

Bid Set – For Construction

**Water Resource Recovery Facility
Improvements Project**

**Contract Documents and
Technical Specifications**



Prepared for:

City of Rome, New York

Issue Date:

November 2024



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**City of Rome, New York
Water Resource Recovery Facility Improvements Project**

**INVITATION TO BID
RFB 2024-031**

Sealed Bids for construction of the “Water Resource Recovery Facility Improvement Project” will be received by the City of Rome at the City Clerk’s office, Rome City Hall, 198 North Washington Street, Rome, New York 13440, until 11:00 AM Eastern Standard Time (EST) on January 9, 2025, and at that time and place bids will be publicly opened and read aloud.

Sealed bids will be received for the following:

RFB 2024-031

Water Resource Recovery Facility Improvement Project

The general contract will generally consist of: replacing four dry pit submersible pumps rated for 6,000 gpm each and the discharge header in the Main Pump Station (MPS), temporary bypass pumping and bypass piping around the MPS, MPS sludge valve and flow meter replacements; Filtrate Pump Station submersible pump and buried forcemain replacement; secondary clarifier plug valve replacements and temporary bypass pumping and piping; buried digested sludge forcemain replacement; new 100,000 glass lined bolted steel leachate storage tank with truck unloading pump station, flow meter and control valve vault and underground piping; instrumentation and control system upgrades and integration.

The electrical contract will generally consist of: replacing the MPS MCC-10 and re-feeding other existing panels during construction, new VFD’s and branch circuit wiring to the new pumps in the MPS, MPS lighting upgrades; new underground duct banks to the Filtrate Pump Station and leachate valve vault; modifications to the gravity thickener MCC for the new leachate truck unload pump; instrumentation wire and conduit to control panels from new equipment.

BID MATERIALS

Bids will be advertised electronically at:

- <http://www.romenewyork.com/treasurer-purchasing/>
- <https://www.bidnetdirect.com/new-york/city-of-rome>

Digital copies of the contract documents may also be examined at the following locations/sites:

- Dodge Data & Analytics (www.construction.com/projects)
- Mohawk Valley Builders Exchange, 10 Main Street, Suite 202 Whitesboro, NY 13492
- Eastern Contractors Association Inc., 6 Airline Drive, Albany NY 12205
- Syracuse Builders Exchange, 6563 Ridings Road, Syracuse, NY 13206

OFFICIAL PLAN HOLDERS LIST

Bidders who intend to submit a bid must call or email the City of Rome to be placed on the official plan holders list.

All Contractors that obtain contract documents must notify the City of Rome in order to be placed in the official plan holder’s list, in order to receive addenda and any other bid correspondence. Bids received from contractors other than those on the official plan holder’s list will not be accepted. To be placed on the official plan holders list please contact the Department of Engineer at either (315) 339-7627 or jguiliano@romecitygov.com

PRE-BID CONFERENCE & PROJECT QUESTIONS

There will be a pre-bid conference for this bid on December 5, 2024 10:00am – 12:00pm at Rome City Hall. 198 N. Washington Street, Rome, New York 13440 followed by a site visit to the WRRF, located at 7180 East Dominick Street, Rome, New York 13440.

Questions pertaining to the bid package should be directed to Mr. Kurt Dirr, P.E. at CDM Smith via e-mail (dirrkj@cdmsmith.com).

ADDENDA

The City will not issue Addenda, nor will its Engineer issue addenda nor respond to bidder's questions five (5) days prior to the scheduled bid opening unless stated bid date is postponed.

BID SECURITY

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 (5) percent of the Bid. Bidders may not withdraw their Bids for a period of forty-five (45) calendar days after the actual date of the opening of the Bids.

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

ADDITIONAL NOTES

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

Wage rates for this Project are subject per New York State Prevailing Wage Schedule.

The Owner reserves the right to waive any informality in or to reject any or all Bids if deemed to be in its best interest.

Rome City Clerk,
Jean I. Grande

Legal Date: November 19, 2024

DESIGN ENGINEER

Kurt Dirr, P.E.
Project Engineer
CDM Smith
3 Lear Jet Lane, Suite 100N
Latham, NY 12110
Phone: (518) 782-4503
dirrkj@cdmsmith.com

OWNERS CONTACT

Joe Guiliano
Commissioner of Public Works
City of Rome
City Hall
198 N Washington Street
Rome, NY 13440
Phone: (315) 336-6000

COVERSHEET

SECTION 002113.16 - INSTRUCTIONS TO BIDDERS

City of Rome, NY

**Water Resource Recovery Facility Improvements
RFB-2024-031**

**Contract 1G - General
Contract 1E - Electrical**

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.

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 Surveys and investigative reports of subsurface or latent physical conditions at the site which have been relied upon by ENGINEER in preparing the Contract Documents are identified in Article 5 of the Supplementary Conditions. Copies of these reports are included in the Appendix to the Project Manual. These reports are not guaranteed or warranted as to accuracy or completeness, nor are they part of the Contract Documents.

3.3 Before submitting a Bid, Bidders may, at their own expense, make such 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.

3.4 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.

3.5 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.

3.6 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 by CDM Smith, dirrkj@cdmsmith.com Attn: **Kurt Dirr**, 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 with return receipt requested, 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 10:00am – 12:00pm at Rome City Hall, 198 N. Washington Street, Rome, New York 13440 followed by a site visit to the WRRF, located at 7180 East Dominick Street, Rome, New York 13440. 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 **30** days 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.

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 One copy of each Bid shall be submitted in a sealed opaque envelope bearing on the outside the Bidder's name, address, and the Project Title for which the Bid is submitted. (If forwarded by mail, Bid and sealed envelope marked as described above shall be enclosed in another envelope with the notation "BID ENCLOSED" on the face and addressed as indicated in the Invitation to Bid.)

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 shall not be considered. No Bid may be withdrawn for a period of 45 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 45 days, after the actual date of the opening of the Bids. All bids shall remain open for **45** days, 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 15 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. FEDERAL WAGE RATES

None

ARTICLE 15. AMERICAN IRON AND STEEL REQUIREMENT

None

Joe Guiliano
Commissioner of Public Works
City of Rome, New York

END OF DOCUMENT 002114

SECTION 004000

BID SUBMITTAL CHECKLIST

The items listed below are required to be submitted with the Bid Form. Each item on this checklist shall be initialed below indicating each form has been signed and submitted with the bid.

(Owner's check)		(Bidder's initials)
	Bid Form (004113.16)	
	Bid Security (004514)	
	Bidder's Qualifications Statement (004517)	
	Non-Collusion Affidavit (004535)	

SIGNATURE: The undersigned hereby acknowledges and has submitted all requirements listed in the Bid Submission Checklist.

Name of Bidder: _____

By Authorized Representative:

Signature: _____

Date: _____

Print Name and Title: _____

END OF SECTION

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SECTION 004113.16 - BID FORM

BID FORM
TO

City of Rome, NY
Water Resource Recovery Facility Improvements
RFB-2024-031

Contract No. 1G - General

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, 308 Maltbie St. Suite 101, Syracuse, NY 13204 and dated November 2024 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 45 days, after the actual date of the opening of the Bids, the undersigned will within 15 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 10 days following the Effective Date of the Agreement and to fully complete the Work within 550 Calendar Days 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 the Contract Time Limit 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:

Item No	Estimated Quantity	Brief Description of Work	Amount in Figures
1	Lump Sum	General Requirements, not to exceed 5% of the total contract price	\$ _____
2	Lump Sum	All work related to the Main Pump Station as shown on the Drawings and as described under Section 011200, except as included under other Base Bid items.	\$ _____
3	Lump Sum	All work related to the Filtrate Pump Station and flow meter vault as shown on the Drawings and as described under Section 011200, except as included under other Base Bid items.	\$ _____
4	Lump Sum	All work related to the Waste Holding Tank, pressure level/indicator vault, and Waste Transfer Station as shown on the Drawings and as described under Section 011200, except as included under other Base Bid items.	\$ _____
5	Lump Sum	All work related to the Digester No. 2 Control Building as shown on the Drawings and as described under Section 011200, except as included under other Base Bid items.	\$ _____
6	Lump Sum	RAS manhole valve replacements with new manhole top with access hatch.	\$ _____
7	Lump Sum	Power wash and clean wet well, provide scaffolding and review repair quantities with Engineer.	\$ _____
8	60 SF	Repair Type A – deep spall concrete repair. \$ _____ (per square foot).	\$ _____ (total cost)
9	450 SF	Repair Type B – low depth spall concrete repair. \$ _____ (per square foot).	\$ _____ (total cost)
10	110 LF	Repair Type C – crack repair with chemical grout injection. \$ _____ (per linear foot).	\$ _____ (total cost)
A1	Allowance	Contingency Allowance	\$100,000
A2	Allowance	SCADA Allowance	\$60,000

TOTAL CONTRACT BID SUMMARY

TOTAL CONTRACT BID PRICE \$ _____

TOTAL CONTRACT BID PRICE IN WORDS

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

Amounts shall be shown in both words and figures, where indicated. In case of discrepancy, the amount shown in words will govern.

The above prices shall include all labor, materials, bailing, shoring, 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

SECTION 004113.16 - BID FORM

BID FORM
TO

City of Rome, NY
Water Resource Recovery Facility Improvements
RFB-2024-031

Contract No. 1E - Electrical

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, 308 Maltbie St. Suite 101, Syracuse, NY 13204 and dated November 2024 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 45 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 10 days following the Effective Date of the Agreement and to fully complete the Work within 550 Calendar Days 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 the Contract Time Limit 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:

Item No	Estimated Quantity	Brief Description of Work	Amount in Figures
1	Lump Sum	General Requirements, not to exceed 5% of the total contract price	\$ _____
2	Lump Sum	All work related to the Main Pump Station as shown on the Drawings as described under Section 011200.	\$ _____
3	Lump Sum	All work related to the Filtrate Pump Station and flow meter vault as shown on the Drawings and as described under Section 011200.	\$ _____
4	Lump Sum	All work related to the Waste Holding Tank, pressure level/indicator vault, Waste Transfer Station as shown on the Drawings and as described under Section 011200.	\$ _____
A1	Allowance	Contingency Allowance	\$50,000

TOTAL CONTRACT BID SUMMARY

TOTAL CONTRACT BID PRICE \$ _____

TOTAL CONTRACT BID PRICE IN WORDS

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

Amounts shall be shown in both words and figures, where indicated. In case of discrepancy, the amount shown in words will govern.

The above prices shall include all labor, materials, bailing, shoring, 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

SECTION 004514 - BID BOND

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

Signed, this day of _____, 20____

The Condition of the above obligation is such that whereas the Principal has submitted to certain Bid,
attached hereto and hereby made a part hereof to enter into a contract in writing, for the Water Resource
Recovery Facility Improvements Project.

NOW THEREFORE,

- (a) If said Bid shall be rejected, or in the alternate,
- (b) If said Bid shall be accepted and the Principal shall execute and deliver to OWNER the appropriate documents including the Contract Form and Contract Bond Form, and shall in all other respects perform the agreement created by the acceptance of said Bid, then this obligation shall be void, otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

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

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

Principal (Print Full Name)

Surety (Print Full Name)

BY: _____ (L.S.)

BY: _____ (L.S.)

TITLE: _____

TITLE: _____

IMPORTANT - Surety companies executing bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the State of New York.

END OF SECTION 004514

SECTION 004517 - BIDDER'S QUALIFICATION STATEMENT

The undersigned warrants the truth and accuracy of all statements and answers herein contained. Include additional sheets if necessary.

1. How many years has your organization been in business as a Prime Contractor?

2. Describe and give the date and owner of the last project that you have completed similar in type, size, and nature as the one proposed?

3. Have you ever failed to complete work awarded to you? If so, where and why?

4. Name three individuals or corporations for which you have performed work and to which you refer:

5. Have you personally inspected the site of the proposed work? Describe any anticipated problems with the site and your proposed solutions:

6. Will you Subcontract any part of this Work? If so, describe which portions:

7. Please list the names and addresses of the subcontractors to be used for the portions of the work listed below. Additional information will be required in accordance with the Instructions to Bidders, Item 8

8. What equipment do you own that is available for the work?

9. What equipment will you purchase for the work?

10. What equipment will you rent for the work?

11. The following is given as a summary of the Financial Statement of the undersigned: (List Assets and Liabilities and use insert sheet if necessary.)

12. State the true and exact, correct, and complete name under which you do business.

BIDDER IS: _____

SOLE PROPRIETORSHIP

(Individual's Signature)

(SEAL)

(Individual's Name)

doing business as _____

Business address: _____

Phone No.: _____

A PARTNERSHIP

(Partnership Name)

(SEAL)

(General Partner's Signature)

(General Partner's Name)

Business address: _____

Phone No.: _____

A CORPORATION

(Corporation Name)

(State of Incorporation)

By _____

(Name of person authorized to sign)

(Title)

(Authorized Signature)

(CORPORATE SEAL)

Attest _____

(Secretary)

Business address: _____

Phone No.: _____

13. List the following in connection with the Surety which is providing the Bid Bond:

Surety's Name: _____

Surety's Address: _____

14. Name and address of Surety's resident agent for service of process in _____:

END OF SECTION 004517

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SECTION 004535 - NON-COLLUSIVE AFFIDAVIT

State of _____)

County of _____)

_____ being first duly sworn, deposes and says that:

- (1) He is the _____, of
(Owner, Partner, Officer, Representative or Agent)
_____, the Bidder that has submitted the attached Bid;
- (2) He is fully informed respecting the preparation and contents of the attached Bid and of all pertinent circumstances respecting such Bid;
- (3) Such Bid is genuine and is not a collusive or sham Bid;
- (4) Neither the said Bidder nor any of its officers, partners, owners, agents, representatives, employees or parties in interest, including this affiant, have in any way colluded, conspired, connived or agreed, directly or indirectly, with any other Bidder, firm, or person to submit a collusive or sham Bid in connection with the Work for which the attached Bid has been submitted; or to refrain from bidding in connection with such Work; or have in any manner, directly or indirectly, sought by agreement or collusion, or communication, or conference with any Bidder, firm, or person to fix the price or prices in the attached Bid or of any other Bidder, or to fix any overhead, profit, or cost elements of the Bid price or the Bid price of any other Bidder, or to secure through any collusion, conspiracy, connivance, or unlawful agreement any advantage against (Recipient), or any person interested in the proposed Work;
- (5) The price or prices quoted in the attached Bid are fair and proper and are not tainted by any collusion, conspiracy, connivance, or unlawful agreement on the part of the Bidder or any other of its agents, representatives, owners, employees or parties in interest, including this affiant.

BY _____

(Title)

Subscribed and sworn to before me

this ____ day of _____, 20____.

My commission expires on _____

END OF SECTION 004535

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SECTION 005214.16 - AGREEMENT

**City of Rome, New York
Water Resource Recovery Facility Improvements
RFB-2024-031**

AGREEMENT

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

between the City of Rome

acting through its Department of Public Works

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 in SECTION 011000.

ARTICLE 2. ENGINEER

2.1 The Project has been designed by CDM Smith 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 Contract Time shall be 550 Calendar Days commencing ten days following the Effective Date of this Agreement.

3.2 CONTRACTOR agrees that the Work shall be prosecuted regularly, diligently and uninterruptedly and at such rate of progress as will insure full 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 the average climatic range and usual industrial conditions prevailing in this locality.

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 Contract 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 95 percent of the value of the Work completed and 95 percent 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 99 percent 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.

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 \$1,000 per day for each calendar day of delay until the Work is 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 Parts I and II.

9.1.8 Specifications (as listed in Table of Contents).

9.1.9 Drawings, numbered G-1 through I-4, inclusive and dated November 2024.

9.1.10 Addenda numbers _____ to _____, inclusive.

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.

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.

END OF DOCUMENT 005214

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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National Society of Professional Engineers
1420 King Street, Alexandria, VA 22314-2794
(703) 684-2882
www.nspe.org

American Council of Engineering Companies
1015 15th Street N.W., Washington, DC 20005
(202) 347-7474
www.acec.org

American Society of Civil Engineers
1801 Alexander Bell Drive, Reston, VA 20191-4400
(800) 548-2723
www.asce.org

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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 EJDC® 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 EJDC's sponsoring organizations.

PERFORMANCE BOND

<p>Contractor</p> <p>Name: [Full formal name of Contractor]</p> <p>Address <i>(principal place of business)</i>: [Address of Contractor's principal place of business]</p>	<p>Surety</p> <p>Name: [Full formal name of Surety]</p> <p>Address <i>(principal place of business)</i>: [Address of Surety's principal place of business]</p>
<p>Owner</p> <p>Name: [Full formal name of Owner]</p> <p>Mailing address <i>(principal place of business)</i>: [Address of Owner's principal place of business]</p>	<p>Contract</p> <p>Description <i>(name and location)</i>: [Owner's project/contract name, and location of the project]</p> <p>Contract Price: [Amount from Contract]</p> <p>Effective Date of Contract: [Date from Contract]</p>
<p>Bond</p> <p>Bond Amount: [Amount]</p> <p>Date of Bond: [Date]</p> <p><i>(Date of Bond cannot be earlier than Effective Date of Contract)</i></p> <p>Modifications to this Bond form: <input type="checkbox"/> None <input type="checkbox"/> See Paragraph 16</p>	
<p>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.</p>	
Contractor as Principal	Surety
<p>_____</p> <p><i>(Full formal name of Contractor)</i></p>	<p>_____</p> <p><i>(Full formal name of Surety) (corporate seal)</i></p>
<p>By: _____</p> <p style="text-align: center;"><i>(Signature)</i></p>	<p>By: _____</p> <p style="text-align: center;"><i>(Signature)(Attach Power of Attorney)</i></p>
<p>Name: _____</p> <p style="text-align: center;"><i>(Printed or typed)</i></p>	<p>Name: _____</p> <p style="text-align: center;"><i>(Printed or typed)</i></p>
<p>Title: _____</p>	<p>Title: _____</p>
<p>Attest: _____</p> <p style="text-align: center;"><i>(Signature)</i></p>	<p>Attest: _____</p> <p style="text-align: center;"><i>(Signature)</i></p>
<p>Name: _____</p> <p style="text-align: center;"><i>(Printed or typed)</i></p>	<p>Name: _____</p> <p style="text-align: center;"><i>(Printed or typed)</i></p>
<p>Title: _____</p>	<p>Title: _____</p>
<p><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></p>	

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

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

statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.

14. Definitions

- 14.1. *Balance of the Contract Price*—The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.
 - 14.2. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.
 - 14.3. *Contractor Default*—Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.
 - 14.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
 - 14.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.
15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.
16. Modifications to this Bond are as follows: **[Describe modification or enter “None”]**

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

Prepared By



Endorsed By



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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

<p>Contractor</p> <p>Name: [Full formal name of Contractor]</p> <p>Address <i>(principal place of business)</i>: [Address of Contractor's principal place of business]</p>	<p>Surety</p> <p>Name: [Full formal name of Surety]</p> <p>Address <i>(principal place of business)</i>: [Address of Surety's principal place of business]</p>
<p>Owner</p> <p>Name: [Full formal name of Owner]</p> <p>Mailing address <i>(principal place of business)</i>: [Address of Owner's principal place of business]</p>	<p>Contract</p> <p>Description <i>(name and location)</i>: [Owner's project/contract name, and location of the project]</p> <p>Contract Price: [Amount, from Contract]</p> <p>Effective Date of Contract: [Date, from Contract]</p>
<p>Bond</p> <p>Bond Amount: [Amount]</p> <p>Date of Bond: [Date]</p> <p><i>(Date of Bond cannot be earlier than Effective Date of Contract)</i></p> <p>Modifications to this Bond form: <input type="checkbox"/> None <input type="checkbox"/> See Paragraph 18</p>	
<p>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.</p>	
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: _____
<p><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></p>	

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

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

- 16.1.5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
 - 16.1.6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
 - 16.1.7. The total amount of previous payments received by the Claimant; and
 - 16.1.8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.
- 16.2. *Claimant*—An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic’s lien or similar statute against the real property upon which the Project is located. The intent of this Bond is to include without limitation in the terms of “labor, materials, or equipment” that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor’s subcontractors, and all other items for which a mechanic’s lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.
- 16.3. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.
- 16.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
- 16.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.
17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.
18. Modifications to this Bond are as follows: **[Describe modification or enter “None”]**

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



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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

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

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

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

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

33. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative (RPR) includes any assistants or field staff of Resident Project Representative.
34. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
35. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer’s review of the submittals.
36. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor’s Applications for Payment.
37. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.
38. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands or areas furnished by Owner which are designated for the use of Contractor.
39. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
40. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.
41. *Submittal*—A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers’ instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.
42. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion of such Work.

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

1.02 Terminology

- A. The words and terms discussed in Paragraphs 1.02.B, C, D, and E are not defined terms that require initial capital letters, but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. *Intent of Certain Terms or Adjectives:* The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.
- C. *Day:* The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. *Defective:* The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
1. does not conform to the Contract Documents;
 2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 3. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or Paragraph 15.04).
- E. *Furnish, Install, Perform, Provide*
1. The word “furnish,” when used in connection with services, materials, or equipment, means to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
 2. The word “install,” when used in connection with services, materials, or equipment, means to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
 3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, means to furnish and install said services, materials, or equipment complete and ready for intended use.
 4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words “furnish,” “install,” “perform,” or “provide,” then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

- F. *Contract Price or Contract Times*: References to a change in “Contract Price or Contract Times” or “Contract Times or Contract Price” or similar, indicate that such change applies to (1) Contract Price, (2) Contract Times, or (3) both Contract Price and Contract Times, as warranted, even if the term “or both” is not expressed.
- G. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2—PRELIMINARY MATTERS

2.01 *Delivery of Performance and Payment Bonds; Evidence of Insurance*

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

2.02 *Copies of Documents*

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

2.03 *Before Starting Construction*

- A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise required by the Contract Documents), Contractor shall submit to Engineer for timely review:
 - 1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;
 - 2. a preliminary Schedule of Submittals; and
 - 3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work

into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work, and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other Submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review the schedules submitted in accordance with Paragraph 2.03.A. No progress payment will be made to Contractor until acceptable schedules are submitted to Engineer.
 - 1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
 - 2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
 - 3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.
 - 4. If a schedule is not acceptable, Contractor will have an additional 10 days to revise and resubmit the schedule.

2.06 *Electronic Transmittals*

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

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

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

3.02 *Reference Standards*

- A. *Standards Specifications, Codes, Laws and Regulations*
 - 1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, means the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
 - 2. No provision of any such standard specification, manual, reference standard, or code, and no instruction of a Supplier, will be effective to change the duties or responsibilities of Owner, Contractor, or Engineer from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner or Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility

inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*

1. *Contractor's Verification of Figures and Field Measurements:* Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.
2. *Contractor's Review of Contract Documents:* If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:
 - a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or
 - b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

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

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

3.05 *Reuse of Documents*

- A. Contractor and its Subcontractors and Suppliers shall not:
 - 1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media versions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or
 - 2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein precludes Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

- A. The Contract Times will commence to run on the 30th day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the 60th day after the day of Bid opening or the 30th day after the Effective Date of the Contract, whichever date is earlier.

4.02 *Starting the Work*

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

4.03 *Reference Points*

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the

established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 *Progress Schedule*

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

4.05 *Delays in Contractor's Progress*

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

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

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

5.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor in writing of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.

- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

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

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas, or to improvements, structures, utilities, or similar facilities located at such adjacent lands or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.
 2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.13, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or in a court of competent jurisdiction; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.
- B. *Removal of Debris During Performance of the Work:* During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris will conform to applicable Laws and Regulations.
 - C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment

and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

- D. *Loading of Structures*: Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

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

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

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

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

- D. *Limitations of Other Data and Documents*: Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto;
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings;
3. the contents of other Site-related documents made available to Contractor, such as record drawings from other projects at or adjacent to the Site, or Owner's archival documents concerning the Site; or
4. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 *Differing Subsurface or Physical Conditions*

- A. *Notice by Contractor:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site:
1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate;
 2. is of such a nature as to require a change in the Drawings or Specifications;
 3. differs materially from that shown or indicated in the Contract Documents; or
 4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

- B. *Engineer's Review:* After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine whether it is necessary for Owner to obtain additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- C. *Owner's Statement to Contractor Regarding Site Condition:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.
- D. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the subsurface or physical condition in question may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the condition in question has been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- E. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in

Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

- a. Such condition must fall within any one or more of the categories described in Paragraph 5.04.A;
 - b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,
 - c. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
- a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise;
 - b. The existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
 - c. Contractor failed to give the written notice required by Paragraph 5.04.A.
3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.
4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.
- F. *Underground Facilities; Hazardous Environmental Conditions*: Paragraph 5.05 governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.06 governs rights and responsibilities regarding Hazardous Environmental Conditions. The provisions of Paragraphs 5.03 and 5.04 are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

5.05 *Underground Facilities*

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

3. verifying the actual location of those Underground Facilities shown or indicated in the Contract Documents as being within the area affected by the Work, by exposing such Underground Facilities during the course of construction;
 4. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 5. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.
- B. *Notice by Contractor:* If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated on the Drawings, or was not shown or indicated on the Drawings with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing regarding such Underground Facility.
- C. *Engineer's Review:* Engineer will:
1. promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy;
 2. identify and communicate with the owner of the Underground Facility; prepare recommendations to Owner (and if necessary issue any preliminary instructions to Contractor) regarding the Contractor's resumption of Work in connection with the Underground Facility in question;
 3. obtain any pertinent cost or schedule information from Contractor; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and
 4. advise Owner in writing of Engineer's findings, conclusions, and recommendations.

During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

- D. *Owner's Statement to Contractor Regarding Underground Facility:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.
- E. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the Underground Facility may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the Underground Facility in question and conditions affected by its presence have been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- F. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, to the extent that any existing Underground Facility at the Site that was not shown

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

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

5.06 *Hazardous Environmental Conditions at Site*

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

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

B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures

- of construction to be employed by Contractor, and safety precautions and programs incident thereto;
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.
- D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.
- E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.
- F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.
- G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, as a result of such Work stoppage, such special conditions under which Work is agreed to be resumed by Contractor, or any costs or expenses incurred in response to the Hazardous Environmental Condition, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off. Entitlement to any such adjustment is subject to the provisions of Paragraphs 4.05.D, 4.05.E, 11.07, and 11.08.
- H. If, after receipt of such written notice, Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special

conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

- I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court, arbitration, or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I obligates Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J obligates Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

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

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

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

6.02 *Insurance—General Provisions*

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

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

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

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

6.03 Contractor's Insurance

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

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

6.04 *Builder's Risk and Other Property Insurance*

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

6.05 *Property Losses; Subrogation*

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

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

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

6.06 *Receipt and Application of Property Insurance Proceeds*

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

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.01 *Contractor's Means and Methods of Construction*

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

7.02 *Supervision and Superintendence*

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who will not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.03 *Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall maintain good discipline and order at the Site.

