTROL

- A. Refer to Section 406121.20.

3.5 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system's operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.
- B. While starting up the instruments, the manufacturer to provide training to the Owner's instrumentation technicians as follows:
 - 1. How to calibrate, install, troubleshoot, read the diagnostics, and maintain the gauge.

END OF SECTION 407336

SECTION 432331.41 – VERTICAL IN-LINE MULTISTAGE CENTRIFUGAL PUMP

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes vertical in-line multistage centrifugal pumps.
 - 1. RO Feed Pumps: A total of four duty RO feed pumps are to be provided, with each pump dedicated to an individual RO skid (Skids 1 through 4). The system operates with variable flow using VFDs.
- B. Related Requirements:
 - 1. Section 007200 – Standard General Conditions of the Construction Contract.
 - 2. Section 013300 – Submittals.
 - 3. Section 013513.24 – Special Procedures for Maintenance of Plant Operations and Construction
 - 4. Section 014000 – Quality Requirements
 - 5. Section 016100 – Common Product Requirements
 - 6. Section 017823 – Operation and Maintenance Data

1.3 COORDINATION

- A. See Section 013513.24 “Special Procedures for Maintenance of Plant Operations and Construction” for coordination requirements.

1.4 ACTION SUBMITTALS

- A. See Section 013300 “Submittals” for submittals requirements.
- B. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for vertical in-line multistage centrifugal pump.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 3. Manufacturer's rating curves showing pump characteristics of head, brake horsepower, discharge, efficiency and NPSHR. This information shall be prepared specially for the pumps proposed. Catalog sheets showing a family of curves will not be acceptable.

4. Manufacturer's rating curves showing pump characteristics of head, brake horsepower, discharge, efficiency and NPSHR. This information shall be prepared specially for the pump proposed. Catalog sheets showing a family of curves will not be acceptable.
 5. Data on motors and power factor correction capacitors.
 6. Descriptive literature, bulletins and/or catalogs of the equipment.
 7. The total weight of equipment including the weight of the single largest item or component and including the maximum weight "wet".
- C. Shop Drawings: Shop and erection drawings showing materials, details of construction, dimensions and anchor bolt locations.
1. Provide control panel showing clearly all safety switches, disconnects, wires, contacts, lights, buttons, switches, terminals, pressure gauges, devices etc. and complete wiring schematics.
 - a. Completely illustrate the equipment to be supplied.
 - b. Typical diagrams are not acceptable. Each unit shall have its own wiring interconnection diagram and materials list.
- D. A complete total bill of materials for all equipment.
- E. A list of the manufacturer's recommended spare parts.
- F. Written confirmation that submitted system can be installed in location required.
- G. Description of surface preparation and shop painting.

1.5 DELEGATED DESIGN SUBMITTALS

- A. Delegated Design Submittals: Signed and sealed detailed dimensional Shop Drawings with design calculations and assumptions confirming required suction and discharge pressures and flows are acceptable for these pumps.
1. Included with Shop Drawings will be data for materials and equipment, including wiring and control diagrams, performance charts and curves, installation and anchoring requirements, fasteners, and other details as specified.
 2. Complete description of surface preparation and shop prime painting.

1.6 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificates:
1. Products meet or exceed specified requirements.
 2. Installation is completed according to manufacturer's instructions.
- B. Manufacturer's Instructions: Detailed instructions on installation requirements, including storage and handling procedures.
- C. Source Quality-Control Submittals: Results of factory tests and inspections.

- D. Field Quality-Control Submittals: Results of Contractor-furnished tests and inspections.

1.7 CLOSEOUT SUBMITTALS

- A. See Section 017000 “Execution and Closeout Requirements” for submittals requirements.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. See Section 017000 “Execution and Closeout Requirements” for maintenance materials requirements.
- B. Spare Parts: One set of manufacturer's recommended spare parts.
- C. Tools: Special tools and other devices required for Owner to maintain equipment.