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

7.04 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.
- B. All materials and equipment incorporated into the Work must be new and of good quality, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications will expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- C. All materials and equipment must be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.05 *"Or Equals"*

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

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

7.06 *Substitutes*

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

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

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

7.07 *Concerning Subcontractors and Suppliers*

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

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

7.08 *Patent Fees and Royalties*

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If an invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights will be disclosed in the Contract Documents.
- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.
- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.09 *Permits*

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

7.10 *Taxes*

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.11 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It is not Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this does not relieve Contractor of its obligations under Paragraph 3.03.
- C. Owner or Contractor may give written notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such written notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.12 *Record Documents*

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

7.13 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations.
- B. Contractor shall designate a qualified and experienced safety representative whose duties and responsibilities are the prevention of Work-related accidents and the maintenance and supervision of safety precautions and programs.
- C. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:
 - 1. all persons on the Site or who may be affected by the Work;
 - 2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 - 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- D. All damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
- E. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection.
- F. Contractor shall notify Owner; the owners of adjacent property; the owners of Underground Facilities and other utilities (if the identity of such owners is known to Contractor); and other contractors and utility owners performing work at or adjacent to the Site, in writing, when Contractor knows that prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.
- G. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.
- H. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

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

7.14 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of safety data sheets (formerly known as material safety data sheets) or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused by an emergency, or are required as a result of Contractor's response to an emergency. If Engineer determines that a change in the Contract Documents is required because of an emergency or Contractor's response, a Work Change Directive or Change Order will be issued.

7.16 *Submittals*

A. *Shop Drawing and Sample Requirements*

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

3. With each Shop Drawing or Sample, Contractor shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Contract Documents. This notice must be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.
- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.
1. *Shop Drawings*
 - a. Contractor shall submit the number of copies required in the Specifications.
 - b. Data shown on the Shop Drawings must be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide, and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.C.
 2. *Samples*
 - a. Contractor shall submit the number of Samples required in the Specifications.
 - b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the Submittal for the limited purposes required by Paragraph 7.16.C.
 3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.
- C. *Engineer's Review of Shop Drawings and Samples*
1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. Engineer's review and approval will be only to determine if the items covered by the Submittals will, after installation or incorporation in the Work, comply with the requirements of the Contract Documents, and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
 2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction, or to safety precautions or programs incident thereto.
 3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
 4. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will

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

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

D. Resubmittal Procedures for Shop Drawings and Samples

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous Submittals.
2. Contractor shall furnish required Shop Drawing and Sample submittals with sufficient information and accuracy to obtain required approval of an item with no more than two resubmittals. Engineer will record Engineer's time for reviewing a third or subsequent resubmittal of a Shop Drawing or Sample, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges.
3. If Contractor requests a change of a previously approved Shop Drawing or Sample, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

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

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

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

7.17 Contractor's General Warranty and Guarantee

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer is entitled to rely on Contractor's warranty and guarantee.
- B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.08. The time in which Owner may enforce its warranty and guarantee rights under this Paragraph 7.17 is limited only by applicable Laws and Regulations restricting actions to enforce such rights; provided, however, that after the end of the correction period under Paragraph 15.08:
1. Owner shall give Contractor written notice of any defective Work within 60 days of the discovery that such Work is defective; and
 2. Such notice will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the notice.
- C. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
1. abuse, or improper modification, maintenance, or operation, by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 2. normal wear and tear under normal usage.
- D. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents, a release of Contractor's obligation to perform the Work in accordance with the Contract Documents, or a release of Owner's warranty and guarantee rights under this Paragraph 7.17:
1. Observations by Engineer;
 2. Recommendation by Engineer or payment by Owner of any progress or final payment;
 3. The issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 4. Use or occupancy of the Work or any part thereof by Owner;
 5. Any review and approval of a Shop Drawing or Sample submittal;
 6. The issuance of a notice of acceptability by Engineer;
 7. The end of the correction period established in Paragraph 15.08;
 8. Any inspection, test, or approval by others; or

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

7.18 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from losses, damages, costs, and judgments (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable.
- B. In any and all claims against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A will not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

7.19 *Delegation of Professional Design Services*

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

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

ARTICLE 8—OTHER WORK AT THE SITE

8.01 *Other Work*

- A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.
- B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any third-party utility work that Owner has arranged to take place at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford proper and safe access to the Site to each contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work.
- D. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.

- E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.
- F. The provisions of this article are not applicable to work that is performed by third-party utilities or other third-party entities without a contract with Owner, or that is performed without having been arranged by Owner. If such work occurs, then any related delay, disruption, or interference incurred by Contractor is governed by the provisions of Paragraph 4.05.C.3.

8.02 *Coordination*

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

8.03 *Legal Relationships*

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

- B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site.
 - 1. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this Paragraph 8.03.B.
 - 2. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due Contractor.
- C. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9—OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

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

9.02 *Replacement of Engineer*

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

9.03 *Furnish Data*

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

9.04 *Pay When Due*

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

- 9.05 *Lands and Easements; Reports, Tests, and Drawings*
- A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.
 - B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.
 - C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.
- 9.06 *Insurance*
- A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.
- 9.07 *Change Orders*
- A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.
- 9.08 *Inspections, Tests, and Approvals*
- A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.
- 9.09 *Limitations on Owner's Responsibilities*
- A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- 9.10 *Undisclosed Hazardous Environmental Condition*
- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.
- 9.11 *Evidence of Financial Arrangements*
- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract (including obligations under proposed changes in the Work).
- 9.12 *Safety Programs*
- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.
 - B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

- A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe, as an experienced and qualified design professional, the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.07. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Resident Project Representative*

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

10.04 *Engineer's Authority*

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

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

10.05 *Determinations for Unit Price Work*

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

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

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

10.07 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, will create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation, and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Contractor under Paragraph 15.06.A, will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 10.07 also apply to the Resident Project Representative, if any.

10.08 *Compliance with Safety Program*

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

ARTICLE 11—CHANGES TO THE CONTRACT

11.01 *Amending and Supplementing the Contract*

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

11.02 *Change Orders*

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

11.03 *Work Change Directives*

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

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

11.04 *Field Orders*

- A. Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly.
- B. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.05 *Owner-Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.
- B. Such changes in the Work may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work must be performed under the applicable conditions of the Contract Documents.
- C. Nothing in this Paragraph 11.05 obligates Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.06 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.C.2.

11.07 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment of Contract Price must comply with the provisions of Article 12.
- B. An adjustment in the Contract Price will be determined as follows:

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

11.08 *Change of Contract Times*

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

11.09 *Change Proposals*

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

B. *Change Proposal Procedures*

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

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

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

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

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

11.10 *Notification to Surety*

- A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12—CLAIMS

12.01 *Claims*

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

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

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

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

13.01 *Cost of the Work*

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

2. When needed to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.
- B. *Costs Included:* Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work will be in amounts no higher than those commonly incurred in the locality of the Project, will not include any of the costs itemized in Paragraph 13.01.C, and will include only the following items:
1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor in advance of the subject Work. Such employees include, without limitation, superintendents, foremen, safety managers, safety representatives, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work will be apportioned on the basis of their time spent on the Work. Payroll costs include, but are not limited to, salaries and wages plus the cost of fringe benefits, which include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, will be included in the above to the extent authorized by Owner.
 2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts will accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment will accrue to Owner, and Contractor shall make provisions so that they may be obtained.
 3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, which will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee will be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.
 4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed or retained for services specifically related to the Work.
 5. Other costs consisting of the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, which are

consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

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

c. *Construction Equipment Rental*

- 1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.
- 2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.
- 3) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed Work.

- d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
- e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
- f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of builder's risk or other property insurance established in accordance with Paragraph 6.04), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will be included in the Cost of the Work for the purpose of determining Contractor's fee.

- g. The cost of utilities, fuel, and sanitary facilities at the Site.
- h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.
- i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

C. *Costs Excluded*: The term Cost of the Work does not include any of the following items:

- 1. Payroll costs and other compensation of Contractor's officers, executives, principals, general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.
- 2. The cost of purchasing, renting, or furnishing small tools and hand tools.
- 3. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
- 4. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
- 5. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
- 6. Expenses incurred in preparing and advancing Claims.
- 7. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. *Contractor's Fee*

- 1. When the Work as a whole is performed on the basis of cost-plus-a-fee, then:
 - a. Contractor's fee for the Work set forth in the Contract Documents as of the Effective Date of the Contract will be determined as set forth in the Agreement.
 - b. for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work, Contractor's fee will be determined as follows:
 - 1) When the fee for the Work as a whole is a percentage of the Cost of the Work, the fee will automatically adjust as the Cost of the Work changes.
 - 2) When the fee for the Work as a whole is a fixed fee, the fee for any additions or deletions will be determined in accordance with Paragraph 11.07.C.2.
- 2. When the Work as a whole is performed on the basis of a stipulated sum, or any other basis other than cost-plus-a-fee, then Contractor's fee for any Work covered by a Change

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

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

13.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.
- B. *Cash Allowances*: Contractor agrees that:
1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment for any of the foregoing will be valid.
- C. *Owner's Contingency Allowance*: Contractor agrees that an Owner's contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor for Work covered by allowances, and the Contract Price will be correspondingly adjusted.

13.03 Unit Price Work

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision

thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, and the final adjustment of Contract Price will be set forth in a Change Order, subject to the provisions of the following paragraph.

E. *Adjustments in Unit Price*

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

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

14.01 *Access to Work*

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply with such procedures and programs as applicable.

14.02 *Tests, Inspections, and Approvals*

- A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.
- B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work will be governed by the provisions of Paragraph 14.05.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

- D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:
1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
 2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
 3. by manufacturers of equipment furnished under the Contract Documents;
 4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
 5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

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

- E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.
- F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering will be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

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

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

14.04 *Acceptance of Defective Work*

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

14.05 *Uncovering Work*

- A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.
- B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.
- C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.
 - 1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.
 - 2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work,

or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work will not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 *Owner May Correct Defective Work*

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace defective Work as required by Engineer, then Owner may, after 7 days' written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.
- C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.
- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

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

15.01 *Progress Payments*

- A. *Basis for Progress Payments:* The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments for Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.
- B. *Applications for Payments*
 - 1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.
 - 2. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation

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

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

C. *Review of Applications*

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:
 - a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or
 - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work;
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work;
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.
6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or
 - e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due*

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

E. *Reductions in Payment by Owner*

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

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

15.02 *Contractor's Warranty of Title*

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

15.03 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time

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

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

15.04 *Partial Use or Occupancy*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without

significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. At any time, Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through 15.03.E for that part of the Work.
2. At any time, Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.04 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 *Final Payment*

A. *Application for Payment*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.12), and other documents, Contractor may make application for final payment.
2. The final Application for Payment must be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents;
 - b. consent of the surety, if any, to final payment;
 - c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.

- d. a list of all duly pending Change Proposals and Claims; and
 - e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.
- B. *Engineer's Review of Final Application and Recommendation of Payment:* If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.
- C. *Notice of Acceptability:* In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.
- D. *Completion of Work:* The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment and issuance of notice of the acceptability of the Work.
- E. *Final Payment Becomes Due:* Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

15.07 *Waiver of Claims*

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

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

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

15.08 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. correct the defective repairs to the Site or such adjacent areas;
 - 2. correct such defective Work;
 - 3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, and
 - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting from the corrective measures.
- B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.
- C. If, after receipt of a notice of defect within 60 days and within the correction period, Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.
- D. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- E. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

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

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times directly attributable to any such suspension. Any Change Proposal seeking such adjustments must be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

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

attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

- F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.
- G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond will govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate for Convenience*

- A. Upon 7 days' written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
 - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and
 - 3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.
- B. Contractor shall not be paid for any loss of anticipated profits or revenue, post-termination overhead costs, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon 7 days' written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.
- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, 7 days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The

provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17—FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

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

ARTICLE 18—MISCELLANEOUS

18.01 *Giving Notice*

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

18.02 *Computation of Times*

- A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

18.03 *Cumulative Remedies*

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

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

18.05 *No Waiver*

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

18.06 *Survival of Obligations*

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

18.07 *Controlling Law*

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

18.08 *Assignment of Contract*

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

18.09 *Successors and Assigns*

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

18.10 *Headings*

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

SECTION 007300.16 - SUPPLEMENTARY CONDITIONS
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- 1.0. FEDERAL GOVERNMENT PROVISIONS
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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 46 of the Project Manual.

ARTICLE 2 - PRELIMINARY MATTERS

SC-2.01C.

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

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 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.1 of the General Conditions in its entirety and replace it with the following:

1. Those reports of explorations and tests of subsurface conditions at or contiguous to the Site that Engineer has used in preparing the Contract Documents. Engineer has relied upon the data obtained from subsurface investigations made at the site in the form of test borings. Such data is in the form of boring logs which are included in the Appendix to the Project Manual . The locations of the test borings are indicated on the Drawings. Such logs and samples are not part of the Contract Documents. In the preparation of Drawings and Specifications, the Engineer has relied upon the following reports and tests of subsurface physical conditions at the site. Copies of these reports are included in the appendix to the Project Manual Such reports 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-6.02D

General Aggregate	\$2,000,000
Products Completed Operations Aggregate	\$2,000,000
Personal and Advertising Injury	\$1,000,000
Each Occurrence	\$2,000,000
Fire Damage	\$50,000
Medical Expense	\$5,000

- 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.

General Aggregate	\$2,000,000
Products Completed Operations Aggregate	\$2,000,000
Personal and Advertising Injury	\$1,000,000
Each Occurrence	\$2,000,000
Fire Damage	\$50,000
Medical Expense	\$5,000

- a. 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:

Combined Single Limit of Liability	\$1,000,000
Each Occurrence Limit of Liability	

Business Automobile Liability (AL) with limits of insurance of not less than \$1,000,000, Combined Single Limit. AL coverage must include coverage for liability arising out of all owned, leased, hired and non-owned automobiles.

OWNER and ENGINEER shall be included as additional insureds on the CONTRACTOR's AL policy. The AL coverage for the additional insured shall apply as primary and non-contributing insurance before any insurance maintained by the additional insureds.

- b. Umbrella or Excess Liability:

Each Occurrence Limit	\$5,000,000
Aggregate	\$5,000,000

- c. Contractor's Pollution Liability:

Bodily Injury	\$1,000,000
Property Damage	\$500,000
OR	

Combined Single Limit	\$1,000,000
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- If box is checked, Contractor is required to provide Contractor's Pollution Liability insurance under this Contract.

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:

The City of Rome and CDM Smith NY 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 the City of Rome and CDM Smith NY Inc., their subsidiaries, officers, directors, partners, employees and other consultants and subcontractors.

ARTICLE 7 - CONTRACTOR'S RESPONSIBILITIES

SC-7.03

Add the following 2 new paragraphs immediately after Paragraph 7.03C. of the General Conditions which are to read as follows:

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

E. 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.

SC-7.02E.

Add the following new paragraphs immediately after what will be Paragraph 7.03E. (or 7.03D. if D and E are not used) of the General Conditions, which are to read as follows:

F. 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.

G. 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.

H. 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.

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 New York. Contractor shall obtain the proper certificates, maintain the necessary records and otherwise comply with the requirements of the State of New York.

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-7.17A.

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.

ARTICLE 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.

ARTICLE 9. OWNER'S RESPONSIBILITIES

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.

ARTICLE 10 - ENGINEER'S STATUS DURING CONSTRUCTION

SC-10.03 Resident Project Representative

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.

ARTICLE 11 - CHANGES TO THE CONTRACT

None

ARTICLE 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.

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.

ARTICLE 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.

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

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.

ARTICLE 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.

ARTICLE 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.

ARTICLE 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.

PART 2 - FEDERAL, STATE AND LOCAL 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

None

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.

3.0 CITY OF ROME, NEW YORK PROVISIONS

END OF SECTION 007300.16

SECTION 007301

SUPPLEMENTARY CONDITIONS
ADDITIONAL ARTICLES

These Supplementary Conditions add new topics to the Standard General Conditions of the Construction Contract (EJCDC Document C-700, 2018 Edition) and other provisions of the Contract Documents.

Articles and paragraphs herein are numbered as a continuation of the General Conditions. Some numbers in sequence may not appear because those numbered Articles and paragraphs are not applicable to this Project and have been deleted when transferring this Section from the office master document.

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SUPPLEMENTARY CONDITIONS - ADDITIONAL ARTICLES

ARTICLE 18. PROVISIONS REQUIRED BY LAW DEEMED INSERTED

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

ARTICLE 19. NEW YORK STATE NONDISCRIMINATION CLAUSES

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

19.1 The Contractor shall not discriminate against any employee or applicant for employment because of race, creed, color, or national origin, and will take affirmative action to ensure that they are afforded equal employment opportunities without discrimination because of race, creed, color or national origin. Such action shall be taken with reference but not limited to: recruitment, employment, job assignment, promotion, upgrading, demotion, transfer, layoff or termination, rates of pay other forms of compensation, and selection for training or retraining, including apprenticeship and on-the-job training.

19.2 The Contractor will send to each labor union or representative of workers with which he/she has or is bound by a collective bargaining or other agreement or understanding, a notice, to be provided by the State Commission for Human Rights, advising such labor union or representative of the Contractor's agreement under clauses (19.1) through (19.8) hereinafter called nondiscrimination clauses. If the Contractor was directed to do so by the contracting agency as part of the bid or negotiation of this contract, the Contractor shall request the labor union or representative to furnish him/her with a written statement that such labor union or representative will not discriminate because of race, creed, color or national origin and that such labor union or representative either will affirmatively cooperate within the limits of its legal and contractual authority in the implementation of the policy and provisions of these nondiscrimination clauses, or that it consents and agrees that recruitment, employment, and the terms and conditions of employment under this contract shall be in accordance with the purposes and provisions of these nondiscrimination clauses. If such labor union or representative fails or refuses to comply with such a request that it furnish such a statement, the Contractor shall promptly notify the State Commission for Human Rights of such failure or refusal.

19.3 The Contractor will post and keep posted in conspicuous places, available to employees and applicants for employment, notices to be provided by the State Commission for Human Rights setting forth the substance of the provisions of clauses (19.1) through (19.2) and such provisions of the State's Laws against discrimination as the State Commission for Human Rights shall determine.

19.4 The Contractor will state, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, that all qualified applicants will be afforded equal employment opportunities without discrimination because of race, creed, color or national origin.

19.5 The Contractor will comply with the provisions of the Executive Law, Human Rights Law, Article 15, and will furnish all information and reports deemed necessary by the State Commission for Human Rights under these nondiscrimination clauses and such sections of the Executive Law, and will permit access to his/her books, records and accounts by the State Commission for Human Rights, the Attorney

General, District Commissioner of Housing and Community Renewal and the Industrial Commission for

purposes of investigation to ascertain compliance with these nondiscrimination clauses of the Executive Law, Human Rights Law, Article 15.

19.6 This Contract may be forthwith canceled, terminated or suspended, in whole or in part by the contracting agency upon the basis of a finding made by the State Commission for Human Rights that the Contractor has not complied with these nondiscrimination clauses, and the Contractor may be declared ineligible for future contracts made by or on behalf of the Site or a public authority or agency of the State or housing authority, or an urban renewal agency, or contract requiring the approval of the Commissioner of Housing and Community Renewal, until he/she has satisfied the State Commission for Human Rights after conciliation efforts by the Commission have failed to achieve compliance with these nondiscrimination clauses and after a verified complaint has been filed with the Commission, notice thereof has been afforded him/her to be heard publicly before three members of the Commission. Such sanctions may be imposed and remedies invoked independently of or in addition to sanctions and remedies otherwise provided by law.

19.7 If this contract is canceled or terminated under clause (19.6), in addition to other rights of the contracting agency provided in this Contract upon its breach by the Contractor, the Contractor will hold the contracting agency harmless against any additional expenses or costs incurred by the contracting agency in completing the work or in purchasing the services, materials, equipment or supplies contemplated by the contract, and the contracting agency may withhold payments from the Contractor in an amount sufficient for this purpose and recourse may be had against the surety on the performance bond if necessary.

19.8 The Contractor will include the provisions of clauses (19.1) through (19.7) in every subcontract or purchase order altered only to reflect the proper identity of the parties in such manner that such provisions will be binding upon each subcontractor or vendor as to operations to be performed within the State of New York. The Contractor will take such actions in enforcing such provisions of such subcontract or purchase order as the contracting agency may direct, including sanctions or remedies for non-compliance. If the Contractor becomes involved in or is threatened with litigation with a subcontractor or vendor as a result of such direction by the contracting agency the Contractor shall promptly so notify the Attorney General, requesting him/her to intervene and to protect the interests of the State of New York.

ARTICLE 20. NEW YORK STATE NON-COLLUSIVE BIDDING CERTIFICATION

In addition to the other provisions herein contained to be done or performed by the Contractor as part of this Contract, the said Contractor certifies, pursuant to the provisions of Section 103-d of the New York State General Municipal Law that:

20.1 By submission of this bid, each bidder and such person signing on behalf of any bidder certifies, and in the case of a joint bid each party thereto certifies as to its own organization, under penalty of perjury, that to the best of his/her knowledge and belief:

- A. The prices in this bid have been arrived at independently without collusion, consultation, communication or agreement, for the purpose of restricting competition, as to any competitor; and
- B. Unless otherwise required by law, the prices which have been quoted in this bid have not knowingly been disclosed by the bidder and will not knowingly be disclosed by the bidder prior to opening, directly or indirectly, to any other bidder or to any competitor; and

C. No attempt has been made or will be made by the bidder to induce any other person, partnership or corporation to submit or not to submit a bid for the purpose of restricting competition.

20.2 A bid shall not be considered for award nor shall any award be made where A, B, and C above have not been complied with; provided however, that if in any case the bidder cannot make the foregoing certification, the bidder shall so state and shall furnish with the bid a signed statement which sets forth in detail the reasons therefore. Where A and C above have not been complied with, the bid shall not be considered for award nor shall any award be made unless the head of the purchasing unit of the political subdivision, public department, agency or official thereof to which the bid is made, or his designee, has determined that such disclosure was not made for the purpose of restricting competition.

The fact that a bidder (1) has published price lists, rates, or tariffs covering items being procured, (2) has informed prospective customers of proposed or pending publication of new or revised price lists for such items, or (3) has sold the same items to other customers at the same prices being bid, does not constitute, without more, a disclosure within the meaning of subparagraph (A).

Any bid hereafter made to any political subdivision of state or any public department, agency or official thereof by a corporate bidder for work or services performed or to be performed or goods sold or to be sold, where competitive bidding is required by statute, rule, regulation, or local law, and where such bid contains the certification referred to in subdivision (A) of this section, shall be deemed to have been authorized by the board of directors of the bidder, and such authorization shall be deemed to include the signing and submission of the bid and the inclusion therein of the certificate as to non-collusion as the act and deed of the corporation.

ARTICLE 22. PROTECTION OF EXISTING FACILITIES

22.1 The Contractor shall conduct his/her operations and take all special temporary and permanent precautions necessary to insure a stable and secure job, and as may be required by the contract documents, the Engineer, the Owner, and the public utilities, to protect and sustain in normal service all existing structures, equipment, utility lines, roadways, and subsurface, submerged and overhead facilities which are to remain in place and undisturbed by his/her operations under this contract completely at his/her own expense, unless otherwise provided for in the contract documents. The Contractor shall be held accountable for damage resulting from failure to exercise proper judgment in the progress of the work.

22.2 When power poles, light poles, pipes, or portions of any other existing structures, or utilities, either visible or underground, constitute an unavoidable interference to his/her operations, the Contractor shall consult with the owner of such facility prior to performing any work at or near the same. If permitted by the owner of the facility, the Contractor shall relocate or temporarily remove, and later restore, the interfering portion of the facility, as directed by said owner and the project Owner, through the Engineer. If the owner of the facility so elects, he will perform such work with his own forces. Under either arrangement, the work shall be done at the Contractor's expense unless stated otherwise in the contract documents.

22.3 The Contractor shall immediately notify the Engineer and the owner of any facilities which are disturbed, damaged or injured as a result of the Contractor's operations. The Contractor shall consult with the owner of such facility as to the proper method of replacing, repairing, or restoring the affected facilities to the conditions which existed prior to the Contractor's operations. If permitted by the owner of the facility, the Contractor shall, at his/her own expense, replace, repair, or restore the affected facilities to their original condition, to the satisfaction of said owner.

22.4 In the event that the owner of the facility desires to use his/her own forces to perform the replacement, repairing or restoring of affected facilities, the Contractor shall reimburse the owner of said facilities for such expenses as said owner may accrue in performing such work. The Contractor shall not be entitled to receive additional compensation under this contract for such work.

22.5 Upon learning of the existence and location of any utility omitted from or shown incorrectly on the contract drawings the Contractor shall notify the utility owner and the Engineer and assumes full responsibility for that utility's protection or relocation as described above.

ARTICLE 23. MATERIALS FOUND AT THE SITE

23.1 All timbers, fences, buildings, stone, sand, utility lines, pipes, and any other appurtenances, materials, or articles of value found on lands or in excavations within the contract limits shall be brought to the attention of the Engineer.

23.2 If such items are found in or upon lands of the Owner, they shall remain the property of the Owner.

Such materials may, therefore be used by the Contractor in the work at the discretion of the Engineer or the Owner, for purposes for which they are acceptable. If not otherwise claimed by the Owner of his/her representatives, such items shall be considered waste and shall be disposed of by the Contractor as stipulated hereafter.

23.3 If such items are found in or upon lands or easements being used in the project but being owned by parties other than the Owner, they shall remain the property of such other owners. If claimed by these owners, the items shall be turned over to these owners at the site of the work as the Engineer directs. If such items are not claimed by these owners, they may similarly be used in the work as stipulated in the preceding paragraph, or be considered waste and be disposed of by the Contractor as stipulated hereafter.

23.4 Disposal of waste materials shall be the Contractor's responsibility as an integral part of the contract and shall be done without special payment from the Owner. The decision as to whether disposal takes place inside or outside of the project limits shall be subject to control by the Engineer. If disposal takes place within the project limits, it shall be done by the Contractor subject to the direction and satisfaction of the Engineer. Waste material shall not be sold to parties within the project limits. If disposal takes place outside the project limits, it shall be done by the Contractor exclusively at his/her discretion and be solely his/her responsibility. The Contractor will be required to show the Engineer how he/she plans to dispose of the waste (i.e., unsuitable backfill, rock, etc.) in an environmentally acceptable manner. The Engineer will require copies of release forms from property owners who have agreed with Contractor to accept spoil materials.

ARTICLE 24. OPERATION OF VALVES AND HYDRANTS

24.1 Operation of all valves and hydrants under pressure shall be done by representatives of the Owner or owner of the utility of the locality where the work is performed, or under their direct supervision and with their approval.

24.2 The Contractor shall give sufficient notice to the Engineer when and where he/she desires operation of valves and hydrants so that the Owner can be contacted and be present.

ARTICLE 25. USE AND PROTECTION OF WATERS IN NEW YORK STATE

The Contractor is advised that any work or operations which in any way disturb or affect the streambed or

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November 2024

banks of any stream which is classified by the New York State Department of Environmental Conservation falls under the control and supervision of the Department of Environmental Conservation. In compliance with the law, the Contractor will be required to contact the Local Permit Agent of NYSDEC and advise him/her of his/her intent to impact said stream. They will then advise the Contractor of the procedures and conditions to be followed.

END OF SECTION

DOCUMENT 007345 – NEW YORK STATE PREVAILING RATE SCHEDULE

PART 1 - GENERAL

1.1 Current New York State Prevailing Rate Schedule.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF DOCUMENT 007345

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Kathy Hochul, Governor

Roberta Reardon, Commissioner

City of Rome
Megan McCoskey
CDM Smith
3 Lear Jet Lane, Suite 100N
Latham NY 12110

Schedule Year 2024 through 2025
Date Requested 11/08/2024
PRC# 2024014128

Location Rome, NY
Project ID#
Project Type Main Pump Station and filtrate pump station improvements and leachate transfer station upgrades.

PREVAILING WAGE SCHEDULE FOR ARTICLE 8 PUBLIC WORK PROJECT

Attached is the current schedule(s) of the prevailing wage rates and prevailing hourly supplements for the project referenced above. A unique Prevailing Rate Case Number (PRC#) has been assigned to the schedule(s) for your project.

The schedule is effective from July 2024 through June 2025. All updates, corrections, posted on the 1st business day of each month, and future copies of the annual determination are available on the Department's website www.labor.ny.gov. Updated PDF copies of your schedule can be accessed by entering your assigned PRC# at the proper location on the website.

It is the responsibility of the contracting agency or its agent to annex and make part, the attached schedule, to the specifications for this project, when it is advertised for bids and /or to forward said schedules to the successful bidder(s), immediately upon receipt, in order to insure the proper payment of wages.

Please refer to the "General Provisions of Laws Covering Workers on Public Work Contracts" provided with this schedule, for the specific details relating to other responsibilities of the Department of Jurisdiction.

Upon completion or cancellation of this project, enter the required information and mail **OR** fax this form to the office shown at the bottom of this notice, **OR** fill out the electronic version via the NYSDOL website.

NOTICE OF COMPLETION / CANCELLATION OF PROJECT

Date Completed: _____ Date Cancelled: _____

Name & Title of Representative: _____

Phone: (518) 457-5589 Fax: (518) 485-1870
W. Averell Harriman State Office Campus, Bldg. 12, Room 130, Albany, NY 12240

General Provisions of Laws Covering Workers on Article 8 Public Work Contracts

Introduction

The Labor Law requires public work contractors and subcontractors to pay laborers, workers, or mechanics employed in the performance of a public work contract not less than the prevailing rate of wage and supplements (fringe benefits) in the locality where the work is performed.

Responsibilities of the Department of Jurisdiction

A Department of Jurisdiction (Contracting Agency) includes a state department, agency, board or commission; a county, city, town or village; a school district, board of education or board of cooperative educational services; a sewer, water, fire, improvement and other district corporation; a public benefit corporation; and a public authority awarding a public work contract.

The Department of Jurisdiction (Contracting Agency) awarding a public work contract MUST obtain a Prevailing Rate Schedule listing the hourly rates of wages and supplements due the workers to be employed on a public work project. This schedule may be obtained by completing and forwarding a "Request for wage and Supplement Information" form (PW 39) to the Bureau of Public Work. The Prevailing Rate Schedule MUST be included in the specifications for the contract to be awarded and is deemed part of the public work contract.

Upon the awarding of the contract, the law requires that the Department of Jurisdiction (Contracting Agency) furnish the following information to the Bureau: the name and address of the contractor, the date the contract was let and the approximate dollar value of the contract. To facilitate compliance with this provision of the Labor Law, a copy of the Department's "Notice of Contract Award" form (PW 16) is provided with the original Prevailing Rate Schedule.

The Department of Jurisdiction (Contracting Agency) is required to notify the Bureau of the completion or cancellation of any public work project. The Department's PW 200 form is provided for that purpose.

Both the PW 16 and PW 200 forms are available for completion [online](#).

Hours

No laborer, worker, or mechanic in the employ of a contractor or subcontractor engaged in the performance of any public work project shall be permitted to work more than eight hours in any day or more than five days in any week, except in cases of extraordinary emergency. The contractor and the Department of Jurisdiction (Contracting Agency) may apply to the Bureau of Public Work for a dispensation permitting workers to work additional hours or days per week on a particular public work project.

Wages and Supplements

The wages and supplements to be paid and/or provided to laborers, workers, and mechanics employed on a public work project shall be not less than those listed in the current Prevailing Rate Schedule for the locality where the work is performed. If a prime contractor on a public work project has not been provided with a Prevailing Rate Schedule, the contractor must notify the Department of Jurisdiction (Contracting Agency) who in turn must request an original Prevailing Rate Schedule from the Bureau of Public Work. Requests may be submitted by: mail to NYSDOL, Bureau of Public Work, State Office Bldg. Campus, Bldg. 12, Rm. 130, Albany, NY 12226; Fax to Bureau of Public Work (518) 485-1870; or electronically at the NYSDOL website www.labor.ny.gov.

Upon receiving the original schedule, the Department of Jurisdiction (Contracting Agency) is REQUIRED to provide complete copies to all prime contractors who in turn MUST, by law, provide copies of all applicable county schedules to each subcontractor and obtain from each subcontractor, an affidavit certifying such schedules were received. If the original schedule expired, the contractor may obtain a copy of the new annual determination from the NYSDOL website www.labor.ny.gov.

The Commissioner of Labor makes an annual determination of the prevailing rates. This determination is in effect from July 1st through June 30th of the following year. The annual determination is available on the NYSDOL website www.labor.ny.gov.

Payrolls and Payroll Records

Every contractor and subcontractor MUST keep original payrolls or transcripts subscribed and affirmed as true under penalty of perjury. As per Article 6 of the Labor law, contractors and subcontractors are required to establish, maintain, and preserve for not less than six (6) years, contemporaneous, true, and accurate payroll records. At a minimum, payrolls must show the following information for each person employed on a public work project: Name, Address, Last 4 Digits of Social Security Number, Classification(s) in which the worker was employed, Hourly wage rate(s) paid, Supplements paid or provided, and Daily and weekly number of hours worked in each classification.

The filing of payrolls to the Department of Jurisdiction is a condition of payment. Every contractor and subcontractor shall submit to the Department of Jurisdiction (Contracting Agency), within thirty (30) days after issuance of its first payroll and every thirty (30) days thereafter, a transcript of the original payrolls, subscribed and affirmed as true under penalty of perjury. The Department of Jurisdiction (Contracting Agency) shall collect, review for facial validity, and maintain such payrolls.

In addition, the Commissioner of Labor may require contractors to furnish, with ten (10) days of a request, payroll records sworn to as their validity and accuracy for public work and private work. Payroll records include, but are not limited to time cards, work description sheets, proof that supplements were provided, cancelled payroll checks and payrolls. Failure to provide the requested information within the allotted ten (10) days will result in the withholding of up to 25% of the contract, not to exceed \$100,000.00. If the contractor or subcontractor does not maintain a place of business in New York State and the amount of the contract exceeds \$25,000.00, payroll records and certifications must be kept on the project worksite.

The prime contractor is responsible for any underpayments of prevailing wages or supplements by any subcontractor.

All contractors or their subcontractors shall provide to their subcontractors a copy of the Prevailing Rate Schedule specified in the public work contract as well as any subsequently issued schedules. A failure to provide these schedules by a contractor or subcontractor is a violation of Article 8, Section 220-a of the Labor Law.

All subcontractors engaged by a public work project contractor or its subcontractor, upon receipt of the original schedule and any subsequently issued schedules, shall provide to such contractor a verified statement attesting that the subcontractor has received the Prevailing Rate Schedule and will pay or provide the applicable rates of wages and supplements specified therein. (See NYS Labor Laws, Article 8 . Section 220-a).

Determination of Prevailing Wage and Supplement Rate Updates Applicable to All Counties

The wages and supplements contained in the annual determination become effective July 1st whether or not the new determination has been received by a given contractor. Care should be taken to review the rates for obvious errors. Any corrections should be brought to the Department's attention immediately. It is the responsibility of the public work contractor to use the proper rates. If there is a question on the proper classification to be used, please call the district office located nearest the project. Any errors in the annual determination will be corrected and posted to the NYS DOL website on the first business day of each month. Contractors are responsible for paying these updated rates as well, retroactive to July 1st.

When you review the schedule for a particular occupation, your attention should be directed to the dates above the column of rates. These are the dates for which a given set of rates is effective. To the extent possible, the Department posts rates in its possession that cover periods of time beyond the July 1st to June 30th time frame covered by a particular annual determination. Rates that extend beyond that instant time period are informational ONLY and may be updated in future annual determinations that actually cover the then appropriate July 1st to June 30th time period.

Withholding of Payments

When a complaint is filed with the Commissioner of Labor alleging the failure of a contractor or subcontractor to pay or provide the prevailing wages or supplements, or when the Commissioner of Labor believes that unpaid wages or supplements may be due, payments on the public work contract shall be withheld from the prime contractor in a sufficient amount to satisfy the alleged unpaid wages and supplements, including interest and civil penalty, pending a final determination.

When the Bureau of Public Work finds that a contractor or subcontractor on a public work project failed to pay or provide the requisite prevailing wages or supplements, the Bureau is authorized by Sections 220-b and 235.2 of the Labor Law to so notify the financial officer of the Department of Jurisdiction (Contracting Agency) that awarded the public work contract. Such officer MUST then withhold or cause to be withheld from any payment due the prime contractor on account of such contract the amount indicated by the Bureau as sufficient to satisfy the unpaid wages and supplements, including interest and any civil penalty that may be assessed by the Commissioner of Labor. The withholding continues until there is a final determination of the underpayment by the Commissioner of Labor or by the court in the event a legal proceeding is instituted for review of the determination of the Commissioner of Labor.

The Department of Jurisdiction (Contracting Agency) shall comply with this order of the Commissioner of Labor or of the court with respect to the release of the funds so withheld.

Summary of Notice Posting Requirements

The current Prevailing Rate Schedule must be posted in a prominent and accessible place on the site of the public work project. The prevailing wage schedule must be encased in, or constructed of, materials capable of withstanding adverse weather conditions and be titled "PREVAILING RATE OF WAGES" in letters no smaller than two (2) inches by two (2) inches.

The "[Public Work Project](#)" notice must be posted at the beginning of the performance of every public work contract, on each job site.

Every employer providing workers. compensation insurance and disability benefits must post notices of such coverage in the format prescribed by the Workers. Compensation Board in a conspicuous place on the jobsite.

Every employer subject to the NYS Human Rights Law must conspicuously post at its offices, places of employment, or employment training centers, notices furnished by the State Division of Human Rights.

Employers liable for contributions under the Unemployment Insurance Law must conspicuously post on the jobsite notices furnished by the NYS Department of Labor.

Apprentices

Employees cannot be paid apprentice rates unless they are individually registered in a program registered with the NYS Commissioner of Labor. The allowable ratio of apprentices to journeyworkers in any craft classification can be no greater than the statewide building trade ratios promulgated by the Department of Labor and included with the Prevailing Rate Schedule. An employee listed on a payroll as an apprentice who is not registered as above or is performing work outside the classification of work for which the apprentice is indentured, must be paid the prevailing journeyworker's wage rate for the classification of work the employee is actually performing.

NYSDOL Labor Law, Article 8, Section 220-3, require that only apprentices individually registered with the NYS Department of Labor may be paid apprenticeship rates on a public work project. No other Federal or State Agency of office registers apprentices in New York State.

Persons wishing to verify the apprentice registration of any person must do so in writing by mail, to the NYSDOL Office of Employability Development / Apprenticeship Training, State Office Bldg. Campus, Bldg. 12, Albany, NY 12226 or by Fax to NYSDOL Apprenticeship Training (518) 457-7154. All requests for verification must include the name and social security number of the person for whom the information is requested.

The only conclusive proof of individual apprentice registration is written verification from the NYSDOL Apprenticeship Training Albany Central office. Neither Federal nor State Apprenticeship Training offices outside of Albany can provide conclusive registration information.

It should be noted that the existence of a registered apprenticeship program is not conclusive proof that any person is registered in that program. Furthermore, the existence or possession of wallet cards, identification cards, or copies of state forms is not conclusive proof of the registration of any person as an apprentice.

Interest and Penalties

In the event that an underpayment of wages and/or supplements is found:

- Interest shall be assessed at the rate then in effect as prescribed by the Superintendent of Banks pursuant to section 14-a of the Banking Law, per annum from the date of underpayment to the date restitution is made.
- A Civil Penalty may also be assessed, not to exceed 25% of the total of wages, supplements, and interest due.

Debarment

Any contractor or subcontractor and/or its successor shall be ineligible to submit a bid on or be awarded any public work contract or subcontract with any state, municipal corporation or public body for a period of five (5) years when:

- Two (2) willful determinations have been rendered against that contractor or subcontractor and/or its successor within any consecutive six (6) year period.
- There is any willful determination that involves the falsification of payroll records or the kickback of wages or supplements.

Criminal Sanctions

Willful violations of the Prevailing Wage Law (Article 8 of the Labor Law) may be a felony punishable by fine or imprisonment of up to 15 years, or both.

Discrimination

No employee or applicant for employment may be discriminated against on account of age, race, creed, color, national origin, sex, disability or marital status.

No contractor, subcontractor nor any person acting on its behalf, shall by reason of race, creed, color, disability, sex or national origin discriminate against any citizen of the State of New York who is qualified and available to perform the work to which the employment relates (NYS Labor Law, Article 8, Section 220-e(a)).

No contractor, subcontractor, nor any person acting on its behalf, shall in any manner, discriminate against or intimidate any employee on account of race, creed, color, disability, sex, or national origin (NYS Labor Law, Article 8, Section 220-e(b)).

The Human Rights Law also prohibits discrimination in employment because of age, marital status, or religion.

There may be deducted from the amount payable to the contractor under the contract a penalty of \$50.00 for each calendar day during which such person was discriminated against or intimidated in violation of the provision of the contract (NYS Labor Law, Article 8, Section 220-e(c)).

The contract may be cancelled or terminated by the State or municipality. All monies due or to become due thereunder may be forfeited for a second or any subsequent violation of the terms or conditions of the anti-discrimination sections of the contract (NYS Labor Law, Article 8, Section 220-e(d)).

Every employer subject to the New York State Human Rights Law must conspicuously post at its offices, places of employment, or employment training centers notices furnished by the State Division of Human Rights.

Workers' Compensation

In accordance with Section 142 of the State Finance Law, the contractor shall maintain coverage during the life of the contract for the benefit of such employees as required by the provisions of the New York State Workers' Compensation Law.

A contractor who is awarded a public work contract must provide proof of workers' compensation coverage prior to being allowed to begin work.

The insurance policy must be issued by a company authorized to provide workers' compensation coverage in New York State. Proof of coverage must be on form C-105.2 (Certificate of Workers' Compensation Insurance) and must name this agency as a certificate holder.

If New York State coverage is added to an existing out-of-state policy, it can only be added to a policy from a company authorized to write workers' compensation coverage in this state. The coverage must be listed under item 3A of the information page.

The contractor must maintain proof that subcontractors doing work covered under this contract secured and maintained a workers' compensation policy for all employees working in New York State.

Every employer providing worker's compensation insurance and disability benefits must post notices of such coverage in the format prescribed by the Workers' Compensation Board in a conspicuous place on the jobsite.

Unemployment Insurance

Employers liable for contributions under the Unemployment Insurance Law must conspicuously post on the jobsite notices furnished by the New York State Department of Labor.



Kathy Hochul, Governor

Roberta Reardon, Commissioner

City of Rome
Megan McCoskey
CDM Smith
3 Lear Jet Lane, Suite 100N
Latham NY 12110

Schedule Year 2024 through 2025
Date Requested 11/08/2024
PRC# 2024014128

Location Rome, NY
Project ID#
Project Type Main Pump Station and filtrate pump station improvements and leachate transfer station upgrades.

Notice of Contract Award

New York State Labor Law, Article 8, Section 220.3a requires that certain information regarding the awarding of public work contracts, be furnished to the Commissioner of Labor. One "Notice of Contract Award" (PW 16, which may be photocopied), **MUST** be completed for **EACH** prime contractor on the above referenced project.

Upon notifying the successful bidder(s) of this contract, enter the required information and mail **OR** fax this form to the office shown at the bottom of this notice, **OR** fill out the electronic version via the NYSDOL website.

Contractor Information

All information must be supplied

Federal Employer Identification Number: _____		
Name: _____		
Address: _____ _____		
City: _____	State: _____	Zip: _____
Amount of Contract: \$ _____	Contract Type:	
Approximate Starting Date: ____/____/____	<input type="checkbox"/> (01) General Construction	
Approximate Completion Date: ____/____/____	<input type="checkbox"/> (02) Heating/Ventilation	
	<input type="checkbox"/> (03) Electrical	
	<input type="checkbox"/> (04) Plumbing	
	<input type="checkbox"/> (05) Other : _____	

Phone: (518) 457-5589 Fax: (518) 485-1870
W. Averell Harriman State Office Campus, Bldg. 12, Room 130, Albany, NY 12226

Social Security Numbers on Certified Payrolls:

The Department of Labor is cognizant of the concerns of the potential for misuse or inadvertent disclosure of social security numbers. Identity theft is a growing problem and we are sympathetic to contractors' concern regarding inclusion of this information on payrolls if another identifier will suffice.

For these reasons, the substitution of the use of the last four digits of the social security number on certified payrolls submitted to contracting agencies on public work projects is now acceptable to the Department of Labor. This change does not affect the Department's ability to request and receive the entire social security number from employers during its public work/ prevailing wage investigations.

Construction Industry Fair Play Act: Required Posting for Labor Law Article 25-B § 861-d

Construction industry employers must post the "Construction Industry Fair Play Act" notice in a prominent and accessible place on the job site. Failure to post the notice can result in penalties of up to \$1,500 for a first offense and up to \$5,000 for a second offense. The posting is included as part of this wage schedule. Additional copies may be obtained from the NYS DOL website, <https://dol.ny.gov/public-work-and-prevailing-wage>

If you have any questions concerning the Fair Play Act, please call the State Labor Department toll-free at 1-866-435-1499 or email us at: dol.misclassified@labor.ny.gov .

Worker Notification: (Labor Law §220, paragraph a of subdivision 3-a)

Effective June 23, 2020

This provision is an addition to the existing wage rate law, Labor Law §220, paragraph a of subdivision 3-a. It requires contractors and subcontractors to provide written notice to all laborers, workers or mechanics of the *prevailing wage and supplement rate* for their particular job classification *on each pay stub**. It also requires contractors and subcontractors to *post a notice* at the beginning of the performance of every public work contract *on each job site* that includes the telephone number and address for the Department of Labor and a statement informing laborers, workers or mechanics of their right to contact the Department of Labor if he/she is not receiving the proper prevailing rate of wages and/or supplements for his/her job classification. The required notification will be provided with each wage schedule, may be downloaded from our website www.labor.ny.gov or be made available upon request by contacting the Bureau of Public Work at 518-457-5589. *In the event the required information will not fit on the pay stub, an accompanying sheet or attachment of the information will suffice.

(12.20)

**To all State Departments, Agency Heads and Public Benefit Corporations
IMPORTANT NOTICE REGARDING PUBLIC WORK ENFORCEMENT FUND**

Budget Policy & Reporting Manual

B-610

Public Work Enforcement Fund

effective date December 7, 2005

1. Purpose and Scope:

This Item describes the Public Work Enforcement Fund (the Fund, PWEF) and its relevance to State agencies and public benefit corporations engaged in construction or reconstruction contracts, maintenance and repair, and announces the recently-enacted increase to the percentage of the dollar value of such contracts that must be deposited into the Fund. This item also describes the roles of the following entities with respect to the Fund:

- New York State Department of Labor (DOL),
- The Office of the State of Comptroller (OSC), and
- State agencies and public benefit corporations.

2. Background and Statutory References:

DOL uses the Fund to enforce the State's Labor Law as it relates to contracts for construction or reconstruction, maintenance and repair, as defined in subdivision two of Section 220 of the Labor Law. State agencies and public benefit corporations participating in such contracts are required to make payments to the Fund.

Chapter 511 of the Laws of 1995 (as amended by Chapter 513 of the Laws of 1997, Chapter 655 of the Laws of 1999, Chapter 376 of the Laws of 2003 and Chapter 407 of the Laws of 2005) established the Fund.

3. Procedures and Agency Responsibilities:

The Fund is supported by transfers and deposits based on the value of contracts for construction and reconstruction, maintenance and repair, as defined in subdivision two of Section 220 of the Labor Law, into which all State agencies and public benefit corporations enter.

Chapter 407 of the Laws of 2005 increased the amount required to be provided to this fund to .10 of one-percent of the total cost of each such contract, to be calculated at the time agencies or public benefit corporations enter into a new contract or if a contract is amended. The provisions of this bill became effective August 2, 2005.

**To all State Departments, Agency Heads and Public Benefit Corporations
IMPORTANT NOTICE REGARDING PUBLIC WORK ENFORCEMENT FUND**

OSC will report to DOL on all construction-related ("D") contracts approved during the month, including contract amendments, and then DOL will bill agencies the appropriate assessment monthly. An agency may then make a determination if any of the billed contracts are exempt and so note on the bill submitted back to DOL. For any instance where an agency is unsure if a contract is or is not exempt, they can call the Bureau of Public Work at the number noted below for a determination. Payment by check or journal voucher is due to DOL within thirty days from the date of the billing. DOL will verify the amounts and forward them to OSC for processing.

For those contracts which are not approved or administered by the Comptroller, monthly reports and payments for deposit into the Public Work Enforcement Fund must be provided to the Administrative Finance Bureau at the DOL within 30 days of the end of each month or on a payment schedule mutually agreed upon with DOL.

Reports should contain the following information:

- Name and billing address of State agency or public benefit corporation;
- State agency or public benefit corporation contact and phone number;
- Name and address of contractor receiving the award;
- Contract number and effective dates;
- Contract amount and PWEF assessment charge (if contract amount has been amended, reflect increase or decrease to original contract and the adjustment in the PWEF charge); and
- Brief description of the work to be performed under each contract.

Checks and Journal Vouchers, payable to the "New York State Department of Labor" should be sent to:

Department of Labor
Administrative Finance Bureau-PWEF Unit
Building 12, Room 464
State Office Campus
Albany, NY 12226

Any questions regarding billing should be directed to NYSDOL's Administrative Finance Bureau-PWEF Unit at (518) 457-3624 and any questions regarding Public Work Contracts should be directed to the Bureau of Public Work at (518) 457-5589.

Required Notice under Article 25-B of the Labor Law

**Attention All Employees, Contractors and Subcontractors:
You are Covered by the Construction Industry Fair Play Act**

The law says that you are an employee unless:

- You are free from direction and control in performing your job, **and**
- You perform work that is not part of the usual work done by the business that hired you, **and**
- You have an independently established business.

Your employer cannot consider you to be an independent contractor unless all three of these facts apply to your work.

It is against the law for an employer to misclassify employees as independent contractors or pay employees off the books.

Employee Rights: If you are an employee, you are entitled to state and federal worker protections. These include:

- Unemployment Insurance benefits, if you are unemployed through no fault of your own, able to work, and otherwise qualified,
- Workers' compensation benefits for on-the-job injuries,
- Payment for wages earned, minimum wage, and overtime (under certain conditions),
- Prevailing wages on public work projects,
- The provisions of the National Labor Relations Act, and
- A safe work environment.

It is a violation of this law for employers to retaliate against anyone who asserts their rights under the law. Retaliation subjects an employer to civil penalties, a private lawsuit or both.

Independent Contractors: If you are an independent contractor, **you must pay all taxes and Unemployment Insurance contributions required by New York State and Federal Law.**

Penalties for paying workers off the books or improperly treating employees as independent contractors:

- **Civil Penalty**
 - First offense: Up to \$2,500 per employee
 - Subsequent offense(s): Up to \$5,000 per employee
- **Criminal Penalty**
 - First offense: Misdemeanor - up to 30 days in jail, up to a \$25,000 fine and debarment from performing public work for up to one year.
 - Subsequent offense(s): Misdemeanor - up to 60 days in jail or up to a \$50,000 fine and debarment from performing public work for up to 5 years.

If you have questions about your employment status or believe that your employer may have violated your rights and you want to file a complaint, call the Department of Labor at (866) 435-1499 or send an email to dol.misclassified@labor.ny.gov. All complaints of fraud and violations are taken seriously. You can remain anonymous.

Employer Name:

IA 999 (09/16)



Attention Employees

THIS IS A: **PUBLIC WORK PROJECT**

If you are employed on this project as a **worker, laborer, or mechanic** you are entitled to receive the **prevailing wage and supplements rate** for the classification at which you are working.

Your pay stub and wage notice received upon hire must clearly state your wage rate and supplement rate.

Chapter 629 of the Labor Laws of 2007:

These wages are set by law and must be posted at the work site. They can also be found at:
<https://dol.ny.gov/bureau-public-work>



If you feel that you have not received proper wages or benefits, please call our nearest office.*

Albany	(518) 457-2744	Patchogue	(631) 687-4882
Binghamton	(607) 721-8005	Rochester	(585) 258-4505
Buffalo	(716) 847-7159	Syracuse	(315) 428-4056
Garden City	(516) 228-3915	Utica	(315) 793-2314
New York City	(212) 932-2419	White Plains	(914) 997-9507
Newburgh	(845) 568-5287		

* For New York City government agency construction projects, please contact the Office of the NYC Comptroller at (212) 669-4443, or www.comptroller.nyc.gov – click on Bureau of Labor Law.

Contractor Name: _____

Project Location: _____

Requirements for OSHA 10 Compliance

Article 8 §220-h requires that when the advertised specifications, for every contract for public work, is \$250,000.00 or more the contract must contain a provision requiring that every worker employed in the performance of a public work contract shall be certified as having completed an OSHA 10 safety training course. The clear intent of this provision is to require that all employees of public work contractors, required to be paid prevailing rates, receive such training "prior to the performing any work on the project."

The Bureau will enforce the statute as follows:

All contractors and sub contractors must attach a copy of proof of completion of the OSHA 10 course to the first certified payroll submitted to the contracting agency and on each succeeding payroll where any new or additional employee is first listed.

Proof of completion may include but is not limited to:

- Copies of bona fide course completion card (*Note: Completion cards do not have an expiration date.*)
- Training roster, attendance record or other documentation from the certified trainer pending the issuance of the card.
- Other valid proof

**A certification by the employer attesting that all employees have completed such a course is not sufficient proof that the course has been completed.

Any questions regarding this statute may be directed to the New York State Department of Labor, Bureau of Public Work at 518-457-5589.

WICKS

Public work projects are subject to the Wicks Law requiring separate specifications and bidding for the plumbing, heating and electrical work, when the total project's threshold is \$3 million in Bronx, Kings, New York, Queens and, Richmond counties; \$1.5 million in Nassau, Suffolk and Westchester counties; and \$500,000 in all other counties.

For projects below the monetary threshold, bidders must submit a sealed list naming each subcontractor for the plumbing, HVAC and electrical and the amount to be paid to each. The list may not be changed unless the public owner finds a legitimate construction need, including a change in specifications or costs or the use of a Project Labor Agreement (PLA), and must be open to public inspection.

Allows the state and local agencies and authorities to waive the Wicks Law and use a PLA if it will provide the best work at the lowest possible price. If a PLA is used, all contractors shall participate in apprentice training programs in the trades of work it employs that have been approved by the Department of Labor (DOL) for not less than three years. They shall also have at least one graduate in the last three years and use affirmative efforts to retain minority apprentices. PLA's would be exempt from Wicks, but deemed to be public work subject to prevailing wage enforcement.

The Commissioner of Labor shall have the power to enforce separate specification requirements on projects, and may issue stop-bid orders against public owners for non-compliance.

Other new monetary thresholds, and similar sealed bidding for non-Wicks projects, would apply to certain public authorities including municipal housing authorities, NYC Construction Fund, Yonkers Educational Construction Fund, NYC Municipal Water Finance Authority, Buffalo Municipal Water Finance Authority, Westchester County Health Care Association, Nassau County Health Care Corp., Clifton-Fine Health Care Corp., Erie County Medical Center Corp., NYC Solid Waste Management Facilities, and the Dormitory Authority.

Contractors must pay subcontractors within a 7 days period.