1.9 QUALITY ASSURANCE

- A. The feed pumps shall be furnished by a manufacturer who is fully experienced, reputable and qualified in the manufacture of the equipment to be furnished. The system supplier shall be fully responsible for the proper operation and performance of the system. The system as a whole and the pumping units shall be designed, constructed and installed in accordance with the best practices and methods and shall operate satisfactorily when installed where indicated on the Drawings.
- B. Manufacturer Qualifications: At least 5 years of manufacturing specified products and at least 10 installations in Florida.
- C. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in Manufacturer’s original packaging and inspect for damage. As necessary, provide inspection report to Manufacturer identifying any damage and rework necessary prior to installation.
- B. Storage: Store pumps and all appurtenances according to Manufacturer’s instructions.
- C. Do not disassemble factory assembled parts and components for shipment unless written permission received from Engineer.
- D. Protection
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to Manufacturer’s instructions.
 - 3. Protect unpainted finished iron and steel surfaces to prevent rust and corrosion.
 - 4. Protect finished surfaces of exposed flanges with wood or equivalent blank flanges.

5. Protect bearings against formation of rust in accordance with bearing manufacturer's recommendations. Apply lubricant or corrosion inhibiting treatment during transportation, storage, handling, installation, and lapse of time prior to start-up. Intermittently manually rotate equipment prior to start-up to ensure distribution of lubricant/protection

1.11 SITE CONDITIONS

- A. Ambient Temperature Range: minus 10 to 50 degrees C.
- C. Field Measurements: As applicable confirm field measurements and interferences prior to fabrication. Indicate field measurements on Shop Drawings.

1.12 WARRANTY

- A. The manufacturer shall provide warranty: Section 017000 "Execution and Closeout Requirements" specifies requirements for warranties
- B. If Installer is included as signer of the warranty, the maximum warranty period that sureties will allow is two years. Use specified form of special warranty only when it is included at the end of the Section.
- C. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of Vertical In-Line Multistage Centrifugal Pump that fail(s) in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 1. Afton Pumps Inc.
 2. Grundfos Pump. (Bid alternative)

2.2 SYSTEM DESCRIPTION

- A. RO Feed pump for Skid No.1 (P-22-1), Skid No. 2 (P-22-2), Skid No. 3 (P-22-3) and Skid No. 4 (P-22-4)
 1. Description: RO skid feed pump No. 1, 2, 3 and 4.
 2. Location: As shown in the drawing
 3. Equipment Tag Number: P-22-1, P-22-2, P-22-3 and P-22-4.
 4. Number of Pumps (operating/ standby): 4(4/0)
 5. Liquid Pumped: Cartridge filtered raw water
 6. Suction Condition: Pressurized
 7. Maximum Speed: 3600 rpm
 8. Allowable Motor Horsepower: 120 HP

9.	Motor Design Voltage/Phase/Frequency:	460/3/60 V/Ph/Freq.
10.	Anticipated Pumped Fluid Temperature:	20–60°F minimum
11.	Pump Suction Nozzle Size:	2 inches minimum, flanged.
12.	Pump Discharge Nozzle Size:	3 inches minimum, flanged.
13.	Pump Shut Off Head at Motor FLS Range:	750–770 feet
14.	Design Point Flow Rate:	295 gal per min.
15.	TDH At Design Point:	690 feet
16.	Flow Rate at Secondary Operation Point:	265 gal per min.
17.	TH at Secondary Operation Point:	460 feet minimum.
18.	Efficiency at Design Point:	53-70 percent minimum.
19.	NPSH3 at Design Point:	11-12 feet maximum.
20.	Best Efficiency Point (BEP) Flow Rate Range:	320 – 325 gpm (min/max).
21.	Efficiency at BEP:	54-72 percent minimum.
22.	BEP Location Relative to Design Point:	Above
23.	Flow Rate at Run-out Point:	380 gal per min minimum.
24.	Drive: VFD.	

2.3 PERFORMANCE REQUIREMENTS

- A. Design and proportion of all parts as to have liberal strength, stability and stiffness and to be especially adapted for the work to be done. Provide the room and facilities for inspection, repairs and adjustment.
- B. Furnish the water booster pumps complete with all pumps, motors, suction and discharge manifolds, shut-off valves, control valves, controls, control panel and motor starters required. Factory install all components on a steel skid base and wired, such that only external connections of piping and wiring shall be required in the field.
- C. Provide all necessary foundation bolts, plates, nuts, and washers by the equipment manufacturer. Provide items to be embedded in concrete for installation by others.
 - 1. Anchor Bolts: Type 316 stainless steel.
- D. Nameplates: Attach brass or stainless steel indicating the name of the manufacturer, the rated capacity, head, speed and all other pertinent data to each pump.
- E. Design and construct the pumps and motors to avoid the generation of objectionable noise or vibration. The noise limitations shall apply to the entire system, regardless of the number of pumps running.