(07.19)

Introduction to the Prevailing Rate Schedule

Information About Prevailing Rate Schedule

This information is provided to assist you in the interpretation of particular requirements for each classification of worker contained in the attached Schedule of Prevailing Rates.

Classification

It is the duty of the Commissioner of Labor to make the proper classification of workers taking into account whether the work is heavy and highway, building, sewer and water, tunnel work, or residential, and to make a determination of wages and supplements to be paid or provided. It is the responsibility of the public work contractor to use the proper rate. If there is a question on the proper classification to be used, please call the district office located nearest the project. District office locations and phone numbers are listed below.

Prevailing Wage Schedules are issued separately for "General Construction Projects" and "Residential Construction Projects" on a county-by-county basis.

General Construction Rates apply to projects such as: Buildings, Heavy & Highway, and Tunnel and Water & Sewer rates.

Residential Construction Rates generally apply to construction, reconstruction, repair, alteration, or demolition of one family, two family, row housing, or rental type units intended for residential use.

Some rates listed in the Residential Construction Rate Schedule have a very limited applicability listed along with the rate. Rates for occupations or locations not shown on the residential schedule must be obtained from the General Construction Rate Schedule. Please contact the local Bureau of Public Work office before using Residential Rate Schedules, to ensure that the project meets the required criteria.

Payrolls and Payroll Records

Contractors and subcontractors are required to establish, maintain, and preserve for not less than six (6) years, contemporaneous, true, and accurate payroll records.

Every contractor and subcontractor shall submit to the Department of Jurisdiction (Contracting Agency), within thirty (30) days after issuance of its first payroll and every thirty (30) days thereafter, a transcript of the original payrolls, subscribed and affirmed as true under penalty of perjury.

Paid Holidays

Paid Holidays are days for which an eligible employee receives a regular day's pay, but is not required to perform work. If an employee works on a day listed as a paid holiday, this remuneration is in addition to payment of the required prevailing rate for the work actually performed.

Overtime

At a minimum, all work performed on a public work project in excess of eight hours in any one day or more than five days in any workweek is overtime. However, the specific overtime requirements for each trade or occupation on a public work project may differ. Specific overtime requirements for each trade or occupation are contained in the prevailing rate schedules.

Overtime holiday pay is the premium pay that is required for work performed on specified holidays. It is only required where the employee actually performs work on such holidays.

The applicable holidays are listed under HOLIDAYS: OVERTIME. The required rate of pay for these covered holidays can be found in the OVERTIME PAY section listings for each classification.

Supplemental Benefits

Particular attention should be given to the supplemental benefit requirements. Although in most cases the payment or provision of supplements is straight time for all hours worked, some classifications require the payment or provision of supplements, or a portion of the supplements, to be paid or provided at a premium rate for premium hours worked. Supplements may also be required to be paid or provided on paid holidays, regardless of whether the day is worked. The Overtime Codes and Notes listed on the particular wage classification will indicate these conditions as required.

Effective Dates

When you review the schedule for a particular occupation, your attention should be directed to the dates above the column of rates. These are the dates for which a given set of rates is effective. The rate listed is valid until the next effective rate change or until the new annual determination which takes effect on July 1 of each year. All contractors and subcontractors are required to pay the current prevailing rates of wages and supplements. If you have any questions please contact the Bureau of Public Work or visit the New York State Department of Labor website (www.labor.ny.gov) for current wage rate information.

Apprentice Training Ratios

The following are the allowable ratios of registered Apprentices to Journey-workers.

For example, the ratio 1:1,1:3 indicates the allowable initial ratio is one Apprentice to one Journeyworker. The Journeyworker must be in place on the project before an Apprentice is allowed. Then three additional Journeyworkers are needed before a second Apprentice is allowed. The last ratio repeats indefinitely. Therefore, three more Journeyworkers must be present before a third Apprentice can be hired, and so on.

Please call Apprentice Training Central Office at (518) 457-6820 if you have any questions.

Title (Trade)	Ratio
Boilermaker (Construction)	1:1,1:4
Boilermaker (Shop)	1:1,1:3
Carpenter (Bldg.,H&H, Pile Driver/Dockbuilder)	1:1,1:4
Carpenter (Residential)	1:1,1:3
Electrical (Outside) Lineman	1:1,1:2
Electrician (Inside)	1:1,1:3
Elevator/Escalator Construction & Modernizer	1:1,1:2
Glazier	1:1,1:3
Insulation & Asbestos Worker	1:1,1:3
Iron Worker	1:1,1:4
Laborer	1:1,1:3
Mason	1:1,1:4
Millwright	1:1,1:4
Op Engineer	1:1,1:5
Painter	1:1,1:3
Plumber & Steamfitter	1:1,1:3
Roofer	1:1,1:2
Sheet Metal Worker	1:1,1:3
Sprinkler Fitter	1:1,1:2

If you have any questions concerning the attached schedule or would like additional information, please contact the nearest BUREAU of PUBLIC WORK District Office or write to:

New York State Department of Labor
 Bureau of Public Work
 State Office Campus, Bldg. 12
 Albany, NY 12226

District Office Locations:	Telephone #	FAX #
Bureau of Public Work - Albany	518-457-2744	518-485-0240
Bureau of Public Work - Binghamton	607-721-8005	607-721-8004
Bureau of Public Work - Buffalo	716-847-7159	716-847-7650
Bureau of Public Work - Garden City	516-228-3915	516-794-3518
Bureau of Public Work - Newburgh	845-568-5287	845-568-5332
Bureau of Public Work - New York City	212-932-2419	212-775-3579
Bureau of Public Work - Patchogue	631-687-4882	631-687-4902
Bureau of Public Work - Rochester	585-258-4505	585-258-4708
Bureau of Public Work - Syracuse	315-428-4056	315-428-4671
Bureau of Public Work - Utica	315-793-2314	315-793-2514
Bureau of Public Work - White Plains	914-997-9507	914-997-9523
Bureau of Public Work - Central Office	518-457-5589	518-485-1870

Oneida County General Construction

Boilermaker **11/01/2024**

JOB DESCRIPTION Boilermaker **DISTRICT 7**

ENTIRE COUNTIES
 Cayuga, Clinton, Cortland, Franklin, Jefferson, Lewis, Madison, Oneida, Onondaga, Oswego, Seneca, St. Lawrence, Tompkins

WAGES
 Per hour: 07/01/2024

Boilermaker \$ 37.98

SUPPLEMENTAL BENEFITS

Per hour:
 Journeyworker \$ 26.62*
 + 1.48

*This portion of the benefits subject to the same premium rate as shown for overtime wages.

OVERTIME PAY
 See (B, E, Q) on OVERTIME PAGE

HOLIDAY
 Paid: See (1) on HOLIDAY PAGE
 Overtime: See (5, 6, 15, 25) on HOLIDAY PAGE

NOTE: When a holiday falls on Sunday, the day observed by the State or Nation shall be observed. When Christmas Day and New Year's fall on Saturday, Friday will be observed as the holiday.

REGISTERED APPRENTICES

WAGES per hour: Six (6) month terms at the following percentage of Journeyworker's wage.

1st	2nd	3rd	4th	5th	6th	7th	8th
65%	65%	70%	75%	80%	85%	90%	95%

SUPPLEMENTAL BENEFITS per hour:

\$ 19.78*	\$ 19.78*	\$ 20.76*	\$ 21.73*	\$ 22.71*	\$ 23.69*	\$ 24.67*	\$ 25.64*
+ 1.48	+ 1.48	+ 1.48	+ 1.48	+ 1.48	+ 1.48	+ 1.48	+ 1.48

*This portion of the benefits subject to the same premium rate as shown for overtime wages.

7-175

Carpenter - Building **11/01/2024**

JOB DESCRIPTION Carpenter - Building **DISTRICT 6**

ENTIRE COUNTIES
 Cayuga, Herkimer, Madison, Oneida, Seneca, Yates

WAGES

Per hour:	07/01/2024	07/01/2025
		Additional
Carpenter	\$ 30.85	\$ 1.30*
Floor Coverer	30.85	1.30*
Carpet Layer	30.85	1.30*
Drywall	30.85	1.30*
Diver - Wet Day	61.25	0.00
Diver - Dry Day	31.85	1.30*
Dive Tender	31.85	1.30*

*To be allocated at a later date.

NOTE ADDITIONAL AMOUNTS PAID FOR THE FOLLOWING WORK LISTED BELOW (per hour worked):

- Pile Drivers/Dock Builders shall receive \$0.25 per hour over the Journeyworker's rate of pay when performing piledriving/dock building work.
- Certified Welders shall receive \$1.00 per hour over the Journeyworker's rate of pay when the employee is required to be certified and performs DOT or ABS specified welding work.
- When an employee performs work within a contaminated area on a State and/or Federally designated hazardous waste site, and where relevant State and/or Federal regulations require employees to be furnished and use or wear required forms of personal protection, then the employee shall receive his regular hourly rate plus \$1.50 per hour.
- Depth pay for Divers based upon deepest depth on the day of the dive (per diem payment):

- 0' to 80' no additional fee
- 81' to 100' additional \$0.50 per foot
- 101' to 150' additional \$0.75 per foot
- 151' and deeper additional \$1.25 per foot

- Penetration pay for Divers based upon deepest penetration on the day of the dive (per diem payment):

- 0' to 50' no additional fee
- 51' to 100' additional \$0.75 per foot
- 101' and deeper additional \$1.00 per foot

- Diver rates applies to all hours worked on dive day.

SHIFT WORK

On Agency/Owner mandated shift work, the following rates will be applicable:

- 1st Shift - Regular Rate
- 2nd Shift - Premium of 7% of base wage per hour
- 3rd Shift - Premium of 14% of base wage per hour

Shift work shall be defined as implementing at least two (2) shifts in a twenty-four (24) consecutive hour period. Shift work must be for a minimum of three (3) consecutive days.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker \$ 21.69

OVERTIME PAY

See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6) on HOLIDAY PAGE

NOTE: Any holiday which occurs on Sunday shall be observed the following Monday. If Christmas falls on a Saturday, it shall be observed on the prior Friday.

REGISTERED APPRENTICES

Wages per hour (1300 hour terms at the following percentage of Journeyworker's base wage):

1st	2nd	3rd	4th
65%	70%	75%	80%

Supplemental Benefits per hour:

\$ 12.60	\$ 12.61	\$ 15.21	\$ 15.21
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NOTE ADDITIONAL AMOUNTS PAID TO APPRENTICES FOR THE FOLLOWING WORK LISTED BELOW (per hour worked):

- Pile Driving/Dock Builder apprentices shall receive an additional \$0.25 per hour worked when performing piledriving/dock building work.
- Certified Welders shall receive \$1.00 per hour over the apprentices rate of pay when the apprentice is required to be certified and performs DOT or ABS specified welding work.
- When an apprentice performs work within a contaminated area on a State and/or Federally designated hazardous waste site, and where relevant State and/or Federal regulations require the apprentice to be furnished and use or wear required forms of personal protection, then the apprentice shall receive his regular hourly rate plus \$1.50 per hour.

6-277B-Cay

Carpenter - Building / Heavy&Highway

11/01/2024

JOB DESCRIPTION Carpenter - Building / Heavy&Highway

DISTRICT 2

ENTIRE COUNTIES

Albany, Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orleans, Oswego, Otsego, Rensselaer, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Wyoming, Yates

PARTIAL COUNTIES

Orange: The area lying on Northern side of Orange County demarcated by a line drawn from the Bear Mountain Bridge continuing west to the Bear Mountain Circle, continue North on 9W to the town of Cornwall where County Road 107 (also known as Quaker Rd) crosses under 9W, then east on County Road 107 to Route 32, then north on Route 32 to Orrs Mills Rd, then west on Orrs Mills Rd to Route 94, continue west and south on Route 94 to the Town of Chester, to the intersection of Kings Highway, continue south on Kings Highway to Bellvale Rd, west on Bellvale Rd to Bellvale Lakes Rd, then south on Bellvale Lakes Rd to Kain Rd, southeast on Kain Rd to Route 17A, then north and southeast along Route 17A to Route 210, then follow Route 210 to NJ Border.

WAGES

Wages per hour: 07/01/2024

Carpenter - ONLY for
Artificial Turf/Synthetic
Sport Surface \$ 36.48

Note - Does not include the operation of equipment. Please see Operating Engineers rates.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker \$ 26.55

OVERTIME PAY

See (B, E, Q, X) on OVERTIME PAGE

HOLIDAY

Paid: See (5) on HOLIDAY PAGE

Overtime: See (5, 6, 16) on HOLIDAY PAGE

Notes:

When a holiday falls upon a Saturday, it shall be observed on the preceding Friday. When a holiday falls upon a Sunday, it shall be observed on the following Monday.

An employee taking an unexcused day off the regularly scheduled day before or after a paid Holiday shall not receive Holiday pay.

REGISTERED APPRENTICES

Wages per hour (1300 hour terms at the following percentage of Journeyworker's wage):

1st	2nd	3rd	4th
65%	70%	75%	80%

Supplemental Benefits per hour:

\$18.58	\$19.14	\$21.24	\$21.79
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2-42AtSS

Carpenter - Heavy&Highway

11/01/2024

JOB DESCRIPTION Carpenter - Heavy&Highway

DISTRICT 2

ENTIRE COUNTIES

Chenango, Herkimer, Madison, Oneida, Otsego

WAGES

Per hour 07/01/2024

Carpenter	\$ 42.28
Piledriver	42.28
Diver-Wet Day	67.28
Diver-Dry Day	43.28
Diver-Tender	43.28

NOTE ADDITIONAL AMOUNTS PAID FOR THE FOLLOWING WORK LISTED BELOW (per hour worked):

- State or Federal designated hazardous site, requiring protective gear shall be an additional \$2.50 per hour.
- Certified welders when required to perform welding work will receive an additional \$2.50 per hour.

ADDITIONAL NOTES PERTAINING TO DIVERS/TENDERS:

- Divers and Tenders shall receive one and one half (1 1/2) times their regular diver and tender rate of pay for Effluent and Slurry diving.
- Divers and tenders being paid at the specified rate for Effluent and Slurry diving shall have all overtime rates based on the specified rate plus the appropriate overtime rates (one and one half or two times the specified rate for Slurry and Effluent divers and tenders).
- The pilot of an ADS or submersible will receive one and one-half (1 1/2) times the Diver-Wet Day Rate for time submerged.
- All crew members aboard a submersible shall receive the Diver-Wet Day rate.
- Depth pay for Divers based upon deepest depth on the day of the dive (per diem payment):
 - 0' to 50' no additional fee
 - 51'to 100' additional \$.50 per foot
 - 101'to 150' additional \$.75 per foot
 - 151'and deeper additional \$1.25 per foot
- Penetration pay for Divers based upon deepest penetration on the day of the dive (per diem payment):
 - 0' to 50' no additional fee
 - 51' to 100' additional \$.75 per foot
 - 101' and deeper additional \$1.00 per foot
- Diver rates applies to all hours worked on dive day.

SHIFT WORK

When project owner mandates a single irregular work shift, the Journeyworkers and Apprentices will receive an additional \$3.00 per hour. A single irregular work shift can start any time from 5:00 p.m. to 1:00 a.m.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker \$ 26.55

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6) on HOLIDAY PAGE
 Overtime: See (5, 6) on HOLIDAY PAGE

- In the event a Holiday falls on a Saturday, the Friday before will be observed as a Holiday. If a Holiday falls on a Sunday, then Monday will be observed as a Holiday.
- The employee must work their scheduled workday before and their scheduled workday after the holiday to receive holiday pay.

REGISTERED APPRENTICES

CAPRENTER APPRENTICES

Wages per hour (1040 hour terms at the following percentage of journeyworker's base wage):

1st	2nd	3rd	4th	5th
65%	70%	75%	80%	85%

Supplemental Benefits per hour:

\$ 18.58	\$ 19.14	\$ 21.19	\$ 21.74	\$ 22.29
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PILEDRIVER/DOCKBUILDER APPRENTICES

Wages per hour (1300 hour terms at the following percentage of journeyworker's base wage):

1st	2nd	3rd	4th
65%	70%	75%	80%

Supplemental Benefits per hour:

\$ 18.58	\$ 19.14	\$ 21.19	\$ 21.74
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NOTE ADDITIONAL AMOUNTS PAID PER HOUR WORKED TO APPRENTICES FOR SPECIFIC TYPES OF WORK PERFORMED:

- State or Federal designated hazardous site, requiring protective gear shall be an additional \$2.50 per hour.
- Certified welders when required to perform welding work will receive an additional \$2.50 per hour.

2-277HH-CHMOO

Electrician

11/01/2024

JOB DESCRIPTION Electrician

DISTRICT 6

ENTIRE COUNTIES

Cortland, Herkimer, Madison, Oneida, Oswego

PARTIAL COUNTIES

Cayuga: Townships of Ira, Locke, Sempronius, Sterling, Summerhill and Victory.

Chenango: Only the Townships of Columbus, New Berlin and Sherburne.

Onondaga: Entire County except Townships of Elbridge and Skaneateles.

Otsego: Only the Townships of Plainfield, Richfield, Springfield, Cherry Valley, Roseboom, Middlefield, Otsego, Exeter, Edmeston, Burlington, Pittsfield and New Lisbon.

Tompkins: Only the Township of Groton.

Wayne: Only the Townships of Huron, Wolcott, Rose and Butler.

WAGES

Per hour:	07/01/2024	06/01/2025	06/01/2026
Electrician	\$ 47.00	Additional \$ 5.00*	Additional \$ 5.25*
Teledata	47.00		
Cable Splicer	51.70		

* To be allocated at a later date.

NOTE: Additional premiums for the following work listed (Amounts subject to premiums):

- Additional \$2.50 per hour for work performed over 35 feet above the ground, floor, or roof levels or where work is required in tunnels, shafts, or under compressed air 35 feet below the ground level.
- Additional \$3.00 per hour for working over 50 feet above or below ground, floor, or roof level. This includes work on ladders, "toothpicks", scaffolds, boatswain chairs, towers, smokestacks or other open structures, or mechanical lifts used over 60 feet.

Occupied Conditions: When necessary to perform alteration and/or renovation work and owner mandates (due to occupied conditions) prevent the work from being performed during "normal" working hours (defined as between 6:00 a.m. and 4:30 p.m. Monday through Friday), alternate hours may be worked, provided: 1) The hours are established for a minimum of five (5) days duration or the length of the job, whichever is shorter; and 2) An entire work scope within a job-site area is performed utilizing the varied hours. If these conditions are satisfied, all hours worked Monday through Friday of a shift that starts before or ends after the "normal" hours, shall be paid at the appropriate rate plus fifteen percent (15%). However, the following restrictions shall apply:

- 1) "Alternate" hours shall consist of a minimum of eight (8) consecutive hours per day.
- 2) Hours worked in excess of eight (8) hours per day, Monday through Friday, shall be paid at a rate of one and one-half times the applicable rate (day-shift + 15%).
- 3) Hours worked on Saturday shall be paid at time and one-half the applicable rate.
- 4) Hours worked on Sundays and Holidays shall be paid at double the straight time rate.

5) Work of a new construction nature may not be worked under these conditions.

SHIFT WORK

THE FOLLOWING RATES WILL APPLY ON ALL CONTRACTING AGENCY MANDATED MULTIPLE SHIFTS OF EIGHT (8) HOURS FOR AT LEAST FIVE (5) DAYS DURATION WHICH MAY HAVE BEEN WORKED. WHEN TWO (2) SHIFTS OR THREE (3) SHIFTS ARE WORKED:

1ST SHIFT	8:00AM - 4:30PM:	Regular wage rate
2ND SHIFT	4:30 PM - 1:00 AM:	Regular wage rate plus 15%
3RD SHIFT	12:30 AM - 9:00 AM:	Regular wage rate plus 25%

SUPPLEMENTAL BENEFITS

Per hour:

	\$ 31.92 plus
Journeyworker	3% of hourly wage paid*

*NOTE: The 3% is based on the hourly wage paid, straight time or premium rate.

OVERTIME PAY

See (B, *E, Q) on OVERTIME PAGE

* NOTE: On Saturday the first 8 hours worked shall be paid at a rate of one and one-half times the applicable rate. All additional hours are payable at double the straight time rate.

WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked. Contractor is still responsible to pay the hourly benefit amount for each hour worked.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
 Overtime: See (5, 6, 15, 26) on HOLIDAY PAGE

NOTE: If any of the above holidays fall on Saturday, Friday shall be observed as the holiday. If any of the above holidays fall on Sunday, Monday shall be observed as the holiday.

REGISTERED APPRENTICES

WAGES per hour: Hourly terms at the following percentage of Journeyworker's wage.

1st period 40% (0-1000 hrs.)	\$ 18.80
2nd period 45% (1001-2000)	21.15
3rd period 50% (2001-3500)	23.50
4th period 60% (3501-5000)	28.20
5th period 70% (5001-6500)	32.90
6th Period 80% (6501-8000)	37.60

SUPPLEMENTAL BENEFITS per hour:

1st period	\$ 14.34*
2nd period	14.34*
3rd period	28.92*
4th period	29.52*
5th period	30.12*
6th period	30.72*

* PLUS 3% OF HOURLY WAGE PAID, STRAIGHT TIME RATE OR PREMIUM RATE.

6-43

Elevator Constructor

11/01/2024

JOB DESCRIPTION Elevator Constructor

DISTRICT 6

ENTIRE COUNTIES

Broome, Cayuga, Chenango, Cortland, Franklin, Jefferson, Lewis, Onondaga, Oswego, St. Lawrence, Tioga, Tompkins

PARTIAL COUNTIES

Delaware: Only the towns of: Tompkins, Walton, Masonville, Sidney, Franklin and Deposit.

Madison: Only the towns of: Cazenovia, DeRuyter, Eaton, Fenner, Georgetown, Lebanon, Lenox, Nelson and Sullivan.

Oneida: Only the towns of: Camden, Florence and Vienna.

WAGES

Per hour:	07/01/2024	01/01/2025	01/01/2026
Elevator Constructor	\$ 56.01	\$ 58.455	\$ 61.003
Helper	39.21	40.92	42.70

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker \$ 37.885* \$ 38.435* \$ 38.985*

*NOTE - add 6% of regular hourly rate for all hours worked. Add 8% of regular hourly rate if more than 5 years of service.

OVERTIME PAY

See (D, O) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6, 15, 16) on HOLIDAY PAGE

Overtime: See (5, 6, 15, 16) on HOLIDAY PAGE

NOTE: When a holiday falls on a Saturday, it shall be observed on Friday. When a holiday falls on Sunday, it shall be observed on Monday.

REGISTERED APPRENTICES

WAGES per hour: 1 year terms at the following percentage of the Elevator Constructor wage.

0-6 months	6-12 months	2nd year	3rd year	4th year
50%	55%	65%	70%	80%

SUPPLEMENTAL BENEFITS per hour:

0-6 months: 6% of the hourly apprentice rate paid, no additional supplemental benefits.

All other terms: Same as Journeyworker

6-62.1

Elevator Constructor

11/01/2024

JOB DESCRIPTION Elevator Constructor

DISTRICT 1

ENTIRE COUNTIES

Albany, Clinton, Essex, Fulton, Hamilton, Herkimer, Montgomery, Otsego, Rensselaer, Saratoga, Schenectady, Schoharie, Warren, Washington

PARTIAL COUNTIES

Madison: Madison Only the towns of: Brookfield, Hamilton, Lincoln, Madison, Smithfield, Stockbridge and the City of Oneida
 Oneida: Entire county except the towns of: Camden, Florence, and Vienna.

WAGES

Per hour	07/01/2024	01/01/2025
Mechanic	\$ 55.32	\$ 57.73
Helper	70% of Mechanic Wage Rate	70% of Mechanic Wage Rate

SUPPLEMENTAL BENEFITS

Per hour	07/01/2024	01/01/2025
Journeyworker/Helper	\$ 37.885*	\$ 38.435*

(*)Plus 6% of hourly rate, if less than 5 years of service. Plus 8% of hourly rate, if more than 5 years of service.

OVERTIME PAY

See (D, O) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6, 15, 16) on HOLIDAY PAGE

Overtime: See (5, 6, 15, 16) on HOLIDAY PAGE

Note: When a paid holiday falls on Saturday, it shall be observed on Friday. When a paid holiday falls on Sunday, it shall be observed on Monday.

REGISTERED APPRENTICES

Wages per hour:

0-6 mo*	6-12 mo	2nd yr	3rd yr	4th yr
50%	55 %	65 %	70 %	80 %

(*)Plus 6% of the hourly rate, no additional supplemental benefits.

Supplemental Benefits - per hour worked:

Same as Journeyperson/Helper

1-35

Glazier

11/01/2024

JOB DESCRIPTION Glazier

DISTRICT 5

ENTIRE COUNTIES

Cayuga, Cortland, Herkimer, Madison, Oneida, Onondaga, Oswego

WAGES

Per Hour: 07/01/2024

Glazier \$ 28.00

SUPPLEMENTAL BENEFITS

Per hour:

Journeyman \$ 26.69

OVERTIME PAY

See (B,E,E2*,Q) on OVERTIME PAGE.

*Note - Or circumstances beyond the control of the employer.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

1000 hour terms:

Appr. 1st term	\$18.00
Appr. 2nd term	19.00
Appr. 3rd term	20.00
Appr. 4th term	21.00
Appr. 5th term	22.00
Appr. 6th term	23.00
Appr. 7th term	24.00
Appr. 8th term	25.00

Supplemental Benefits per hour:

Appr. 1st term	\$ 12.87
Appr. 2nd term	12.87
Appr. 3rd term	18.87
Appr. 4th term	18.87
Appr. 5th term	19.87
Appr. 6th term	19.87
Appr. 7th term	20.87
Appr. 8th term	20.87

5-677.Z-2

Insulator - Heat & Frost

11/01/2024

JOB DESCRIPTION Insulator - Heat & Frost

DISTRICT 7

ENTIRE COUNTIES

Broome, Cayuga, Chemung, Chenango, Cortland, Herkimer, Jefferson, Lewis, Madison, Oneida, Onondaga, Oswego, Otsego, Schuyler, Seneca, St. Lawrence, Tioga, Tompkins

WAGES

Per hour: 07/01/2024

Asbestos Installer	\$ 41.50
Insulation Installer	41.50
(On mechanical systems only)	

SHIFT WORK

The following rates will apply on all contracting agency-mandated shifts worked:

1st Shift	\$ 41.50
2nd Shift	47.72

3rd Shift 49.80

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker \$ 25.09

OVERTIME PAY

See (*B1, **K, P) on OVERTIME PAGE

*NOTE: First 10 hours on Saturday.

**NOTE: Holidays that fall on Sunday are subject to double time.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (2*,4,6,28) on HOLIDAY PAGE

*Triple time for Labor Day if worked.

REGISTERED APPRENTICES

WAGES per hour: One (1) year terms at the following percentage of Journeyworker's wage.

1st 60%	2nd 70%	3rd 80%	4th 90%
\$ 24.90	\$ 29.05	\$ 33.20	\$ 37.35

SUPPLEMENTAL BENEFITS per hour:

\$ 22.59	\$ 22.59	\$ 25.09	\$ 25.09
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7-30-Syracuse

Ironworker

11/01/2024

JOB DESCRIPTION Ironworker

DISTRICT 7

ENTIRE COUNTIES

Franklin, Herkimer, Lewis, Oneida, St. Lawrence

PARTIAL COUNTIES

Chenango: Only the Townships of Columbus, New Berlin, North Norwich, Plymouth, Sherburne and Smyrna.

Fulton: Only the Townships of Caroga, Ephratah, Oppenheim, and Stratford.

Hamilton: Only the Townships of Arietta, Indian Lake, Inlet, Lake Pleasant, Long Lake and Morehouse.

Jefferson: Only the Townships of Antwerp, Champion, Philadelphia and Wilna.

Madison: Only the Townships of Brookfield, Eaton, Hamilton, Lebanon, Madison, Oneida and Stockbridge.

Montgomery: Only the Townships of Canajoharie, Minden, Palatine and St. Johnsville.

Otsego: Only the Townships of Burlington, Cherry Valley, Decatur, Edmeston, Exeter, Hartwick, Middlefield, New Lisbon, Otsego, Pittsfield, Plainfield, Richfield, Roseboom, Springfield and Westford, and the Village of Cooperstown.

WAGES

Per hour:	07/01/2024	07/01/2025 Additional	07/01/2026 Additional
Structural/Reinforcing	\$ 33.50	\$ 2.63*	\$ 2.74*
Mach. Mover/Ornamental	33.50	2.63*	2.74*
Stone Derrickman	33.50	2.63*	2.74*
Chain Link Fence	33.50	2.63*	2.74*
Sheeter Ironworker	33.50	2.63*	2.74*
Pre-Engineered Building	33.50	2.63*	2.74*
Window Erector	33.50	2.63*	2.74*
Precast Erector	33.50	2.63*	2.74*
Welder	33.50	2.63*	2.74*

*To be allocated at a later date.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker \$ 32.28

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

NOTE: Any holiday which occurs on Sunday shall be observed the following Monday. Any holiday which occurs on Saturday shall be observed the previous Friday.

REGISTERED APPRENTICES

WAGES per hour: 1500 hour terms at the following wage.

1-1500hrs	\$ 21.50
1501-3000hrs	23.50
3001-4500hrs	25.50
4501-6000hrs	27.50

SUPPLEMENTAL BENEFITS per hour:

1-1500hrs	\$ 13.69
1501-3000hrs	22.06
3001-4500hrs	23.26
4501-6000hrs	24.45

7-440

Laborer - Building **11/01/2024**

JOB DESCRIPTION Laborer - Building

DISTRICT 1

ENTIRE COUNTIES

Hamilton, Herkimer, Madison, Oneida

PARTIAL COUNTIES

Fulton: Only the Townships of Stratford, Oppenheim, Caroga and Ephratah
 Montgomery: Only the Townships of Minden, St. Johnsville, Canajoharie, Palatine and Root

WAGES

- GROUP #1: Basic
- GROUP #2: Pipe Layer, Mortar Mixer, Walk behind Mortar Buggy and Power Lift
- GROUP #3: Wagon Drill(Where separate air compressor unit supplies power.)
- GROUP #4: Blaster, Formsetter, Riding Mortar Buggy
- GROUP #5: Hazardous Waste Removal
- GROUP #6: Asbestos and Lead Removal

WAGES per hour: 07/01/2024

Building Laborer:

Group # 1	\$ 32.64
Group # 2	32.79
Group # 3	33.04
Group # 4	33.14
Group # 5	34.14
Group # 6	34.14

SUPPLEMENTAL BENEFITS

Per hour:

07/01/2024

All groups \$ 27.30

OVERTIME PAY

See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
 Overtime: See (5, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wages per hour

1000 Hour terms at the following percentage of Journeyperson's basic hourly wage.

1st	2nd	3rd	4th
65 %	70 %	80 %	80 %

Supplemental Benefits per hour worked

07/01/2024

Apprentices \$ 27.30

1-190z2B

Laborer - Heavy&Highway **11/01/2024**

JOB DESCRIPTION Laborer - Heavy&Highway

DISTRICT 1

ENTIRE COUNTIES

Hamilton, Herkimer, Madison, Oneida

PARTIAL COUNTIES

Fulton: Only Townships of Stratford, Oppenheim, Caroga and Ephratah
Montgomery: Only Townships of Minden, St. Johnsville, Canajoharie, Palatine and Root.

WAGES

GROUP # A: Basic, Drill Helper, Flagman, Outboard and Hand Boats.

GROUP # B: Bull Float, Chain Saw, Concrete Aggregate Bin, Concrete Bootmen, Gin Buggy, Hand or Machine Vibrator, Jack Hammer, Mason Tender, Mortar Mixer, Pavement Breaker, Handlers of all SteelMash, Small Generators for Laborers Tools, Installation of Bridge Drainage Pipe, Pipe Layers, Vibrator Type Rollers, Tamper, Drill Doctor, Tail or Screw Operator on Asphalt Paver, Water Pump Operators(1-1/2" and Single Diaphragm), Nozzle (Asphalt, Gunit, Seeding, and Sand Blasting), Laborers on Chain Link Fence Erection, Rock Splitter and Power Unit, Pusher Type Concrete Saw and all other Gas, Electric, Oil and Air Tool Operators, Wrecking Laborer.

GROUP # C: Rock or Drilling Machine Operators (only where a separate air compressor unit supplies power), Acetylene Torch Operators, Asphalt Raker and Powderman.

GROUP # D: Blasters, Form Setters (prefab curb radius), Stone or Granite Curb Setters.

GROUP # E: Employees performing hazardous waste removal, lead abatement and removal, or asbestos abatement and removal on a State and/or Federally designated waste site & where relevant State or Federal regulations require employees to use or wear forms of personal protection.

Per hour: 07/01/2024

Heavy/Highway Laborer:

GROUP # A	\$ 40.65
GROUP # B	40.85
GROUP # C	41.05
GROUP # D	41.25
GROUP # E	43.15

SHIFT WORK

All employees who work a single irregular workday that starts from 5:00 pm to 1:00 am on a governmental mandated night shift shall be paid an additional \$5.00 per hour.

SUPPLEMENTAL BENEFITS

Per hour: \$ 28.69

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

Note: If the holiday falls on Sunday, it will be celebrated on Monday. If the Monday Holiday is worked it will be paid at double time plus the Holiday pay. If the Holiday falls on a Saturday employer can choose to celebrate Saturday or give Friday off with pay. If the Saturday Holiday is worked it will be paid at double time plus the Holiday pay

REGISTERED APPRENTICES

Wages per hour

1000 hour terms at the following percentage of Journeyman's wage

1st	2nd	3rd	4th
65%	70%	80%	80%

SUPPLEMENTAL BENEFITS per hour worked

Apprentices \$ 28.69

1-190z2H/H

Laborer - Tunnel

11/01/2024

JOB DESCRIPTION Laborer - Tunnel

DISTRICT 1

ENTIRE COUNTIES

Albany, Fulton, Hamilton, Herkimer, Madison, Montgomery, Oneida, Rensselaer, Saratoga, Schenectady, Schoharie, Washington

WAGES

Class 1: All support laborers/sandhogs working above the shaft or tunnel

Class 2: All laborers/sandhogs working in the shaft or tunnel

Class 4: Safety Miners

Class 5: Site work related to Shaft/Tunnel

Per Hour

07/01/2024

Class 1	\$ 47.20
Class 2	49.20
Class 4	51.45
Class 5	43.45

Toxic and hazardous waste, lead abatement and asbestos abatement work will be paid an additional \$ 3.00 an hour.

SUPPLEMENTAL BENEFITS

Per hour

Journeyworker \$ 29.15

OVERTIME PAY

See (B, E, Q, V) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6, 15, 25) on HOLIDAY PAGE

Overtime: See (5, 6, 15, 16, 25) on HOLIDAY PAGE

Note: When a holiday falls on Sunday, the following Monday shall be considered a holiday and all work performed on either day shall be at the double time rate. When a holiday falls on Saturday, the preceding Friday shall be considered a holiday and all work performed on either day shall be at the double time rate.

REGISTERED APPRENTICES

FOR APPRENTICE RATES, refer to the appropriate Laborer Heavy & Highway wage rate contained in the wage schedule for the County and Location where the work is to be performed.

1-190/157T

Lineman Electrician

11/01/2024

JOB DESCRIPTION Lineman Electrician

DISTRICT 6

ENTIRE COUNTIES

Albany, Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Rensselaer, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Wyoming, Yates

WAGES

A Lineman/Technician shall perform all overhead aerial work. A Lineman/Technician on the ground will install all electrical panels, connect all grounds, install and connect all electrical conductors, assembly of all electrical materials, conduit, pipe, or raceway; placing of fish wire; pulling of cables, wires or fiber optic cable through such raceways; splicing of conductors; dismantling of such structures, lines or equipment.

Crane Operators: Operation of any type of crane on line projects.

Crawler Backhoe: Operation of tracked excavator/crawler backhoe with 1/2 yard bucket or larger on line projects.

Digging Machine Operator: All other digging equipment and augering on line projects.

A Groundman/Truck Driver shall: Build and set concrete forms, handle steel mesh, set footer cages, transport concrete in a wheelbarrow, hand or machine concrete vibrator, finish concrete footers, mix mortar, grout pole bases, cover and maintain footers while curing in cold weather, operate jack hammer, operate hand pavement breaker, tamper, concrete and other motorized saws, as a drill helper, operate and maintain generators, water pumps, chainsaws, sand blasting, operate mulching and seeding machine, air tools, electric tools, gas tools, load and unload materials, hand shovel and/or broom, prepare and pour mastic and other fillers, assist digger operator/equipment operator in ground excavation and restoration, landscape work and painting. Only when assisting a lineman technician, a groundman/truck driver may assist in installing conduit, pipe, cables and equipment.

NOTE: Includes Teledata Work within ten (10) feet of High Voltage Transmission Lines. Also includes digging of holes for poles, anchors, footer, and foundations for electrical equipment.

Below rates applicable on all overhead and underground distribution and maintenance work, and all overhead and underground transmission line work and the installation of fiber optic cable where no other construction trades are or have been involved. Includes access matting for line work.

Per hour: 07/01/2024

Group A:

Lineman, Technician \$ 58.90

Crane, Crawler Backhoe 58.90

Welder, Cable Splicer 58.90

Group B:

Digging Mach. Operator 53.01
Tractor Trailer Driver 50.07
Groundman, Truck Driver 47.12
Equipment Mechanic 47.12
Flagman 35.34

Additional \$1.00 per hour for entire crew when a helicopter is used.

Below rates applicable on all electrical sub-stations, switching structures, fiber optic cable and all other work not defined as "Utility outside electrical work." Includes access matting for line work.

Group A:

Lineman, Technician \$ 58.90
Crane, Crawler Backhoe 58.90
Cable Splicer 64.79
Certified Welder,
Pipe Type Cable 61.85

Group B:

Digging Mach. Operator 53.01
Tractor Trailer Driver 50.07
Groundman, Truck Driver 47.12
Equipment Mechanic 47.12
Flagman 35.34

Additional \$1.00 per hour for entire crew when a helicopter is used.

Below rates applicable on all switching structures, maintenance projects, railroad catenary install/maintenance third rail installation, bonding of rails and pipe type cable and installation of fiber optic cable. Includes access matting for line work.

Group A:

Lineman, Tech, Welder \$ 60.22
Crane, Crawler Backhoe 60.22
Cable Splicer 66.24
Certified Welder,
Pipe Type Cable 63.23

Group B:

Digging Mach. Operator 54.20
Tractor Trailer Driver 51.19
Groundman, Truck Driver 48.18
Equipment Mechanic 48.18
Flagman 36.13

Additional \$1.00 per hour for entire crew when a helicopter is used.

Below rates applicable on all overhead and underground transmission line work & fiber optic cable where other construction trades are or have been involved. This applies to transmission line work only, not other construction. Includes access matting for line work.

Group A:

Lineman, Tech, Welder \$ 61.41
Crane, Crawler Backhoe 61.41

Group B:

Digging Mach. Operator 55.27
Tractor Trailer Driver 52.20
Groundman, Truck Driver 49.13
Equipment Mechanic 49.13
Flagman 36.85

Additional \$1.00 per hour for entire crew when a helicopter is used.

SHIFT WORK

THE FOLLOWING RATES WILL APPLY ON ALL CONTRACTING AGENCY MANDATED MULTIPLE SHIFTS OF AT LEAST FIVE (5) DAYS DURATION WORKED BETWEEN THE HOURS LISTED BELOW:

1ST SHIFT	8:00 AM to 4:30 PM REGULAR RATE
2ND SHIFT	4:30 PM to 1:00 AM REGULAR RATE PLUS 17.3 %
3RD SHIFT	12:30 AM to 9:00 AM REGULAR RATE PLUS 31.4 %

SUPPLEMENTAL BENEFITS

Per hour:

	07/01/2024
Group A	\$ 30.90 *plus 7% of the hourly wage paid
Group B	\$ 26.90 *plus 7% of the hourly wage paid

*The 7% is based on the hourly wage paid, straight time or premium time.

OVERTIME PAY

See (B, E, Q, X) on OVERTIME PAGE. NOTE: Double time for all emergency work designated by the Dept. of Jurisdiction.
 WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked. Contractor is still responsible to pay the hourly benefit amount for each hour worked.

HOLIDAY

Paid	See (5, 6, 8, 13, 25) on HOLIDAY PAGE plus Governor of NYS Election Day.
Overtime	See (5, 6, 8, 13, 25) on HOLIDAY PAGE plus Governor of NYS Election Day.

NOTE: All paid holidays falling on Saturday shall be observed on the preceding Friday. All paid holidays falling on Sunday shall be observed on the following Monday. Supplements for holidays paid at straight time.

REGISTERED APPRENTICES

WAGES per hour: 1000 hour terms at the following percentage of the applicable Journeyworker's Lineman wage.

1st	2nd	3rd	4th	5th	6th	7th
60%	65%	70%	75%	80%	85%	90%

SUPPLEMENTAL BENEFITS per hour:

	07/01/2024
	\$ 26.90 *plus 7% of the hourly wage paid

*The 7% is based on the hourly wage paid, straight time or premium time.

6-1249a

Lineman Electrician - Teledata **11/01/2024**

JOB DESCRIPTION Lineman Electrician - Teledata

DISTRICT 6

ENTIRE COUNTIES

Albany, Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Rensselaer, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Westchester, Wyoming, Yates

WAGES

Per hour:

For outside work, stopping at first point of attachment (demarcation).

	07/01/2024	01/01/2025
Cable Splicer	\$ 39.24	\$ 40.81
Installer, Repairman	\$ 37.24	\$ 38.73
Teledata Lineman	\$ 37.24	\$ 38.73
Tech., Equip. Operator	\$ 37.24	\$ 38.73
Groundman	\$ 19.74	\$ 20.53

NOTE: EXCLUDES Teledata work within ten (10) feet of High Voltage (600 volts and over) transmission lines. For this work please see LINEMAN.

SHIFT WORK

THE FOLLOWING RATES APPLY WHEN THE CONTRACTING AGENCY MANDATES MULTIPLE SHIFTS OF AT LEAST FIVE (5) DAYS DURATION ARE WORKED. WHEN TWO (2) OR THREE (3) SHIFTS ARE WORKED THE FOLLOWING RATES APPLY:

1ST SHIFT	REGULAR RATE
2ND SHIFT	REGULAR RATE PLUS 10%
3RD SHIFT	REGULAR RATE PLUS 15%

SUPPLEMENTAL BENEFITS

Per hour:	07/01/2024	01/01/2025
Journeyworker	\$ 5.70 *plus 3% of the hour wage paid	\$ 5.70 *plus 3% of the hour wage paid

*The 3% is based on the hourly wage paid, straight time rate or premium rate.

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked. Contractor is still responsible to pay the hourly benefit amount for each hour worked.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
 Overtime: See (5, 6, 16) on HOLIDAY PAGE

6-1249LT - Teledata

Lineman Electrician - Traffic Signal, Lighting **11/01/2024**

JOB DESCRIPTION Lineman Electrician - Traffic Signal, Lighting **DISTRICT 6**

ENTIRE COUNTIES

Albany, Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Cortland, Delaware, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orleans, Oswego, Otsego, Rensselaer, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Sullivan, Tioga, Tompkins, Warren, Washington, Wayne, Wyoming, Yates

WAGES

Lineman/Technician shall perform all overhead aerial work. A Lineman/Technician on the ground will install all electrical panels, connect all grounds, install and connect all electrical conductors which includes, but is not limited to road loop wires; conduit and plastic or other type pipes that carry conductors, flex cables and connectors, and to oversee the encasement or burial of such conduits or pipes.

Crane Operators: Operation of any type of crane on Traffic Signal/Lighting projects.

Crawler Backhoe: Operation of tracked excavator/crawler backhoe with 1/2 yard bucket or larger on Traffic Signal/Lighting projects.

Digging Machine Operator: All other digging equipment and augering on Traffic Signal/Lighting projects.

A Groundman/Truck Driver shall: Build and set concrete forms, handle steel mesh, set footer cages, transport concrete in a wheelbarrow, hand or machine concrete vibrator, finish concrete footers, mix mortar, grout pole bases, cover and maintain footers while curing in cold weather, operate jack hammer, operate hand pavement breaker, tamper, concrete and other motorized saws, as a drill helper, operate and maintain generators, water pumps, chainsaws, sand blasting, operate mulching and seeding machine, air tools, electric tools, gas tools, load and unload materials, hand shovel and/or broom, prepare and pour mastic and other fillers, assist digger operator/equipment operator in ground excavation and restoration, landscape work and painting. Only when assisting a lineman technician, a groundman/truck driver may assist in installing conduit, pipe, cables and equipment.

A flagger's duties shall consist of traffic control only.

Per hour: 07/01/2024

Group A:	
Lineman, Technician	\$ 50.54
Crane, Crawler Backhoe	50.54
Certified Welder	53.07

Group B:	
Digging Machine	45.49
Tractor Trailer Driver	42.96
Groundman, Truck Driver	40.43
Equipment Mechanic	40.43

Flagman 30.32

Above rates are applicable for installation, testing, operation, maintenance and repair on all Traffic Control (Signal) and Illumination (Lighting) projects, Traffic Monitoring Systems, and Road Weather Information Systems. Includes digging of holes for poles, anchors, footer foundations for electrical equipment; assembly of all electrical materials or raceway; placing of fish wire; pulling of cables, wires or fiber optic cable through such raceways; splicing of conductors; dismantling of such structures, lines or equipment.

SHIFT WORK

THE FOLLOWING RATES WILL APPLY ON ALL CONTRACTING AGENCY MANDATED MULTIPLE SHIFTS OF AT LEAST FIVE (5) DAYS DURATION WORKED BETWEEN THE HOURS LISTED BELOW:

1ST SHIFT	8:00 AM TO 4:30 PM	REGULAR RATE
2ND SHIFT	4:30 PM TO 1:00 AM	REGULAR RATE PLUS 17.3%
3RD SHIFT	12:30 AM TO 9:00 AM	REGULAR RATE PLUS 31.4%

SUPPLEMENTAL BENEFITS

Per hour worked:

07/01/2024

Group A \$ 30.90
*plus 7% of the hourly wage paid

Group B \$ 26.90
*plus 7% of the hourly wage paid

*The 7% is based on the hourly wage paid, straight time or premium time.

OVERTIME PAY

See (B, E, Q, X) on OVERTIME PAGE. NOTE: Double time for all emergency work designated by the Dept. of Jurisdiction. WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked. Contractor is still responsible to pay the hourly benefit amount for each hour worked.

HOLIDAY

Paid: See (5, 6, 8, 13, 25) on HOLIDAY PAGE plus Governor of NYS Election Day.
Overtime: See (5, 6, 8, 13, 25) on HOLIDAY PAGE plus Governor of NYS Election Day.

NOTE: All paid holidays falling on Saturday shall be observed on the preceding Friday. All paid holidays falling on Sunday shall be observed on the following Monday. Supplements for holidays paid at straight time.

REGISTERED APPRENTICES

WAGES per hour: 1000 hour terms at the following percentage of the applicable Journeyworker's Lineman wage.

1st	2nd	3rd	4th	5th	6th	7th
60%	65%	70%	75%	80%	85%	90%

SUPPLEMENTAL BENEFITS per hour:

07/01/2024

\$ 26.90
*plus 7% of the hourly wage paid

*The 7% is based on the hourly wage paid, straight time or premium time.

6-1249a-LT

Lineman Electrician - Tree Trimmer

11/01/2024

JOB DESCRIPTION Lineman Electrician - Tree Trimmer

DISTRICT 6

ENTIRE COUNTIES

Albany, Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Rensselaer, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Wyoming, Yates

WAGES

Applies to line clearance, tree work and right-of-way preparation on all new or existing energized overhead or underground electrical, telephone and CATV lines. This also includes stump removal near underground energized electrical lines including telephone and CATV lines.

Per hour: 07/01/2024

Tree Trimmer	\$ 31.44
Equipment Operator	27.80
Equipment Mechanic	27.80
Truck Driver	23.15
Groundman	19.07
Flag person	15.00*

*NOTE-Rate effective on 01/01/2025 - \$15.50 due to minimum wage increase.

SUPPLEMENTAL BENEFITS

Per hour:

07/01/2024

Journeyworker	\$ 10.48
	*plus 4.5% of
	the hourly
	wage paid

* The 4.5% is based on the hourly wage paid, straight time rate or premium rate.

OVERTIME PAY

See (B, E, Q, X) on OVERTIME PAGE

WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked. Contractor is still responsible to pay the hourly benefit amount for each hour worked.

HOLIDAY

Paid: See (5, 6, 8, 15) on HOLIDAY PAGE

Overtime: See (5, 6, 8, 15, 16, 25) on HOLIDAY PAGE

NOTE: All paid holidays falling on a Saturday shall be observed on the preceding Friday. All paid holidays falling on a Sunday shall be observed on the following Monday.

6-1249TT

Mason - Building

11/01/2024

JOB DESCRIPTION Mason - Building

DISTRICT 12

ENTIRE COUNTIES

Herkimer, Jefferson, Lewis, Oneida, St. Lawrence

PARTIAL COUNTIES

Madison: Entire County except the Townships of Sullivan & Cazenovia

WAGES

Per hour 07/01/2024

Tile/Marble/Terrazzo

Setter	\$ 35.85
Finisher	28.52

SUPPLEMENTAL BENEFITS

Per hour worked

Journeyman Setters	\$ 20.01
Journeyman Finishers	19.30

OVERTIME PAY

See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wages per hour

Hour terms at the following percentage of journeyman's wage

Setter:

1st term 500 hours	60%
2nd term 1000 hours	70%
3rd term 1000 hours	80%
4th term 1000 hours	85%
5th term 1000 hours	90%
6th term 1500 hours	95%

Finsher;

1st term 500 HOURS	70%
2ND term 1000 HOURS	80%
3RD term 1000 HOURS	90%
4TH term 1200 HOURS	95%

Supplemental Benefits per hour worked

Setter:

1st & 2nd Term	\$ 12.41
3rd & 4th Term	16.21
5th Term	18.11
6th Term	20.01

Finishers:

1st & 2nd Term	\$ 11.76
All others	15.53

12-2TS.2

Mason - Building

11/01/2024

JOB DESCRIPTION Mason - Building

DISTRICT 12

ENTIRE COUNTIES

Herkimer, Oneida

PARTIAL COUNTIES

Lewis: The townships of Lewis, Leyden, Osceola, Turin and West Turin
 Madison: Entire County except the Townships of Sullivan and Cazenovia

WAGES

Per hour 07/01/2024

Bricklayer/Blocker	\$ 39.24
Cement Mason(Bldg)	39.24
Plasterer/Fireproofing*	39.24
Stone Mason	39.24
Concrete Cutter	39.24
Pointer/Caulker/Cleaner	39.24

Additional \$.25 per hr. for work in restricted radiation area of atomic plant.

Additional \$5.00 per day more for employees working on a two-point suspension scaffold (Pointer, Caulker, and Cleaner are excluded).

(*)Fireproof on Structural only.

SUPPLEMENTAL BENEFITS

Per hour worked

Journeyman \$ 21.63

OVERTIME PAY

See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
 Overtime: See (5, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wages per hour

750 hour terms at the following percentage of Journey's wage

1st	2nd	3rd	4th	5th	6th	7th	8th
60%	60%	65%	70%	75%	80%	85%	90%

Supplemental Benefits per hour worked:

All Terms \$21.63

12-2b.2

Mason - Heavy&Highway

11/01/2024

JOB DESCRIPTION Mason - Heavy&Highway

DISTRICT 12

ENTIRE COUNTIES

Albany, Cayuga, Clinton, Columbia, Essex, Franklin, Fulton, Greene, Hamilton, Herkimer, Jefferson, Lewis, Madison, Montgomery, Oneida, Oswego, Rensselaer, Saratoga, Schenectady, Schoharie, St. Lawrence, Warren, Washington

PARTIAL COUNTIES

Onondaga: For Heavy & Highway Cement Mason or Plaster Work in Onondaga County, refer to Mason-Heavy&Highway tag 1-2h/h on.

WAGES

Per hour

07/01/2024

Mason &

Bricklayer

\$ 42.26

Additional \$1.00 per hour for work on any swing scaffold or staging suspended by means of ropes or cables.

SUPPLEMENTAL BENEFITS

Per hour worked

Journeyman

\$ 22.43

OVERTIME PAY

See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY

Paid:

See (1) on HOLIDAY PAGE

Overtime:

See (5, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wages per hour

750 HR TERMS at the following percent of Journeyman's wage

1st	2nd	3rd	4th	5th	6th	7th	8th
60%	60%	65%	70%	75%	80%	85%	90%

Supplemental Benefits per hour worked

0 to 500 Hours \$ 13.68

All Other 22.43

12-2hh.1

Millwright

11/01/2024

JOB DESCRIPTION Millwright

DISTRICT 6

ENTIRE COUNTIES

Albany, Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orleans, Oswego, Otsego, Rensselaer, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Wyoming, Yates

WAGES

THE FOLLOWING RATE APPLIES TO ANY GAS/STEAM TURBINE AND OR RELATED COMPONENT WORK, INCLUDING NEW INSTALLATIONS OR MAINTENANCE AND ANY/ALL WORK PERFORMED WITHIN THE PROPERTY LIMITS OF A NUCLEAR FACILITY.

Per hour:

07/01/2024

07/01/2025

Additional

Millwright - Power Generation

\$ 45.00

\$2.50*

* To be allocated at a later date.

NOTE: ADDITIONAL PREMIUMS PAID FOR THE FOLLOWING WORK LISTED BELOW (amount subject to any overtime premiums):

- Certified Welders shall receive an additional \$1.75 per hour provided they are directed to perform Certified Welding.

- If a work site has been declared a hazardous site by the Owner and the use of protective gear (including, as a minimum, air purifying canister-type chemical respirators) is required, then that employee shall receive an additional \$1.50 per hour.
- An employee performing the work of a machinist shall receive an additional \$2.00 per hour. For the purposes of this premium to apply, a "machinist" is a person who uses a lathe, Bridgeport, milling machine or similar type of tool to make or modify parts.
- When performing work underground at 500 feet and below, the employee shall receive an additional \$1.00 per hour.

SUPPLEMENTAL BENEFITS

Per hour paid:

Journeyworker \$ 27.95*

*NOTE: Subject to OT premium

OVERTIME PAY

See (B, E, E2, Q, V) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

NOTE: Any holiday that falls on Sunday shall be observed the following Monday. Any holiday that falls on Saturday shall be observed the preceding Friday.