2.4 PUMPS

- A. Type: In-line, non-self-priming, vertical multistage centrifugal pump coupled to a standard motor, with flow and head defined in the specification, manufactured according to the standards of the Hydraulic Institute.
- B. Pumps and motors designed and built for 24-hour continuous service at any and all points within the required range of operation, without overheating, excessive vibration or strain.

C. Casing:

1. Material: Cast Type 316 stainless steel (ASTM CF-8M).
2. The suction/discharge base shall have ANSI Class 150 or Class 300 raised face flange connections in a slip ring (rotating flange) design as indicated in the drawings.
3. Maximum working pressure 740 psig.
4. The connection size: Minimum 2-inch suction and 3-inch discharge connections.
5. Mating Parts: Register fit to ensure alignment.

D. Impeller

1. Design:
 - a. Enclosed, reverse vanes.
 - b. Laser welded, profiled leading edge blades.
 - c. Secured directly to the pump shaft by means of a split cone and nut design.
 - d. Impeller design characteristics shall be focused on achieving optimum pump hydraulic efficiency.
2. Material: Type 316 Stainless Steel.
3. Statically and dynamically balanced after assembly.

E. Pump Thrust Compensation:

1. Thrust compensation shall be accomplished by either:
 - a. For pumps fitted with a motor 100 hp or larger, the axial thrust created by pump operation shall be borne primarily by a maintenance-free, thrust handling device of the thrust bearing type, as opposed to a piston type, which is lubricated and cooled by the pumped liquid and is located in the pump base.
 - b. The axial thrust shall be borne primarily by an external bearing flange mounted between the pump and the motor.

F. Pump Shaft:

1. Stainless steel, AISI 431 or 318 LN.
2. Tapered and keyed at both ends.

G. Pump Shaft Seal Design:

1. Shaft seal shall be single cartridge type design with balanced cartridge O-ring arrangement.
2. Standard shaft seal replacement will be possible without removal of any pump components other than the coupling guard, motor couplings and seal cover.
3. Pumps will have adequate space within the motor stand so that shaft seal replacement is possible without motor removal.

H. Motors:

1. Provide motors rated for operation on 480-volt, 3 phase and 60 hertz power.

2. Pump motors: United States manufacture, close-coupled, totally enclosed, fan cooled type with rodent screens on all ventilating passages.
 - a. 1.15 service factor, and Class F insulation.
 - b. Wound for the starting configuration as called out in the technical data sheet.
 - c. Design pump brake horsepower at duty point shall not exceed 100 percent of motor horsepower exclusive of service factor, and service factor shall not be exceeded at any point on the pump head-capacity curve.
 - d. Motor Shaft: High-strength steel protected by a bronze or stainless-steel shaft sleeve secured to the shaft to prevent rotation.
 - e. Manufacturer listed in 400493.23 - 3
 3. Motors furnished with winding temperature detectors for each phase. Embedded bi-metallic temperature thermostat switches with normally closed contacts and leads terminating in the main conduit box.
- I. Variable-Speed Drive: As specified in 262923.25 "Variable-Frequency Motor Controllers Industrial."

2.5 GENERAL FINISH REQUIREMENTS

- A. All surfaces prepared and prime painted in the manufacturer's shop.
 1. Surface preparation and painting in accordance with the manufacturer's recommendations.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish products after assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Reference Section 017400 "Execution and Closeout Requirements".
- B. Field verify all pertinent data and dimensions to determine exact location and arrangement for equipment to be installed.
- C. Verify that items provided by other Sections of Work are ready to receive Work of this Section.
- D. Verify layout, orientation and connections.
- E. Coordinate with other trades, equipment and systems to the fullest extent possible.

3.2 INSTALLATION

- A. Installation shall be in strict accordance with the manufacturer's instructions and recommendations in the locations indicated on the Drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations. Anchor bolts shall be set in accordance with the manufacturer's recommendations.
- B. Comply with requirements for pipe hangers and supports specified in Section 40 05 07 "Hangers and Supports for Process Piping" in Division 40.