REGISTERED APPRENTICES

WAGES per hour: One year terms at the following percentage of Journeyworker's wage:

Appr. 1st year	65 %*
Appr. 2nd year	75 %*
Appr. 3rd year	80 %*
Appr. 4th year	90 %*

*NOTE: Additional premium for the following work listed below:

Certified Welder	\$ 1.75
Hazardous Waste Work	1.50
Machinist	2.00
Underground (500' and below)	1.00

SUPPLEMENTAL BENEFITS per hour:

Appr. 1st year	\$ 11.89
Appr. 2nd year	23.14
Appr. 3rd year	24.74
Appr. 4th year	26.35

6-1163Power

Millwright

11/01/2024

JOB DESCRIPTION Millwright

DISTRICT 2

ENTIRE COUNTIES

Clinton, Essex, Franklin, Hamilton, Jefferson, Lewis, Oneida, Onondaga, Oswego, St. Lawrence, Warren, Washington

WAGES

Per hour:	07/01/2024	07/01/2025 Additional
Building	\$ 36.32	\$ 3.00*
Heavy & Highway	39.82	3.00*

*To be allocated at a later date

NOTE ADDITIONAL PREMIUMS PAID FOR THE FOLLOWING WORK LISTED BELOW (amount subject to any overtime premiums):

- Certified Welders shall receive \$1.75 per hour in addition to the current Millwrights rate provided he/she is directed to perform certified welding.
- For Building work if a work site has been declared a hazardous site by the Owner and the use of protective gear (including, as a minimum, air purifying canister-type chemical respirators) are required, then that employee shall receive a \$1.50 premium per hour for Building work.
- For Heavy & Highway work if the work is performed at a State or Federally designated hazardous waste site where employees are required to wear protective gear, the employees performing the work shall receive an additional \$2.00 per hour over the millwright heavy and highway wage rate for all hours worked on the day protective gear was worn.
- An employee performing the work of a machinist shall receive \$2.00 per hour in addition to the current Millwrights rate. For the purposes of this premium to apply, a "machinist" is a person who uses a lathe, Bridgeport, milling machine or similar type of tool to make or modify parts.
- When performing work underground at 500 feet and below, the employee shall receive an additional \$1.00.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker \$ 26.59

OVERTIME PAY

See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

Note: Any holiday that falls on Sunday shall be observed the following Monday. Any holiday that falls on Saturday shall be observed the preceding Friday.

REGISTERED APPRENTICES

Wages per hour:

(1)year terms at the following percentage of Journeyworker's rate.

1st	2nd	3rd	4th
65%	75%	80%	90%

Supplemental Benefits per hour:

Apprentices:

1st term	\$ 11.89
2nd term	22.19
3rd term	23.65
4th term	25.13

2-1163.2

Operating Engineer - Building

11/01/2024

JOB DESCRIPTION Operating Engineer - Building

DISTRICT 6

ENTIRE COUNTIES

Cayuga, Cortland, Jefferson, Lewis, Madison, Oneida, Onondaga, Oswego, Seneca, St. Lawrence, Tompkins

WAGES

NOTE:

---If a prime contract is let for site work only, meaning no buildings are involved in their site contract, the Heavy/Highway rates would be applicable. When a prime contract is let for site work and building excavation is part of that contract, the Building rates would be applicable for the Operators classification.

---In the event that equipment listed below is operated by robotic control, the classification covering the operation will be the same as if manually operated.

---If a second employee is required by the employer for operation of any covered machine, they shall be an Engineer Class C.

CLASS A1*: All Cranes (A1 Includes Boom Trucks over 5 tons, Cableway, Cherry Picker, Derrick, Dragline, Dredge, Overhead Crane, Pile Driver, Tower Crane**, Truck Crane, Whirlies).

CLASS A: Air Plako, Asphalt & Blacktop Roller, Automated Concrete Spreader (CMI or equivalent), Automated Fine Grade Machine (CMI), Backhoe, Barrel Shredder, Belt Placer, Blacktop Spreader (such as Barber-Greene & Blaw Knox), Blacktop Plant (automated), Blast or Rotary Drill (Truck or Cat mounted), Boom Trucks 5 ton and under, Burning Plant Operator, Caisson Auger, Central Mix Plant (automated), Concrete Pump, Crusher (Rock), De-watering Press, Diesel Power Unit, Dirt Filter Press with Operation Equipment, Dredge, Dual Drum Paver, Elevating Grader (self-propelled or towed), Elevator Hoist - Two Cage, Excavator - all purpose hydraulically operated, Fork Lift (Loed/Lull and other rough terrain type), Front End Loader (4 c.y. and over), Gradall, Grader (Power), Head Tower (Saurman or equal), Hoist (2 or 3 Drum), Hydroblaster (Laser Pump), Light Plants - Compressors and Generators, Locomotive, Maintenance Engineer, Maintenance Welder, Mine Hoist, Mucking Machine or Mole, Quarry Master or Equivalent, Refrigeration Equipment (for soil stabilization), Scraper, Sea Mule, Shovel, Side Boom, Slip Form Paver, Straddle Buggy (Ross Carrier, Lumber Carrier), Tractor Drawn Belt Type Loader (Euclid Loader), Trenching Machine (digging capacity of over 4ft. depth), Truck or Trailer Mounted Log Chipper (self-feeder), Tug Operator (Manned, rented equipment excluded), Tunnel Shovel, Vibro or Sonic Hammer Controls (when not mounted in proximity to Rig Operator), Work Boat Operator including LCM's.

CLASS B: "A" Frame Truck, Back Dumps, Blacktop Plant (non-automatic), Boring Machine, Bulldozer, Cage-Hoist, Central Mix Plant (non-automated), Compressor, Pump, Generator or Welding machine (when used in battery of not more than five (5)), Concrete Paver (single drum over 16'), Core boring machine, Drill Rigs - tractor mounted, Elevator - as material hoist, Farm Tractor (with or without accessories), Fork Lift (over 10 ton with or without attachments), Front End Loader (under 4 c.y.), Grout Pump, Guniting Machine, High Pressure Boiler (15 lbs. & over), Hoist (one drum), Hydraulic Breaking Hammer (Drop Hammer), Kolman Plant Loader (screening gravel), Maintenance Grease Man, Mixer for stabilized base - self-propelled (Seaman Mixer), Monorail Machine, Parapet Concrete or Pavement Grinder, Parts Man, Post Driver (truck or tractor mounted), Post Hole Digger (truck or tractor mounted), Power Sweeper (Wayne or similar), Pump-Crete or Squeeze-Crete, Road Widener (front end of Grader or self-propelled), Roller, Self-contained hydraulic bench drill, Shell Winder (motorized), Skid steer (Bobcat type loader), Snorkel (overhead arms), Snowblower control man, Tractor (with or without accessories), Trenching Machine (digging capacity of 4 ft. or less), Tugger Hoist, Vacuum Machine (self-propelled or mounted), Vibro Tamp, Well Drill / Well Point System (Submersible pumps when used in lieu of Well Point System), Winch (Motor driven), Winch Cat, Winch Truck.

CLASS C: Compressor (up to 500 cfm), Concrete Paver or Mixer (under 16'), Concrete Pavement Spreaders & Finishers (not automated), Conveyor (over 12 ft), Electric Submersible Pump (4" and over), Fine Grade Machine (not automated), Fireman, Fork Lift ("with or without" attachments, 10 ton and under), Form Tamper, Generator (2,500 watts and over), Hydraulic Pump, Mechanical Heaters (More than two (2) Mechanical Heaters or any Mechanical Heater or Heaters whose combined output exceeds 640,000 BTU per hour (manufacturer's rating) plus one self-contained heating unit - i.e. Sundog or Air Heat type - New Holland Hay Dryer type excluded), Mulching Machine, Oiler, Power Driven Welding Machine (300 amp and over, other than all electric. One Welding Machine under 300 amp will not require an engineer unless in a battery), Power Heaterman (hay dryer), Pumps (water and trash), Revinus Widener (road widener), Single Light Plant, Steam Cleaner or Jenny.

Per hour: Building	07/01/2024	07/01/2025
Class A1*	\$ 47.62	\$ 49.61
Class A	46.12	48.11
Class B	44.00	45.99
Class C	39.78	41.77

Additional \$2.50 per hour if work requires Personal Protective Equipment for hazardous waste site activities with a level C or over rating.

(*) TONNAGE PREMIUMS:

- All cranes up to 64 ton capacity - A1 rate
- All cranes 65 ton to 110 ton capacity - A1 rate plus \$ 1.50
- All cranes 111 ton to 199 ton capacity - A1 rate plus \$ 2.00
- All cranes 200 ton to 399 ton capacity - A1 rate plus \$ 3.00
- All cranes 400 ton to 599 ton capacity - A1 rate plus \$ 4.00
- All cranes 600 ton to 799 ton capacity - A1 rate plus \$ 5.00
- All cranes 800 ton to 999 ton capacity - A1 rate plus \$ 6.00
- All cranes 1000 ton capacity and over - A1 rate plus \$ 7.00

(**) Tower Cranes - A1 rate plus \$2.50 (no tonnage premiums apply)

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker	\$ 31.02	\$ 32.12
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OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6) on HOLIDAY PAGE
 Overtime: See (5, 6) on HOLIDAY PAGE

NOTE: If the holiday falls on Sunday, it will be celebrated on Monday.

REGISTERED APPRENTICES

WAGES per hour: One thousand hour terms at the following percentage of Journeyworker's CLASS A wage:

1st year	60%
2nd year	65%
3rd year	70%
4th year	80%

Additional \$2.50 per hour if work requires Personal Protective Equipment for hazardous waste site activities with a level C or over rating.

SUPPLEMENTAL BENEFITS per hour:

07/01/2024	07/01/2025
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All Terms: \$ 30.95 \$ 32.05

6-158-545b.s

Operating Engineer - Heavy&Highway **11/01/2024**

JOB DESCRIPTION Operating Engineer - Heavy&Highway

DISTRICT 6

ENTIRE COUNTIES

Cayuga, Cortland, Jefferson, Lewis, Madison, Oneida, Onondaga, Oswego, Seneca, St. Lawrence, Tompkins

WAGES

NOTE:

---In the event that equipment listed below is operated by robotic control, the classification covering the operation will be the same as if manually operated.

---If a second employee is required by the employer for operation of any covered machine, they shall be an Engineer Class C.

CLASS A1*: All Cranes that require a NYS Crane License (Boom Truck, Cherry Picker, Derrick, Dragline, Overhead Crane (Gantry or Straddle Type), Pile Driver, Tower Cranes (including self erecting)**, Truck Crane).

CLASS A: Asphalt Curb Machine (self-propelled, slipform); Asphalt Paver; Automated Concrete Spreader (CMI type); Automatic Fine Grader; Backhoe (except tractor mounted, rubber tired); Backhoe Excavator, Full Swing (CAT 212 or similar type); Back Filling Machine; Belt Placer (CMI type); Blacktop Plant (automated);Blacktop Roller; Bull Dozer being operated with active GPS; Cableway; Caisson Auger; Central Mix Concrete Plant (automated); Concrete Curb Machine (self-propelled, slipform); Concrete Pump; Cranes - listed in A1 that do not require a NYS Crane License; Directional Boring/Drilling Machine; Dredge; Dual Drum Paver; Excavator (all purpose-hydraulic, Gradall or similar); Front End Loader (4 cu. yd. & over); Head Tower (Sauerman or equal); Hoist (two or three drum); Holland Loader; Maintenance Engineer; Mine Hoist; Mucking Machine or Mole; Pavement Breaker (SP Wertgen; PB-4 and similar type); Profiler/Milling Machine (over 105 h.p.); Power Grader; Quad 9; Quarry Master (or equivalent); Rotating Telehandler; Scraper (including challenger type); Shovel; Side Boom; Slip Form Paver; Tractor Drawn Belt-Type Loader; Truck or Trailer Mounted Chipper (self-feeder); Tug Operator (manned rented equipment excluded); Tunnel Shovel.

CLASS B: Backhoe (tractor mounted, rubber tired); Bituminous Recycler Machine; Bituminous Spreader and Mixer; Blacktop Plant (non-automated); Blast or Rotary Drill (truck or tractor mounted); Boring Machine; Bridge Deck Finishing Machine; Brokk; Cage Hoist; Central Mix Plant (non-automated) and All Concrete Batching Plants; Concrete Paver (over 16'); Crawler Drill (self-contained); Crusher; Diesel Power Unit; Drill Rigs (truck or tractor mounted); Front End Loader (under 4 cu. yd.); Greaseman - Lubrication Engineer; HiPressure Boiler (15 lbs & over); Hoist (one drum); Hydro-Axe; Kolman Plant Loader & similar type loaders; Locomotive; Material Handling Knuckle Boom; Mini Excavators (under 18,000 lbs.); Mixer (for stabilized base, self-propelled); Monorail Machine; Profiler/Milling Machine (105 h.p. and under); Plant Engineer; Prentice Loader; Pug Mill; Pump Crete; Ready Mix Concrete Plant; Refrigeration Equipment (for soil stabilization); Road Widener; Roller (all above subgrade, See Class A for Blacktop Roller); Sea Mule; Self-contained ride-on Rock Drill (excluding Air-Track type drill); Skidder; Tractor with Dozer and/or Pusher; Trencher; Tugger Hoist; Vacuum Machine (mounted or towed); Vermeer Saws (ride-on, any size or type); Welder; Winch and Winch Cat; Work Boat Operator including L.C.M.'s.

CLASS C: "A" Frame Winch Hoist (On Truck); Aggregate Plant; Articulated Heavy Hauler; Asphalt or Concrete Grooving Machine (ride-on); Ballast Regulator (ride-on); Bituminous Heater (self-propelled); Boat (powered); Boiler (used in conjunction with production); Cement & Bin Operator; Compressors***; Concrete Pavement Spreader and Finisher; Concrete Paver or Mixer (16' & under); Concrete Saw (self-propelled); Conveyor; Deck Hand; Directional Boring/Drilling Machine Locator; Drill (Core); Drill (Well); Dust Collectors***; Electric Pump When Used in Conjunction with Well Point System; Farm Tractor with accessories; Fine Grade Machine; Fireman; Fork Lift; Form Tamper; Generators***; Grout Pump; Gunite Machine; Hammers (hydraulic self-propelled); Heaters***; Hydra-Spiker (ride-on); Hydraulic Pump (jacking system); Hydro-Blaster (water); Light Plants***; Mulching Machine; Oiler; Parapet Concrete or Pavement Grinder; Post Hole Digger (excluding hand-held); Post Driver; Power Broom (towed); Power Heaterman; Power Sweeper; Pumps***; Revinius Widener; Roller (subgrade & fill); Scarifier (ride-on); Shell Winder; Skid Steer Loader (Bobcat or similar, including all attachments); Span Saw (ride-on); Steam Cleaner; Tamper (ride-on); Tie Extractor (ride-on); Tie Handlers (ride-on); Tie Inserters (ride-on); Tie Spacers (ride-on); Tire Repair; Track Liner (ride-on); Tractor; Tractor (with towed accessories); Vacuum Machine (self-propelled); Vibratory Compactor; Vibro Tamp; Welding Machines***; Well Point.

***CLASS C NOTE: Considered Hands-Off (unmanned). Includes only operation and maintenance of the equipment.

Per hour: H/H	07/01/2024	07/01/2025
CLASS A1*	\$ 56.51	\$ 58.85
CLASS A	53.51	55.85
CLASS B	52.63	54.97
CLASS C	49.35	51.69

(*) **TONNAGE PREMIUMS:**

- All cranes up to 64 ton capacity - A1 rate
- All cranes 65 ton to 110 ton capacity - A1 rate plus \$ 1.50
- All cranes 111 ton to 199 ton capacity- A1 rate plus \$ 2.00
- All cranes 200 ton to 399 ton capacity - A1 rate plus \$ 3.00

All cranes 400 ton to 599 ton capacity - A1 rate plus \$ 4.00
All cranes 600 ton to 799 ton capacity - A1 rate plus \$ 5.00
All cranes 800 ton to 999 ton capacity - A1 rate plus \$ 6.00
All cranes 1000 ton capacity and over - A1 rate plus \$ 7.00

(**) Tower Cranes - A1 rate plus \$3.00 (no tonnage premiums apply)

- Cranes in Luffer Configuration - A1 rate plus \$ 5.00
- Cranes with external ballast (Tray or Wagon) - A1 rate plus \$ 5.00

Additional \$2.50 per hour for hazardous waste removal work on a State and/or Federally designated waste site which requires employees to wear Level C or above forms of personal protection.

SHIFT WORK

SINGLE IRREGULAR WORK SHIFT: Additional \$2.50 per hour for all employees who work a single irregular work shift starting from 5:00 PM to 1:00 AM that is mandated by the Contracting Agency.

SUPPLEMENTAL BENEFITS

Per hour:	07/01/2024	07/01/2025
Journeyworker	\$ 32.45	\$ 33.55

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6) on HOLIDAY PAGE
Overtime: See (5, 6) on HOLIDAY PAGE

NOTE: If a holiday falls on Sunday, it will be celebrated on Monday. If an employee works on this Monday, they shall be compensated at double time plus the holiday pay (triple time). If a holiday falls on a Saturday, employees who work a Saturday Holiday shall be paid double time plus the holiday pay.

REGISTERED APPRENTICES

WAGES per hour: One thousand hour terms at the following percentage of Journeyworker's CLASS B wage.

1st term	60%
2nd term	70%
3rd term	80%
4th Term	90%

Additional \$2.50 per hour for hazardous waste removal work on a State and/or Federally designated waste site which requires employees to wear Level C or above forms of personal protection.

SUPPLEMENTAL BENEFITS per hour: Same as Journeyworker

6-158-545h

Operating Engineer - Survey Crew

11/01/2024

JOB DESCRIPTION Operating Engineer - Survey Crew

DISTRICT 12

ENTIRE COUNTIES

Albany, Allegany, Broome, Cayuga, Chemung, Chenango, Clinton, Columbia, Cortland, Essex, Franklin, Fulton, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Oneida, Onondaga, Ontario, Oswego, Otsego, Rensselaer, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Tioga, Tompkins, Warren, Washington, Wayne, Yates

PARTIAL COUNTIES

Dutchess: The northern portion of the county from the northern boundary line of the City of Poughkeepsie, north.

Genesee: Only the portion of the county that lies east of a line down the center of Route 98 to include all area that lies within the City of Batavia.

WAGES

These rates apply to Building, Tunnel and Heavy Highway.

Per hour:

SURVEY CLASSIFICATIONS:

Party Chief - One who directs a survey party.

Instrument Person - One who operates the surveying instruments.

Rod Person - One who holds the rods and assists the Instrument Person.

07/01/2024

Party Chief	\$ 50,65
Instrument Person	46.54

Rod Person 34.55
Additional \$3.00/hr. for Tunnel Work
Additional \$2.50/hr. for Hazardous Work Site

SUPPLEMENTAL BENEFITS

Per hour worked:

Journeyman \$ 29.75

OVERTIME PAY

See (B, E, P, *X) on OVERTIME PAGE

*Note: \$25.10/Hr. Only for "ALL" premium hours paid when worked.

HOLIDAY

Paid: See (5, 6) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

WAGES: 1000 hour terms based on the Percentage of Rod Persons Wage:

07/01/2024

0-1000 60%
1001-2000 70%
2001-3000 80%

SUPPLEMENTAL BENEFIT per hour worked:

0-1000 \$ 21.53 / PHP \$18.45
1001-2000 24.55 / " 20.45
2001-3000 27.58/ " 22.93

NOTE: PHP is premium hours paid when worked.

12-158-545 D.H.H.

Operating Engineer - Survey Crew - Consulting Engineer

11/01/2024

JOB DESCRIPTION Operating Engineer - Survey Crew - Consulting Engineer

DISTRICT 12

ENTIRE COUNTIES

Albany, Allegany, Broome, Cayuga, Chemung, Chenango, Clinton, Columbia, Cortland, Essex, Franklin, Fulton, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Oneida, Onondaga, Ontario, Oswego, Otsego, Rensselaer, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Tioga, Tompkins, Warren, Washington, Wayne, Yates

PARTIAL COUNTIES

Dutchess: The northern portion of the county from the northern boundary line of the City of Poughkeepsie, north.

Genesee: Only the portion of the county that lies east of a line down the center of Route 98 to include all area that lies within the City of Batavia.

WAGES

These rates apply to feasibility and preliminary design surveying, line and grade surveying for inspection or supervision of construction when performed under a Consulting Engineer Agreement.

Per hour:

SURVEY CLASSIFICATIONS:

Party Chief - One who directs a survey party.

Instrument Person - One who operates the surveying instruments.

Rod Person - One who holds the rods and assists the Instrument Person.

07/01/2024

Party Chief \$ 50.65
Instrument Person 46.54
Rod Person 34.55

Additional \$3.00/hr. for Tunnel Work.

Additional \$2.50/hr. for EPA or DEC certified toxic or hazardous waste work.

SUPPLEMENTAL BENEFITS

Per hour worked:

Journeyman \$ 29.75

OVERTIME PAY

See (B, E, Q, *X) on OVERTIME PAGE

*Note: \$25.10/Hr. Only for "ALL" premium hours paid when worked.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

WAGES: 1000 hour terms based on percentage of Rod Persons Wage:

07/01/2024

0-1000	60%
1001-2000	70%
2001-3000	80%

SUPPLEMENTAL BENEFIT per hour worked:

0-1000	\$ 21.53 / PHP \$18.45
1001-2000	\$ 24.55 / " 20.45
2001-3000	\$ 26.98 / " 22.93

NOTE: PHP is premium hours paid when worked.

12-158-545 DCE

Operating Engineer - Tunnel

11/01/2024

JOB DESCRIPTION Operating Engineer - Tunnel

DISTRICT 7

ENTIRE COUNTIES

Albany, Allegany, Broome, Cayuga, Chemung, Chenango, Clinton, Columbia, Cortland, Essex, Franklin, Fulton, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Oneida, Onondaga, Ontario, Oswego, Otsego, Rensselaer, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Tioga, Tompkins, Warren, Washington, Wayne, Yates

PARTIAL COUNTIES

Dutchess: Northern part of Dutchess, to the northern boundary line of the City of Poughkeepie, then due east to Route 115 to Bedell Road, then east along Bedell Road to VanWagner Road, then north along VanWagner Road to Bower Road, then east along Bower Road to Rte. 44 east to Rte. 343, then along Rte. 343 east to the northern boundary of the Town of Dover Plains and east along the northern boundary of the Town of Dover Plains, to the borderline of the State of Connecticut.

Genesee: Only that portion of the county that lies east of a line drawn down the center of Route 98 and the entirety of the City of Batavia.

WAGES

CLASS A: Automatic Concrete Spreader (CMI Type); Automatic Fine Grader; Backhoe (except tractor mounted, rubber tired); Belt Placer (CMI Type); Blacktop Plant (automated); Cableway; Caisson Auger; Central Mix Concrete Plant (automated); Concrete Curb Machine (self-propelled slipform); Concrete Pump (8" or over); Dredge; Dual Drum Paver; Excavator; Front End Loader (4 cu. yd & over); Gradall; Head Tower (Sauerman or Equal); Hoist (shaft); Hoist (two or three Drum); Log Chipper/Loader (self-feeder); Maintenance Engineer (shaft and tunnel); any Mechanical Shaft Drill; Mine Hoist; Mining Machine(Mole and similar types); Mucking Machine or Mole; Overhead Crane (Gantry or Straddle Type); Pile Driver; Power Grader; Remote Controlled Mole or Tunnel Machine; Scraper; Shovel; Side Boom; Slip Form Paver (If a second man is needed, they shall be an Oiler); Tripper/Maintenance Engineer (shaft & tunnel); Tractor Drawn Belt-Type Loader; Tug Operator (manned rented equipment excluded); Tunnel Shovel.

CLASS B: Automated Central Mix Concrete Plant; Backhoe (topside); Backhoe (track mounted, rubber tired); Backhoe (topside); Bituminous Spreader and Mixer, Blacktop Plant (non-automated); Blast or Rotary Drill (truck or tractor mounted); Boring Machine; Cage Hoist; Central Mix Plant(non-automated); all Concrete Batching Plants; Compressors (4 or less exceeding 2,000 c.f.m. combined capacity); Concrete Pump; Crusher; Diesel Power Unit; Drill Rigs (tractor mounted); Front End Loader (under 4 cu. yd.); Grayco Epoxy Machine; Hoist (One Drum); Hoist (2 or 3 drum topside); Knuckle Boom material handler; Kolman Plant Loader & similar type Loaders (if employer requires another person to clean the screen or to maintain the equipment, they shall be an Oiler); L.C.M. Work Boat Operator; Locomotive; Maintenance Engineer (topside); Maintenance Grease Man; Mixer (for stabilized base-self-propelled); Monorail Machine; Plant Engineer; Personnel Hoist; Pump Crete; Ready Mix Concrete Plant; Refrigeration Equipment (for soil stabilization); Road Widener; Roller (all above sub-grade); Sea Mule; Shotcrete Machine; Shovel (topside); Tractor with Dozer and/or Pusher; Trencher; Tugger Hoist; Tunnel Locomotive; Vacuum Machine (mounted or towed); Welder; Winch; Winch Cat.

CLASS C: A Frame Truck; All Terrain Telescoping Material Handler; Ballast Regulator (ride-on); Compressors (4 not to exceed 2,000 c.f.m. combined capacity; or 3 or less with more than 1200 c.f.m. but not to exceed 2,000 c.f.m.); Compressors ((any size, but subject to other provisions for compressors), Dust Collectors, Generators, Pumps, Welding Machines, Light Plants (4 or any type combination)); Concrete Pavement Spreaders and Finishers; Conveyor; Drill (core); Drill (well); Electric Pump used in conjunction with Well Point System; Farm Tractor with Accessories; Fine Grade Machine; Fork Lift; Grout Pump (over 5 cu. ft.); Gunite Machine; Hammers (hydraulic-self-propelled); Hydra-Spiker (ride-on); Hydra-Blaster (water); Hydro-Blaster; Motorized Form Carrier; Post Hole Digger and Post Driver; Power Sweeper; Roller grade & fill); Scarifer (ride-on); Span-Saw (ride-on); Submersible Electric Pump (when used in lieu of well points); Tamper (ride-on); Tie-Extractor (ride-on), Tie Handler (ride-on), Tie Inserter (ride-on), Tie Spacer (ride-on); Track Liner (ride-on); Tractor with towed accessories; Vibratory Compactor; Vibro Tamp, Well Point.

CLASS D: Aggregate Plant; Cement & Bin Operator; Compressors (3 or less not to exceed 1,200 c.f.m. combined capacity); Compressors ((any size, but subject to other provisions for compressors), Dust Collectors, Generators, Pumps, Welding Machines, Light Plants (3 or less or any type or combination)); Concrete Saw (self-propelled); Form Tamper; Greaseman; Hydraulic Pump (jacking system); Junior Engineer; Light Plants; Mulching Machine; Oiler; Parapet Concrete or Pavement Grinder; Power Broom (towed); Power Heaterman (when used for production); Revinius Widener; Shell Winder; Steam Cleaner; Tractor.

Per hour:	07/01/2024	07/01/2025
CLASS A	\$ 55.91	\$ 58.44
CLASS B	54.69	57.22
CLASS C	51.90	54.43
CLASS D	48.89	51.42

Additional \$5.00 per hour for Hazardous Waste Work on a state or federally designated hazardous waste site where the Operating Engineer is in direct contact with hazardous material and when personal protective equipment is required for respiratory, skin and eye protection.

CRANES:

Crane 1: All cranes, including self-erecting.

Crane 2: All Lattice Boom Cranes and all cranes with a manufacturer's rating of fifty (50) ton and over.

Crane 3: All hydraulic cranes and derricks with a manufacturer's rating of forty nine (49) ton and below, including boom trucks.

Crane 1	\$ 59.91	\$ 62.44
Crane 2	58.91	61.44
Crane 3	57.91	60.44

SUPPLEMENTAL BENEFITS

Per hour:		
	\$ 25.05	\$ 25.90
	+ 9.85*	+ 10.10*

* This portion of benefits subject to same premium rate as shown for overtime wages.

OVERTIME PAY

See (B, B2, E, Q, X) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

NOTE: If a holiday falls on Sunday, it shall be observed on Monday.

REGISTERED APPRENTICES

WAGES:(1000) hours terms at the following percentage of Journeyworker's Class B wage.

1st term	60%
2nd term	65%
3rd term	70%
4th term	75%

SUPPLEMENTAL BENEFITS per hour: Same as Journeyworker

7-158-832TL.

Painter

11/01/2024

JOB DESCRIPTION Painter

DISTRICT 6

ENTIRE COUNTIES

Cayuga, Herkimer, Madison, Oneida, Onondaga, Seneca

PARTIAL COUNTIES

Lewis: Only the Townships of High Market, Lewis, Leyden, Lyonsdale, Osceola, Turin and West Turin.

Ontario: The City and Township of Geneva.

Oswego: Only the Townships of Amboy, Constantia, Williamstown and Oneida Lake.

WAGES

Per hour:	07/01/2024
Basic Rate (Brush & Roll)	\$ 27.27
Sign Painting	27.27
Lead Based Paint Abatement	27.27
Drywall Taper/ Finisher	28.02
Wallcovering	28.02
Drywall Machine Operator	28.52
Spray	27.77

Parking Lot, Hwy Striping	27.77
Epoxy (Brush-Roller)	27.77
Epoxy (Spray)	27.77
Sandblasting (Operator)	27.77
Boatswain Chair	27.77
Swing Scaffold	27.77
Structural Steel (except bridges,tanks,tunnel)	27.77
Coal Tar epoxy	28.77
Asbestos Encapsulation	29.47

NOTE - SEE BRIDGE PAINTER RATES FOR BRIDGES, TANKS, OR TUNNELS.

SHIFT WORK

FOR ANY SHIFT WHICH STARTS PRIOR TO 6:00 AM OR AFTER 3:00 PM, ALL EMPLOYEES WHO WORK A SINGLE IRREGULAR WORK SHIFT ON GOVERNMENTAL MANDATED WORK SHALL BE PAID AN ADDITIONAL \$2.00 PER HOUR ABOVE THE APPLICABLE WAGE SCALE.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker	\$ 26.53
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OVERTIME PAY

See (B, *F, R) on OVERTIME PAGE

* NOTE - On exterior work only, if work was missed during the week due to inclement weather, Saturday may be worked at straight time.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

NOTE: A holiday that falls on a Saturday will be celebrated on the preceding Friday. A holiday that falls on a Sunday will be celebrated on the following Monday.

REGISTERED APPRENTICES

WAGES per hour:

Painter/Decorator: 750 hour terms at the following wage rate:

1st	2nd	3rd	4th	5th	6th	7th	8th
\$ 18.00	\$ 18.50	\$ 19.00	\$ 19.50	\$ 20.00	\$ 21.00	\$ 22.00	\$ 23.00

Drywall Taper/ Finisher: 750 hour terms at the following wage rate:

1st	2nd	3rd	4th	5th	6th
\$ 20.00	\$ 20.50	\$ 21.00	\$ 21.50	\$ 22.00	\$ 23.00

SUPPLEMENTAL BENEFITS per hour:

Painter/Decorator:

1st	2nd	3rd	4th	5th	6th	7th	8th
\$ 6.50	\$ 6.50	\$ 7.50	\$ 7.50	\$ 10.50	\$ 10.50	\$ 13.00	\$ 13.00

Drywall Taper/ Finisher:

1st	2nd	3rd	4th	5th	6th
\$ 7.50	\$ 7.50	\$ 7.50	\$ 10.00	\$ 10.00	\$ 12.00

6-31

Painter

11/01/2024

JOB DESCRIPTION Painter

DISTRICT 3

ENTIRE COUNTIES

Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Cortland, Delaware, Erie, Genesee, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Niagara, Oneida, Onondaga, Ontario, Orleans, Oswego, Otsego, Schuyler, Seneca, St. Lawrence, Steuben, Tioga, Tompkins, Wayne, Wyoming, Yates

WAGES

Per hour: 07/01/2024

Bridge	\$ 43.81
Tunnel	43.81
Tank*	41.81

For Bridge Painting Contracts, ALL WORKERS on and off the bridge (including Flagmen) are to be paid Painter's Rate; the contract must be ONLY for Bridge Painting.

Tank rate applies to indoor and outdoor tanks, tank towers, standpipes, digesters, waste water treatment tanks, chlorinator tanks, etc. Covers all types of tanks including but not limited to steel tanks, concrete tanks, fiberglass tanks, etc.

SHIFT WORK

Note an additional \$1.50 per hour is required when the contracting agency or project specification requires any shift to start prior to 6:00am or after 12:00 noon.

SUPPLEMENTAL BENEFITS

Per hour:

\$ 31.39

OVERTIME PAY

Exterior work only See (B, E4, F*, R) on OVERTIME PAGE.

All other work See (B, F*, R) on OVERTIME PAGE.

*Note - Saturday is payable at straight time if the employee misses work, except where a doctor's or hospital verification of illness is produced Monday through Friday when work was available to the employee.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wages per hour:

750 hour terms at the following wage:

1st	2nd	3rd	4th	5th	6th
\$ 24.00	\$ 26.00	\$ 28.00	\$ 30.00	\$ 34.00	\$ 38.00

Supplemental benefits per hour:

1st	2nd	3rd	4th	5th	6th
\$ 6.60	\$ 6.95	\$ 7.30	\$ 7.65	\$ 8.00	\$ 8.35

3-4-Bridge, Tunnel, Tank

Painter - Metal Polisher

11/01/2024

JOB DESCRIPTION Painter - Metal Polisher

DISTRICT 8

ENTIRE COUNTIES

Albany, Allegany, Bronx, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Kings, Lewis, Livingston, Madison, Monroe, Montgomery, Nassau, New York, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Queens, Rensselaer, Richmond, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Suffolk, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Westchester, Wyoming, Yates

WAGES

	07/01/2024
Metal Polisher	\$ 39.33
Metal Polisher*	40.43
Metal Polisher**	43.33

*Note: Applies on New Construction & complete renovation

** Note: Applies when working on scaffolds over 34 feet.

SUPPLEMENTAL BENEFITS

Per Hour: 07/01/2024

Journeyworker:

All classification \$ 12.79

OVERTIME PAY

See (B, E, P, T) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6, 11, 15, 16, 25, 26) on HOLIDAY PAGE

Overtime: See (5, 6, 11, 15, 16, 25, 26) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wages per hour:

One (1) year term at the following wage rates:

07/01/2024

1st year	\$ 19.67
2nd year	21.63
3rd year	23.60

1st year* \$ 22.06

2nd year*	22.07
3rd year*	24.14
1st year**	\$ 22.17
2nd year**	24.13
3rd year**	26.10

*Note: Applies on New Construction & complete renovation
 ** Note: Applies when working on scaffolds over 34 feet.

Supplemental benefits:
 Per hour:

1st year	\$ 8.69
2nd year	8.69
3rd year	8.69

8-8A/28A-MP

Plumber **11/01/2024**

JOB DESCRIPTION Plumber **DISTRICT 7**

ENTIRE COUNTIES
 Herkimer, Oneida

PARTIAL COUNTIES

Hamilton: Only the Town of Inlet.
 Lewis: Towns of Lewis, Leyden, Lyonsdale, and West Turin.
 Madison: Towns of Brookfield, Eaton, Fenner, Hamilton, Lebanon, Lenox, Lincoln, Madison, Nelson, Oneida, Smithfield, and Stockbridge.
 Otsego: Towns of Cherry Valley, Exeter, Middlefield, Otsego, Plainfield, Richfield, Roseboom, and Springfield.

WAGES

Per hour:	07/01/2024	05/01/2025	05/01/2026
		Additional	Additional
Plumber	\$ 43.65	\$ 3.35*	\$ 3.45*
Steamfitter	43.65	3.35*	3.45*

*To be allocated at a later date

SHIFT WORK

Agency-mandated shift operations:

- Shift work shall start no earlier than 6AM Monday and will conclude no later than 9AM Saturday (overtime premiums applicable after 8 hours in a shift).
- Single irregular shiftwork, less than 3 consecutive days will be paid at the rate of time and one-half of the regular hourly rate.
- 3 consecutive work days or more:
 - First Shift - Regular hourly rate.
 - Second Shift - Regular hourly rate plus 12%.
 - Third Shift - Regular hourly rate plus 18%.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker	\$ 14.90
	+ 17.85**

** This portion of the benefit is subject to the SAME PREMIUM as shown for overtime on projects over \$100 million in total construction cost (including engineering & architecture).

OVERTIME PAY

See (B, E, Q, *V) on OVERTIME PAGE

*Portion of supplemental benefits subject to V code when project cost is over \$100 million (including engineering & architecture).

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
 Overtime: See (5, 6) on HOLIDAY PAGE

NOTE: If a holiday falls on Sunday, it will be observed the following day. If a holiday falls on Saturday, it will be observed that day unless so determined by the Federal Government to be celebrated on a different day.

REGISTERED APPRENTICES

WAGES: Yearly terms at the following percentages of Journeyworker's wage.

1st	2nd	3rd	4th	5th
-----	-----	-----	-----	-----

50% 55% 60% 70% 85%

SUPPLEMENTAL BENEFITS per hour:

1st Term: \$ 14.90
 + 8.35**

All others: \$ 14.90
 + 13.39**

** This portion of the benefit is subject to the SAME PREMIUM as shown for overtime on projects over \$100 million in total construction cost (including engineering & architecture).

7-112n-SF

Roofer

11/01/2024

JOB DESCRIPTION Roofer

DISTRICT 6

ENTIRE COUNTIES

Cayuga, Cortland, Franklin, Herkimer, Jefferson, Lewis, Madison, Oneida, Onondaga, Oswego, Seneca, St. Lawrence

WAGES

Per hour: 07/01/2024

Roofer, Waterproofer \$ 34.25

NOTE - Does not include metal roof flashings, gravel stop, or metal roofing; See Sheetmetal Worker wage schedule.

Additional per hour:

Green Roofing** \$ 0.25
 Pitch Removal & Appl. 1.50
 Asbestos Abatement 1.50

** Green Roofing is any component of green technology or living roof above the roof membrane including, but not limited to, the fabric, dirt and plantings.

SHIFT WORK

WHEN MANDATED BY THE OWNER OR CONTRACTING AGENCY, THERE IS AN ADDITIONAL PREMIUM OF \$4.00/HR FOR HOURS WORKED BEFORE 5:30AM AND AFTER 5:30PM.

SUPPLEMENTAL BENEFITS

Per hour:
 Journeyworker \$ 25.85

Additional contribution 0.75
 on any Asbestos Abatement work

OVERTIME PAY

See (B, E, E2*, Q) on OVERTIME PAGE

*NOTE - If a holiday falls in that week and 32 hours were worked, Saturday will be paid at 1 1/2 times the rate.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
 Overtime: See (5, 6) on HOLIDAY PAGE

NOTE: When any of these holidays falls on Sunday, the following day shall be observed as a holiday.

REGISTERED APPRENTICES

WAGES per hour: 1000 hour terms at the following percentage of the Journeyworker's wage:

1st term (0 to 999) 65%
 2nd term (1000 to 1999) 70%
 3rd term (2000 to 2999) 75%
 4th term (3000 to 3999) 85%

Additional per hour:

Green Roofing** \$ 0.25
 Pitch Removal & Appl. 1.50
 Asbestos Abatement 1.50

SUPPLEMENTAL BENEFITS per hour:

1st term \$ 19.48
 2nd term 21.40

3rd term	24.85
4th term	25.85
Additional contribution on any Asbestos Abatement work	\$ 0.75

6-195

Sheetmetal Worker **11/01/2024**

JOB DESCRIPTION Sheetmetal Worker **DISTRICT 6**

ENTIRE COUNTIES
 Cayuga, Chenango, Cortland, Herkimer, Jefferson, Lewis, Madison, Oneida, Onondaga, Oswego, St. Lawrence

WAGES

Per hour:	07/01/2024
Sheetmetal Worker:	
** (under \$10 million)	\$ 35.25
** (over \$10 million)	\$ 36.25

**For total cost of Sheetmetal contract only.

TO INCLUDE METAL ROOF FLASHINGS, GRAVEL STOP, AND METAL STANDING SEAM ROOFING.

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker	\$ 22.85
---------------	----------

OVERTIME PAY
 See (B, E, Q) on OVERTIME PAGE

HOLIDAY
 Paid: See (1) on HOLIDAY PAGE
 Overtime: See (5, 6) on HOLIDAY PAGE
 When any holiday falls on a Saturday, the Friday before such holiday shall be recognized as the legal holiday. Any holiday falling on Sunday, the following Monday shall be recognized as the legal holiday.

REGISTERED APPRENTICES
 WAGES per hour: One year terms at the following percentage of Journeyworker's wage.

1st	2nd	3rd	4th	5th
45%	55%	65%	75%	85%

SUPPLEMENTAL BENEFITS per hour:

1st	2nd	3rd	4th	5th
\$13.53	\$14.60	\$15.66	\$17.77	\$18.84

6-58

Sprinkler Fitter **11/01/2024**

JOB DESCRIPTION Sprinkler Fitter **DISTRICT 1**

ENTIRE COUNTIES
 Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orleans, Oswego, Otsego, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Tioga, Tompkins, Washington, Wayne, Wyoming, Yates

WAGES

Per hour	07/01/2024
Sprinkler Fitter	\$ 42.00

SUPPLEMENTAL BENEFITS

Per hour

Journeyworker	\$ 28.82
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OVERTIME PAY
 See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
 Overtime: See (5, 6) on HOLIDAY PAGE

Note: When a holiday falls on Sunday, the following Monday shall be considered a holiday and all work performed on either day shall be at the double time rate. When a holiday falls on Saturday, the preceding Friday shall be considered a holiday and all work performed on either day shall be at the double time rate.

REGISTERED APPRENTICES

Wages per hour

One Half Year terms at the following wage.

1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
\$ 20.03	\$ 22.26	\$ 24.24	\$ 26.46	\$ 28.69	\$ 30.91	\$ 33.14	\$ 35.37	\$ 37.59	\$ 39.82

Supplemental Benefits per hour

1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
\$ 9.18	\$ 9.18	\$ 20.90	\$ 20.90	\$ 21.15	\$ 21.15	\$ 21.15	\$ 21.15	\$ 21.15	\$ 21.15

1-669

Teamster - Building **11/01/2024**

JOB DESCRIPTION Teamster - Building

DISTRICT 1

ENTIRE COUNTIES

Hamilton, Herkimer, Oneida

PARTIAL COUNTIES

Chenango: Entire county except the Townships of Afton, Bainbridge, Coventry, Greene, Guilford, Oxford and Smithville.

Lewis: Only the Township of Grieg, Lewis, Leyden, Lowville, Lyonsdale, Martinsburg, Turin, West Turin and Watson.

Madison: Only the Townships of Brookfield, Eaton, Hamilton, Lebanon, Lincoln, Madison, Smithfield, Stockbridge and the City of Oneida

Otsego: Entire county EXCEPT Townships of Butternuts, Laurens, Maryland, Milford, Morris, Oneonta, Otego, Unidilla and Worcester.

WAGES

GROUP # A:

Straight trucks, winch, transit mix on the site, road oilers, dump trucks, pick-ups, panel, water trucks, fuel trucks on the site (including nozzle).

GROUP # B:

Low boy or Low boy trailer, Euclids or similar equipment.

WAGES per hour

	07/01/2024	07/01/2025
Group A	\$ 31.44	\$ 34.65
Group B	31.74	34.95

SUPPLEMENTAL BENEFITS

Per hour

Journeyworker	\$ 28.58	\$ 29.56
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OVERTIME PAY

See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE

Overtime: See (5, 6) on HOLIDAY PAGE

Note: Any holiday which occurs on Sunday shall be observed the following Monday.

1-294z2

Teamster - Heavy&Highway **11/01/2024**

JOB DESCRIPTION Teamster - Heavy&Highway

DISTRICT 1

ENTIRE COUNTIES

Albany, Columbia, Fulton, Greene, Hamilton, Herkimer, Montgomery, Oneida, Rensselaer, Saratoga, Schenectady, Schoharie, Washington

PARTIAL COUNTIES

Chenango: Entire county except the Townships of Afton, Bainbridge, Coventry, Greene, Guilford, Oxford and Smithville.

Lewis: Only the Township of Grieg, Lewis, Leyden, Lowville, Lyonsdale, Martinsburg, Turin, West Turin and Watson.

Madison: Only the Townships of Brookfield, Eaton, Hamilton, Lebanon, Lincoln, Madison, Smithfield, Stockbridge and the City of Oneida

Otsego: Entire county EXCEPT Townships of Butternuts, Laurens, Maryland, Milford, Morris, Oneonta, Otego, Unidilla and Worcester.

Warren: Only the Townships of Bolton, Warrensburg, Thurman, Stony Creek, Luzerne, Caldwell (Lake George), and Queensbury.

WAGES

GROUP #1:

Warehousemen, Yardmen, Truck Helpers, Pickups, Panel Trucks, Flatboy Material Trucks(straight jobs), Single Axel Dump Trucks, Dumpsters, Material Checkers and Receivers, Greasers, Truck Tiremen, Mechanics Helpers and Parts Chasers.

GROUP #2:

Tandems and Batch Trucks, Mechanics, Dispatcher.

GROUP #3:

Semi-Trailers, Low-boy Trucks, Asphalt Distributor Trucks, and Agitator, Mixer Trucks and dumpcrete type vehicles, Truck Mechanic, Fuel Trucks.

GROUP #4:

Specialized Earth Moving Equipment, Euclid type, or similar off-highway, where not self-loading, Straddle (Ross) Carrier, and self-contained concrete mobile truck.

GROUP #5:

Off-highway Tandem Back-Dump, Twin Engine Equipment and Double-Hitched Equipment where not self-loading.

WAGES per hour 07/01/2024

Group #1	\$ 39.75
Group #2	39.81
Group #3	39.90
Group #4	40.03
Group #5	40.19

Hazardous waste projects that require a Level C or greater protection shall be paid an additional \$ 1.00 per hour.

SHIFT WORK

All employees who work a single irregular work shift starting between 5pm and 1 am on governmental mandated night shifts shall be paid an additional \$1.50 per hour.

SUPPLEMENTAL BENEFITS

Per hour:

\$ 28.97
+\$1.00 per*
hour worked

(*) not applicable to paid holidays

OVERTIME PAY

See (B, E, Q) on OVERTIME PAGE

HOLIDAY

Paid: See (5, 6) on HOLIDAY PAGE
Overtime: See (5, 6) on HOLIDAY PAGE

1-294h/h

Welder

11/01/2024

JOB DESCRIPTION Welder

DISTRICT 1

ENTIRE COUNTIES

Albany, Allegany, Bronx, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Kings, Lewis, Livingston, Madison, Monroe, Montgomery, Nassau, New York, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Queens, Rensselaer, Richmond, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Suffolk, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Westchester, Wyoming, Yates

WAGES

Per hour 07/01/2024

Welder: To be paid the same rate of the mechanic performing the work.*

*EXCEPTION: If a specific welder certification is required, then the 'Certified Welder' rate in that trade tag will be paid.

OVERTIME PAY

HOLIDAY

1-As Per Trade

Overtime Codes

Following is an explanation of the code(s) listed in the OVERTIME section of each classification contained in the attached schedule. Additional requirements may also be listed in the HOLIDAY section.

NOTE: Supplemental Benefits are 'Per hour worked' (for each hour worked) unless otherwise noted

- (AA) Time and one half of the hourly rate after 7 and one half hours per day
- (A) Time and one half of the hourly rate after 7 hours per day
- (B) Time and one half of the hourly rate after 8 hours per day
- (B1) Time and one half of the hourly rate for the 9th & 10th hours week days and the 1st 8 hours on Saturday.
Double the hourly rate for all additional hours
- (B2) Time and one half of the hourly rate after 40 hours per week
- (C) Double the hourly rate after 7 hours per day
- (C1) Double the hourly rate after 7 and one half hours per day
- (D) Double the hourly rate after 8 hours per day
- (D1) Double the hourly rate after 9 hours per day
- (E) Time and one half of the hourly rate on Saturday
- (E1) Time and one half 1st 4 hours on Saturday; Double the hourly rate all additional Saturday hours
- (E2) Saturday may be used as a make-up day at straight time when a day is lost during that week due to inclement weather
- (E3) Between November 1st and March 3rd Saturday may be used as a make-up day at straight time when a day is lost during that week due to inclement weather, provided a given employee has worked between 16 and 32 hours that week
- (E4) Saturday and Sunday may be used as a make-up day at straight time when a day is lost during that week due to inclement weather
- (E5) Double time after 8 hours on Saturdays
- (F) Time and one half of the hourly rate on Saturday and Sunday
- (G) Time and one half of the hourly rate on Saturday and Holidays
- (H) Time and one half of the hourly rate on Saturday, Sunday, and Holidays
- (I) Time and one half of the hourly rate on Sunday
- (J) Time and one half of the hourly rate on Sunday and Holidays
- (K) Time and one half of the hourly rate on Holidays
- (L) Double the hourly rate on Saturday
- (M) Double the hourly rate on Saturday and Sunday
- (N) Double the hourly rate on Saturday and Holidays
- (O) Double the hourly rate on Saturday, Sunday, and Holidays
- (P) Double the hourly rate on Sunday
- (Q) Double the hourly rate on Sunday and Holidays
- (R) Double the hourly rate on Holidays
- (S) Two and one half times the hourly rate for Holidays

- (S1) Two and one half times the hourly rate the first 8 hours on Sunday or Holidays One and one half times the hourly rate all additional hours.
- (T) Triple the hourly rate for Holidays
- (U) Four times the hourly rate for Holidays
- (V) Including benefits at SAME PREMIUM as shown for overtime
- (W) Time and one half for benefits on all overtime hours.
- (X) Benefits payable on Paid Holiday at straight time. If worked, additional benefit amount will be required for worked hours. (Refer to other codes listed.)

Holiday Codes

PAID Holidays:

Paid Holidays are days for which an eligible employee receives a regular day's pay, but is not required to perform work. If an employee works on a day listed as a paid holiday, this remuneration is in addition to payment of the required prevailing rate for the work actually performed.

OVERTIME Holiday Pay:

Overtime holiday pay is the premium pay that is required for work performed on specified holidays. It is only required where the employee actually performs work on such holidays. The applicable holidays are listed under HOLIDAYS: OVERTIME. The required rate of pay for these covered holidays can be found in the OVERTIME PAY section listings for each classification.

Following is an explanation of the code(s) listed in the HOLIDAY section of each classification contained in the attached schedule. The Holidays as listed below are to be paid at the wage rates at which the employee is normally classified.

- (1) None
- (2) Labor Day
- (3) Memorial Day and Labor Day
- (4) Memorial Day and July 4th
- (5) Memorial Day, July 4th, and Labor Day
- (6) New Year's, Thanksgiving, and Christmas
- (7) Lincoln's Birthday, Washington's Birthday, and Veterans Day
- (8) Good Friday
- (9) Lincoln's Birthday
- (10) Washington's Birthday
- (11) Columbus Day
- (12) Election Day
- (13) Presidential Election Day
- (14) 1/2 Day on Presidential Election Day
- (15) Veterans Day
- (16) Day after Thanksgiving
- (17) July 4th
- (18) 1/2 Day before Christmas
- (19) 1/2 Day before New Years
- (20) Thanksgiving
- (21) New Year's Day
- (22) Christmas
- (23) Day before Christmas
- (24) Day before New Year's
- (25) Presidents' Day
- (26) Martin Luther King, Jr. Day
- (27) Memorial Day
- (28) Easter Sunday

(29) Juneteenth

**New York State Department of Labor - Bureau of Public Work
State Office Building Campus
Building 12 - Room 130
Albany, New York 12226**

REQUEST FOR WAGE AND SUPPLEMENT INFORMATION

As Required by Articles 8 and 9 of the NYS Labor Law

Fax (518) 485-1870 or mail this form for new schedules or for determination for additional occupations.

This Form Must Be Typed

Submitted By:

(Check Only One)

Contracting Agency

Architect or Engineering Firm

Public Work District Office

Date:

A. Public Work Contract to be let by: (Enter Data Pertaining to Contracting/Public Agency)

1. Name and complete address (Check if new or change)

Telephone

Fax

E-Mail:

2. NY State Units (see Item 5).

01 DOT

02 OGS

03 Dormitory Authority

04 State University
Construction Fund

05 Mental Hygiene
Facilities Corp.

06 OTHER N.Y. STATE UNIT

07 City

08 Local School District

09 Special Local District, i.e.,
Fire, Sewer, Water District

10 Village

11 Town

12 County

13 Other Non-N.Y. State
(Describe)

3. SEND REPLY TO (check if new or change)
Name and complete address:

Telephone

Fax

E-Mail:

4. SERVICE REQUIRED. Check appropriate box and provide project information.

New Schedule of Wages and Supplements.

APPROXIMATE BID DATE :

Additional Occupation and/or Redetermination

PRC NUMBER ISSUED PREVIOUSLY FOR
THIS PROJECT :

OFFICE USE ONLY

B. PROJECT PARTICULARS

5. Project Title _____

Description of Work _____

Contract Identification Number _____

Note: For NYS units, the OSC Contract No. _____

6. Location of Project:

Location on Site _____

Route No/Street Address _____

Village or City _____

Town _____

County _____

7. Nature of Project - Check One:

1. New Building
2. Addition to Existing Structure
3. Heavy and Highway Construction (New and Repair)
4. New Sewer or Waterline
5. Other New Construction (Explain)
6. Other Reconstruction, Maintenance, Repair or Alteration
7. Demolition
8. Building Service Contract

8. OCCUPATION FOR PROJECT :

- Construction (Building, Heavy
Highway/Sewer/Water)
- Tunnel
- Residential
- Landscape Maintenance
- Elevator maintenance
- Exterminators, Fumigators
- Fire Safety Director, NYC Only
- Fuel Delivery
- Guards, Watchmen
- Janitors, Porters, Cleaners,
Elevator Operators
- Moving furniture and
equipment
- Trash and refuse removal
- Window cleaners
- Other (Describe)

9. Does this project comply with the Wicks Law involving separate bidding? YES NO

10. Name and Title of Requester

Signature



NEW YORK STATE DEPARTMENT OF LABOR
Bureau of Public Work - Debarment List

**LIST OF EMPLOYERS INELIGIBLE TO BID ON OR BE
AWARDED ANY PUBLIC WORK CONTRACT**

Under Article 8 and Article 9 of the NYS Labor Law, a contractor, sub-contractor and/or its successor shall be debarred and ineligible to submit a bid on or be awarded any public work or public building service contract/sub-contract with the state, any municipal corporation or public body for a period of five (5) years from the date of debarment when:

- Two (2) final determinations have been rendered within any consecutive six-year (6) period determining that such contractor, sub-contractor and/or its successor has WILLFULLY failed to pay the prevailing wage and/or supplements;
- One (1) final determination involves falsification of payroll records or the kickback of wages and/or supplements.