3.3 FIELD QUALITY CONTROL

- A. Furnish the services of a factory representative for one day who has complete knowledge of proper installation, operation and maintenance to inspect the final installation and supervise a test run of the equipment.
- B. After pump has been completely installed, conduct in the presence of the Engineer, such tests as are necessary to indicate that the pump efficiency and discharge conform to the specifications. Field tests shall include all pumps included under this Section. Supply all electric power and water to complete the field tests.
- C. If the pump performance does not meet the requirements specified, corrective measures shall be taken or pumps shall be removed and replaced with pumps, which satisfy the conditions specified. A seven-day operating period of the pumps will be required before acceptance. During this seven-day operating period, supply all power necessary.
- D. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- E. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- F. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Refer to Section 017500 "Starting and Adjusting".
- B. Adjust hardware and moving parts to function smoothly and lubricate as recommended by manufacturer.

3.5 MANUFACTURER'S SERVICES

- A. Manufacturer's technical representative is required to attend the submittal kick-off workshop.
- B. Provide the services of a factory-certified service engineer who has complete knowledge of proper installation, startup, PLC and OIT programming, VFD settings, testing, operation, and maintenance of specified equipment. Submit qualifications of service representative for approval who is a direct, full time employee of the manufacturer.

- C. Manufacturer shall advise, consult, and instruct the Contractor on:
1. Installation procedures and adjustments and inspect the equipment during installation as a condition of acceptance of the work.
 2. Startup and testing of the finished installation.
- D. Provide classroom training and hand-on demonstrations.
1. Develop and submit to Engineer and Owner a training lesson plan. Submit proposed lesson plans for scheduled instruction 30 days prior to the commencement of training. Lesson plans will be approved by the Engineer a minimum of 7 days prior to scheduled instruction.
 2. Lesson Plans: Detail specific instruction topics. Where applicable, reference and attach training aids to be utilized in the instruction. Describe "Hands-on" demonstrations planned for the instruction, including estimated duration for each training segment.
- E. Provide Owner's training including operational and maintenance instruction to two separate operational and maintenance teams over two separate time periods. Give training at times convenient to operational or maintenance teams being trained in coordination with the Owner. Accordingly, some training may be conducted during hours outside a normal Monday through Friday, 7:00 a.m. to 5:00 p.m. workday. Include following operational training as a minimum:
1. Theory of operation.
 2. Process flow description.
 3. Unit capacity and design criteria.
 4. Operational troubleshooting and diagnostics procedures.
 5. Step-by-step startup and shutdown procedures.
 6. System operation and optimization practices.
 7. Control set point modification procedures.
 8. Overall installed control system to include PLC/OIT controls functionality and control panel hardware operations.
 9. PLC and OIT program backup procedures.
- F. Minimum maintenance training topics:
1. Step-by step, "hands-on" assembly and disassembly procedural instructions.
 2. Replacement part identification and ordering procedures.
 3. Lubrication procedures, including drain-down and refill procedures.
 4. Recommended routine maintenance procedures.
 5. Troubleshooting and diagnostic procedures.
- G. Man-hour requirements listed below are exclusive of travel time and do not relieve the manufacturer of the obligation to provide sufficient service to place equipment in satisfactory operation. *1
1. Attend Submittals Kick-Off Workshop: Trips --1; Hours/Trip - 4
 2. Supervise Installation: Trips - 1 Hours/Trip – 8.
 3. Inspect and Approve Installation *2: Trips - 1 Hours/Trip - 8.
 4. Supervise Initial Adjustment *3: Trips - 1 Hours/Trip - 4.
 5. Instruct Owner's personnel in proper startup and O&M *4: Trips - 1 Hours/Trip - 4
 6. Supervise and Assist in Testing *5: Trips - 2 Hours/Trip - 8.
 7. Notes:

- a. *1 - Manufacturer's factory representative shall be present at frequent enough intervals to ensure proper installation, testing and initial operation of the equipment. Minimum time on site per trip based on 8-hour working days.
- b. *2 - Manufacturer's factory representative shall submit to the Engineer a written certification that the system has been installed in accordance with the manufacturer's recommendations.
- c. *3 - May be done upon completion of Item 3 if acceptable to the Engineer.
- d. *4 - Instruction may be given upon completion of Item 4, provided that the O&M manuals have been submitted to and accepted by the Engineer.
- e. *5 - May be done upon completion of Item 5 if acceptable to the Engineer. The time required for performance testing is in addition to the above specified hours.

END OF SECTION 432331.41