The agency issuing the determination and providing the information, is denoted under the heading 'Fiscal Officer'. DOL = New York State Department of Labor; NYC = New York City Comptroller's Office; AG = New York State Attorney General's Office; DA = County District Attorney's Office.

Debarment Database: To search for contractors, sub-contractors and/or their successors debarred from bidding or being awarded any public work contract or subcontract under NYS Labor Law Articles 8 and 9, or under NYS Workers' Compensation Law Section 141-b, access the database at this link: <https://apps.labor.ny.gov/EDList/searchPage.do>

For inquiries please call 518-457-5589.

NYSDOL Bureau of Public Work Debarment List 11/01/2024

Article 8

AGENCY	Fiscal Officer	FEIN	EMPLOYER NAME	EMPLOYER DBA NAME	ADDRESS	DEBARMENT START DATE	DEBARMENT END DATE
DOL	DOL	****5754	0369 CONTRACTORS, LLC		515 WEST AVE UNIT PH 13NORWALK CT 06850	05/12/2021	05/12/2026
DOL	DOL	****5784	A.J.M. TRUCKING, INC.		PO BOX 2064 MONROE NY 10950	02/12/2024	02/12/2029
DOL	DOL		AKHLAQ OULAKH		4307 28TH AVE ASTORIA NY 11103	10/11/2024	10/11/2029
DOL	NYC		ALL COUNTY SEWER & DRAIN, INC.		7 GREENFIELD DR WARWICK NY 10990	03/25/2022	03/25/2027
DOL	DOL	****8387	AMERICAN PAVING & MASONRY, CORP.		8 FOREST AVE GLEN COVE NY 11542	05/24/2024	05/24/2029
DOL	DOL	****8654	AMERICAN PAVING, INC.		8 FORREST AVE. GLEN COVE NY 11542	05/24/2024	05/24/2029
DOL	NYC		AMJED PARVEZ		401 HANOVER AVENUE STATEN ISLAND NY 10304	01/11/2021	01/11/2026
DOL	DOL		ANGELO F COKER		2610 SOUTH SALINA STREET SUITE 14SYRACUSE NY 13205	09/17/2020	09/17/2025
DOL	DOL		ANGELO GARCIA		515 WEST AVE UNIT PH 13NORWALK CT 06850	05/12/2021	05/12/2026
DOL	DOL		ANGELO STANCO		8 FOREST AVE. GLEN COVE NY 11542	05/24/2024	05/24/2029
DOL	DOL		ANGELO TONDO		449 WEST MOMBSHA ROAD MONROE NY 10950	06/06/2022	06/06/2027
DOL	DOL	****4231	ANKER'S ELECTRIC SERVICE, INC.		10 SOUTH 5TH ST LOCUST VALLEY NY 11560	09/26/2022	09/26/2027
DOL	DOL		ANTHONY MONGELLI		PO BOX 2064 MONROE NY 10950	02/12/2024	02/12/2029
DOL	NYC		ARADCO CONSTRUCTION CORP		115-46 132RD ST SOUTH OZONE PARK NY 11420	09/17/2020	09/17/2025
DOL	DOL		ARNOLD A. PAOLINI		1250 BROADWAY ST BUFFALO NY 14212	02/03/2020	02/03/2025
DOL	NYC		ARSHAD MEHMOOD		168-42 88TH AVENUE JAMAICA NY 11432	11/20/2019	11/20/2024
DOL	NYC		AVM CONSTRUCTION CORP		117-72 123RD ST SOUTH OZONE PARK NY 11420	09/17/2020	09/17/2025
DOL	NYC		AZIDABEGUM		524 MCDONALD AVENUE BROOKLYN NY 11218	09/17/2020	09/17/2025
DOL	DOL	****8421	B & B DRYWALL, INC		206 WARREN AVE APT 1WHITE PLAINS NY 10603	12/14/2021	12/14/2026
DOL	DOL		B&L RENOVATION CO.		618 OCEAN PARKWAY APT A6BROOKLYN NY 11230	09/17/2020	09/17/2025
DOL	DOL		BERNARD BEGLEY		38 LONG RIDGE ROAD BEDFORD NY 10506	12/18/2019	12/18/2024
DOL	NYC	****2113	BHW CONTRACTING, INC.		401 HANOVER AVENUE STATEN ISLAND NY 10304	01/11/2021	01/11/2026
DOL	DOL	****3627	BJB CONSTRUCTION CORP.		38 LONG RIDGE ROAD BEDFORD NY 10506	12/18/2019	12/18/2024
DOL	DOL	****5078	BLACK RIVER TREE REMOVAL, LLC		29807 ANDREWS ROAD BLACK RIVER NY 13032	10/17/2023	10/17/2028
DOL	DOL		BRADLEY J SCHUKA		4 BROTHERS ROAD WAPPINGERS FALLS NY 12590	10/20/2020	10/20/2025
DOL	DOL	****9383	C.C. PAVING AND EXCAVATING, INC.		2610 SOUTH SALINA ST SUITE 12SYRACUSE NY 13205	09/17/2020	09/17/2025
DOL	DOL	****4083	C.P.D. ENTERPRISES, INC		P.O BOX 281 WALDEN NY 12586	03/03/2020	03/03/2025
DOL	DOL	****5161	CALADRI DEVELOPMENT CORP.		1223 PARK ST. PEEKSKILL NY 10566	05/17/2021	05/17/2026
DOL	DOL	****3391	CALI ENTERPRISES, INC.		1223 PARK STREET PEEKSKILL NY 10566	05/17/2021	05/17/2026
DOL	DOL	****4155	CASA BUILDERS, INC.	FRIEDLANDER CONSTRUCTI ON	64 N PUTT CONNERS ROAD NEW PALTZ NY 12561	05/10/2023	05/10/2028
DOL	AG	****7247	CENTURY CONCRETE CORP		2375 RAYNOR ST RONKONKOMA NY 11779	08/04/2021	08/04/2026
DOL	DOL	****0026	CHANTICLEER CONSTRUCTION LLC		4 BROTHERS ROAD WAPPINGERS FALLS NY 12590	10/20/2020	10/20/2025
DOL	NYC	****2117	CHARAN ELECTRICAL ENTERPRISES		9-11 40TH AVENUE LONG ISLAND CITY NY 11101	09/26/2023	09/26/2028
DOL	NYC		CHARLES ZAHRADKA		863 WASHINGTON STREET FRANKLIN SQUARE NY 11010	03/10/2020	03/10/2025

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DOL	DOL		CHRISTOPHER GRECO		26 NORTH MYRTLE AVENUE SPRING VALLEY NY 10956	02/18/2021	02/18/2026
DOL	DOL	****2281	CORRAO TRUCKING, INC.		PO BOX 393 NANUET NY 10954	09/17/2024	09/17/2029
DOL	DOL		CRAIG JOHANSEN		10 SOUTH 5TH ST LOCUST VALLEY NY 11560	09/26/2022	09/26/2027
DOL	DOL	****3228	CROSS-COUNTY LANDSCAPING AND TREE SERVICE, INC.	ROCKLAND TREE SERVICE	26 NORTH MYRTLE AVENUE SPRING VALLEY NY 10956	02/18/2021	02/18/2026
DOL	DOL	****7619	DANCO CONSTRUCTION UNLIMITED INC.		485 RAFT AVENUE HOLBROOK NY 11741	10/19/2021	10/19/2026
DOL	DOL		DANIEL ROBERT MCNALLY		7 GREENFIELD DRIVE WARWICK NY 10990	03/25/2022	03/25/2027
DOL	DOL		DARIAN L COKER		2610 SOUTH SALINA ST SUITE 2CSYRACUSE NY 13205	09/17/2020	09/17/2025
DOL	DOL		DARWIN PEQUESE		6400 BALTIMORE NATIONAL SUITE 602CANTONVILLE NY 21228	10/24/2024	10/24/2029
DOL	DOL		DAVID FRIEDLANDER		64 NORTH PUTT CORNERS RD NEW PALTZ NY 12561	05/10/2023	05/10/2028
DOL	NYC		DAVID WEINER		14 NEW DROP LANE 2ND FLOORSTATEN ISLAND NY 10306	11/14/2019	11/14/2024
DOL	DOL		DINA TAYLOR		64 N PUTT CONNERS RD NEW PALTZ NY 12561	05/10/2023	05/10/2028
DOL	DOL	****5175	EAGLE MECHANICAL AND GENERAL CONSTRUCTION LLC		11371 RIDGE RD WOLCOTT NY 14590	02/03/2020	02/03/2025
DOL	AG		EDWIN HUTZLER		23 NORTH HOWELLS RD BELLPORT NY 11713	08/04/2021	08/04/2026
DOL	DA		EDWIN HUTZLER		2375 RAYNOR STREET RONKONKOMA NY 11779	08/04/2021	08/04/2026
DOL	DOL	****0780	EMES HEATING & PLUMBING CONTR		5 EMES LANE MONSEY NY 10952	01/20/2002	01/20/3002
DOL	DOL		EMIL KISZKO		84 DIAMOND ST BROOKLYN NY 11222	07/18/2024	07/18/2029
DOL	DOL	****3298	EMJACK CONSTRUCTION CORP.		84 DIAMOND ST BROOKLYN NY 11222	07/18/2024	07/18/2029
DOL	DOL	****3298	EMJACK CONSTRUCTION LLC		4192 SIR ANDREW CIRCLE DOYLESTOWN PA 18902	07/18/2024	07/18/2029
DOL	DOL		EUGENIUSZ "GINO" KUCHAR		195 KINGSLAND AVE BROOKLYN NY 11222	12/22/2023	12/22/2028
DOL	DA		FREDERICK HUTZLER		2375 RAYNOR STREET RONKONKOMA NY 11779	08/04/2021	08/04/2026
DOL	NYC	****6616	G & G MECHANICAL ENTERPRISES, LLC.		1936 HEMPSTEAD TURNPIKE EAST MEDOW NY 11554	11/29/2019	11/29/2024
DOL	DOL	****2998	G.E.M. AMERICAN CONSTRUCTION CORP.		195 KINGSLAND AVE BROOKLYN NY 11222	12/22/2023	12/22/2028
DOL	NYC		GAYATRI MANGRU		21 DAREWOOD LANE VALLEY STREAM NY 11581	09/17/2020	09/17/2025
DOL	DA		GEORGE LUCEY		150 KINGS STREET BROOKLYN NY 11231	01/19/1998	01/19/2998
DOL	DA		GIOVANNA TRAVALJA		3735 9TH ST LONG ISLAND CITY NY 11101	01/05/2023	01/05/2028
DOL	DA		GIOVANNI NAPOLITANO		2501 BAYVIEW AVENUE WANTAGH NY 11793	02/21/2024	02/21/2029
DOL	DA	****0213	GORILLA CONTRACTING GROUP, LLC		505 MANHATTAN AVE WEST BABYLON NY 11704	10/05/2023	10/05/2028
DOL	DA	****4760	GTX CONSTRUCTION ASSOCIATES, CORP		2501 BAYVIEW AVE WANTAGH NY 11793	02/21/2024	02/21/2029
DOL	DOL		HANS RATH		24 ELDOR AVENUE NEW CITY NY 10956	02/03/2020	02/03/2025
DOL	DOL		HERBERT CLEMEN		42 FOWLER AVENUE CORTLAND MANOR NY 10567	01/24/2023	01/24/2028
DOL	DOL		HERBERT CLEMEN		42 FOWLER AVENUE CORTLAND MANOR NY 10567	10/25/2022	10/25/2027
DOL	DOL	****2397	ISLAND BREEZE MARINE, INC.		6400 BALTIMORE NATIONAL CANTONVILLE MD 21228	10/24/2024	10/24/2029
DOL	DOL	****9211	J. WASE CONSTRUCTION CORP.		8545 RT 9W ATHENS NY 12015	03/09/2021	03/09/2026
DOL	DOL		J.M.J CONSTRUCTION		151 OSTRANDER AVENUE SYRACUSE NY 13205	11/21/2022	11/21/2027
DOL	DOL		J.R. NELSON CONSTRUCTION		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028

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DOL	DOL		J.R. NELSON CONSTRUCTION		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		J.R. NELSON CONSTRUCTION		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		J.R. NELSON, LLC		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		J.R. NELSON, LLC		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL		J.R. NELSON, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		J.R.N COMPANIES, LLC		531 THIRD STREET ALBANY NY 12206	12/12/2022	12/12/2027
DOL	DOL		J.R.N COMPANIES, LLC		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL		J.R.N COMPANIES, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL	*****1147	J.R.N. CONSTRUCTION, LLC		531 THIRD ST ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL	*****1147	J.R.N. CONSTRUCTION, LLC		531 THIRD ST ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL	*****1147	J.R.N. CONSTRUCTION, LLC		531 THIRD ST ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		JAMES J. BAKER		7901 GEE ROAD CANASTOTA NY 13032	08/17/2021	08/17/2026
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	09/29/2021	09/29/2026
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	02/09/2022	02/09/2027
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	11/15/2022	11/15/2027
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL	*****7993	JBS DIRT, INC.		7901 GEE ROAD CANASTOTA NY 13032	08/17/2021	08/17/2026
DOL	DOL	*****2435	JEFFEL D. JOHNSON	JMJ7 AND SON	5553 CAIRNSTRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JEFFEL JOHNSON ELITE CARPENTER REMODEL AND CONSTRUCTION		C2 EVERGREEN CIRCLE LIVERPOOL NY 13090	11/21/2022	11/21/2027
DOL	DOL	*****2435	JEFFREY M. JOHNSON	JMJ7 AND SON	5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	NYC		JENNIFER GUERRERO		1936 HEMPSTEAD TURNPIKE EAST MEADOW NY 11554	11/29/2019	11/29/2024
DOL	DOL		JIM PLAUGHER		17613 SANTE FE LINE ROAD WAYNEFIELD OH 45896	07/16/2021	07/16/2026
DOL	DOL		JMJ7 & SON CONSTRUCTION, LLC		5553 CAIRNS TRAIL LIVERPOOL NY 13041	11/21/2022	11/21/2027
DOL	DOL		JMJ7 AND SONS CONTRACTORS		5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JMJ7 CONTRACTORS		7014 13TH AVENUE BROOKLYN NY 11228	11/21/2022	11/21/2027
DOL	DOL		JMJ7 CONTRACTORS AND SONS		5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JMJ7 CONTRACTORS, LLC		5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JOHN GOCEK		14B COMMERCIAL AVE ALBANY NY 12065	11/14/2019	11/14/2024
DOL	DOL		JOHN MARKOVIC		47 MANDON TERRACE HAWTHORN NJ 07506	03/29/2021	03/29/2026
DOL	DOL		JOHN WASE		8545 RT 9W ATHENS NY 12015	03/09/2021	03/09/2026
DOL	DOL		JORGE RAMOS		8970 MIKE GARCIA DR MANASSAS VA 20109	07/16/2021	07/16/2026
DOL	DOL		JOSEPH K. SALERNO		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	DOL		JOSEPH K. SALERNO II		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	02/09/2022	02/09/2027
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	11/15/2022	11/15/2027
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	09/29/2021	09/29/2026
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027

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DOL	DOL	****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL		JRN CONSTRUCTION CO, LLC		1024 BROADWAY ALBANY NY 12204	11/07/2023	11/07/2028
DOL	DOL	****1147	JRN CONSTRUCTION, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL	****1147	JRN CONSTRUCTION, LLC		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL	****1147	JRN CONSTRUCTION, LLC		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL		JRN PAVING, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		JRN PAVING, LLC		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		JRN PAVING, LLC		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL		JULIUS AND GITA BEHREND		5 EMES LANE MONSEY NY 10952	11/20/2002	11/20/3002
DOL	DOL		KARIN MANGIN		796 PHELPS ROAD FRANKLIN LAKES NJ 07417	12/01/2020	12/01/2025
DOL	DOL		KATE E. CONNOR		7088 INTERSTATE ISLAND RD SYRACUSE NY 13209	03/31/2021	03/31/2026
DOL	DOL		KEAN INDUSTRIES, LLC		2345 RT. 52 SUITE 2NHOPEWELL JUNCTION NY 12533	12/18/2023	12/18/2028
DOL	DOL	****2959	KELC DEVELOPMENT, INC		7088 INTERSTATE ISLAND RD SYRACUSE NY 13209	03/31/2021	03/31/2026
DOL	DOL		KIMBERLY F. BAKER		7901 GEE ROAD CANASTOTA NY 13032	08/17/2021	08/17/2026
DOL	DOL		KMA GROUP II, INC.		29-10 38TH AVENUE LONG ISLAND CITY NY 11101	10/11/2023	10/11/2028
DOL	DOL	****1833	KMA GROUP INC.		29-10 38TH AVENUE LONG ISLAND CITY NY 11101	10/11/2023	10/11/2028
DOL	DOL		KMA INSULATION, INC.		29-10 38TH AVENUE LONG ISLAND CITY NY 11101	10/11/2023	10/11/2028
DOL	DOL		KRIN HEINEMANN		2345 ROUTE 52, SUITE 2N HOPEWELL JUNCTION NY 12533	12/18/2023	12/18/2028
DOL	NYC		KULWANT S. DEOL		9-11 40TH AVENUE LONG ISLAND CITY NY 11101	09/26/2023	09/26/2028
DOL	DA	****8816	LAKE CONSTRUCTION AND DEVELOPMENT CORPORATION		150 KINGS STREET BROOKLYN NY 11231	08/19/1998	08/19/2998
DOL	DOL		LEROY E. NELSON JR		531 THIRD ST ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		LEROY E. NELSON JR		531 THIRD ST ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		LEROY E. NELSON JR		531 THIRD ST ALBANY NY 12206	11/07/2023	11/07/2028
DOL	AG	****3291	LINTECH ELECTRIC, INC.		3006 TILDEN AVE BROOKLYN NY 11226	02/16/2022	02/16/2027
DOL	DOL		LOUIS A. CALICCHIA		1223 PARK ST. PEEKSKILL NY 10566	05/17/2021	05/17/2026
DOL	NYC		LUBOMIR PETER SVOBODA		27 HOUSMAN AVE STATEN ISLAND NY 10303	12/26/2019	12/26/2024
DOL	NYC		M & L STEEL & ORNAMENTAL IRON CORP.		27 HOUSMAN AVE STATEN ISLAND NY 10303	12/26/2019	12/26/2024
DOL	DOL	****2196	MAINSTREAM SPECIALTIES, INC.		11 OLD TOWN RD SELKIRK NY 12158	02/02/2021	02/02/2026
DOL	DA		MANUEL P TOBIO		150 KINGS STREET BROOKLYN NY 14444	08/19/1998	08/19/2998
DOL	DA		MANUEL TOBIO		150 KINGS STREET BROOKLYN NY 11231	08/19/1998	08/19/2998
DOL	DOL		MAQSOOD AHMAD		618 OCEAN PKWY BROOKLYN NY 11230	09/17/2020	09/17/2025
DOL	NYC		MARIA NUBILE		84-22 GRAND AVENUE ELMHURST NY 11373	03/10/2020	03/10/2025
DOL	NYC	****9926	MILLENNIUM FIRE PROTECTION, LLC		325 W. 38TH STREET SUITE 204NEW YORK NY 10018	11/14/2019	11/14/2024
DOL	NYC	****0627	MILLENNIUM FIRE SERVICES, LLC		14 NEW DROP LNE 2ND FLOORSTATEN ISLAND NY 10306	11/14/2019	11/14/2024
DOL	DOL	****1320	MJC MASON CONTRACTING, INC.		42 FOWLER AVENUE CORTLAND MANOR NY 10567	10/25/2022	10/25/2027

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DOL	DOL	****1320	MJC MASON CONTRACTING, INC.		42 FOWLER AVENUE CORTLAND MANOR NY 10567	01/24/2023	01/24/2028
DOL	NYC		MUHAMMED A. HASHEM		524 MCDONALD AVENUE BROOKLYN NY 11218	09/17/2020	09/17/2025
DOL	NYC		NAMOW, INC.		84-22 GRAND AVENUE ELMHURST NY 11373	03/10/2020	03/10/2025
DOL	DOL	****7790	NATIONAL BUILDING & RESTORATION CORP		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	DOL	****1797	NATIONAL CONSTRUCTION SERVICES, INC		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	NYC		NAVIT SINGH		402 JERICHO TURNPIKE NEW HYDE PARK NY 11040	08/10/2022	08/10/2027
DOL	DOL		NELCO CONTRACTING, LLC		1024 BROADWAY ALBANY NY 12204	11/07/2023	11/07/2028
DOL	DA		NICHOLAS T. ANALITIS		505 MANHATTAN AVE WEST BABYLON NY 11704	10/05/2023	10/05/2028
DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	11/15/2022	11/15/2027
DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	09/29/2021	09/29/2026
DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	02/09/2022	02/09/2027
DOL	DOL	****7429	NICOLAE I. BARBIR	BESTUCCO CONSTRUCTION, INC.	444 SCHANTZ ROAD ALLEN TOWN PA 18104	09/17/2020	09/17/2025
DOL	NYC	****5643	NYC LINE CONTRACTORS, INC.		402 JERICHO TURNPIKE NEW HYDE PARK NY 11040	08/10/2022	08/10/2027
DOL	DOL		PATRICK PENNACCHIO		2345 RT. 52 SUITE 2NHOPEWELL JUNCTION NY 12533	12/18/2023	12/18/2028
DOL	DOL		PATRICK PENNACCHIO		2345 RT. 52 SUITE 2NHOPEWELL JUNCTION NY 12533	12/18/2023	12/18/2028
DOL	DOL		PAULINE CHAHALES		935 S LAKE BLVD MAHOPAC NY 10541	03/02/2021	03/02/2026
DOL	DOL		PETER STEVENS		11 OLD TOWN ROAD SELKIRK NY 12158	02/02/2021	02/02/2026
DOL	DOL		PETER STEVENS		8269 21ST ST BELLEROSE NY 11426	12/22/2022	12/22/2027
DOL	DOL	****4168	PHANTOM CONSTRUCTION CORP.		95-27 116TH STREET QUEENS NY 11419	07/12/2024	07/12/2029
DOL	DOL	****4168	PHANTOM CONSTRUCTION CORP.		95-27 116TH STREET QUEENS NY 11419	05/28/2024	05/28/2029
DOL	DOL	****0466	PRECISION BUILT FENCES, INC.		1617 MAIN ST PEEKSKILL NY 10566	03/03/2020	03/03/2025
DOL	NYC		RASHEL CONSTRUCTION CORP		524 MCDONALD AVENUE BROOKLYN NY 11218	09/17/2020	09/17/2025
DOL	DOL	****1068	RATH MECHANICAL CONTRACTORS, INC.		24 ELDOR AVENUE NEW CITY NY 10956	02/03/2020	02/03/2025
DOL	DOL	****2633	RAW POWER ELECTRIC CORP.		3 PARK CIRCLE MIDDLETOWN NY 10940	07/11/2022	07/11/2027
DOL	DA	****7559	REGAL CONTRACTING INC.		24 WOODBINE AVE NORTHPORT NY 11768	10/01/2020	10/01/2025
DOL	DOL		RICHARD REGGIO		1617 MAIN ST PEEKSKILL NY 10566	03/03/2020	03/03/2025
DOL	DOL		ROBBYE BISSE SAR		89-51 SPRINGFIELD BLVD QUEENS VILLAGE NY 11427	01/11/2003	01/11/3003
DOL	DOL		ROMEO WARREN		161 ROBYN RD MONROE NY 10950	07/11/2022	07/11/2027
DOL	DOL		RONALD MESSEN		14B COMMERCIAL AVE ALBANY NY 12065	11/14/2019	11/14/2024
DOL	DOL	****7172	RZ & AL INC.		198 RIDGE AVENUE VALLEY STREAM NY 11581	06/06/2022	06/06/2027
DOL	DOL		SAL FRESINA MASONRY CONTRACTORS, INC.		1935 TEALL AVENUE SYRACUSE NY 13206	07/16/2021	07/16/2026
DOL	DOL		SAL MASONRY CONTRACTORS, INC.		(SEE COMMENTS) SYRACUSE NY 13202	07/16/2021	07/16/2026
DOL	DOL	****9874	SALFREE ENTERPRISES INC		P.O BOX 14 2821 GARDNER RDPOMPEI NY 13138	07/16/2021	07/16/2026
DOL	DOL		SALVATORE A FRESINA A/K/A SAM FRESINA		107 FACTORY AVE P.O BOX 11070SYRACUSE NY 13218	07/16/2021	07/16/2026

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DOL	DOL		SAM FRESINA		107 FACTORY AVE P.O BOX 11070SYRACUSE NY 13218	07/16/2021	07/16/2026
DOL	NYC	****0349	SAM WATERPROOFING INC		168-42 88TH AVENUE APT.1 AJAMAICA NY 11432	11/20/2019	11/20/2024
DOL	DA	****0476	SAMCO ELECTRIC CORP.		3735 9TH ST LONG ISLAND CITY NY 11101	01/05/2023	01/05/2028
DOL	NYC	****1130	SCANA CONSTRUCTION CORP.		863 WASHINGTON STREET FRANKLIN SQUARE NY 11010	03/10/2020	03/10/2025
DOL	DOL	****2045	SCOTT DUFFIE	DUFFIE'S ELECTRIC, INC.	P.O BOX 111 CORNWALL NY 12518	03/03/2020	03/03/2025
DOL	DOL		SCOTT DUFFIE		P.O BOX 111 CORNWALL NY 12518	03/03/2020	03/03/2025
DOL	DA		SILVANO TRAVALJA		3735 9TH ST LONG ISLAND CITY NY 11101	01/05/2023	01/05/2028
DOL	DOL	****0440	SOLAR GUYS INC.		8970 MIKE GARCIA DR MANASSAS VA 20109	07/16/2021	07/16/2026
DOL	NYC		SOMATIE RAMSUNAHAI		115-46 132ND ST SOUTH OZONE PARK NY 11420	09/17/2020	09/17/2025
DOL	DOL	****2221	SOUTH BUFFALO ELECTRIC, INC.		1250 BROADWAY ST BUFFALO NY 14212	02/03/2020	02/03/2025
DOL	NYC	****3661	SPANIER BUILDING MAINTENANCE CORP		200 OAK DRIVE SYOSSET NY 11791	03/14/2022	03/14/2027
DOL	DOL		STANADOS KALOGELAS		485 RAFT AVENUE HOLBROOK NY 11741	10/19/2021	10/19/2026
DOL	DOL	****3496	STAR INTERNATIONAL INC		89-51 SPRINGFIELD BLVD QUEENS VILLAGE NY 11427	08/11/2003	08/11/3003
DOL	DOL	****6844	STEAM PLANT AND CHX SYSTEMS INC.		14B COMMERCIAL AVENUE ALBANY NY 12065	11/14/2019	11/14/2024
DOL	DOL	****9528	STEEL-IT, LLC.		17613 SANTE FE LINE ROAD WAYNESFIELD OH 45896	07/16/2021	07/16/2026
DOL	DOL	****3800	SUBURBAN RESTORATION CO. INC.		5-10 BANTA PLACE FAIR LAWN PLACE NJ 07410	03/29/2021	03/29/2026
DOL	DOL	****9150	SURGE INC.		8269 21ST STREET BELLEROSE NY 11426	12/22/2022	12/22/2027
DOL	DOL		SYED MUHAMMAD S. JAFRI A/K/A SHARRUKH JAFRI		4307 28TH AVE ASTORIA NY 11103	10/11/2024	10/11/2029
DOL	DOL		SYED RAZA		198 RIDGE AVENUE NY 11581	06/06/2022	06/06/2027
DOL	DOL		TARLOK SINGH		95-27 116TH STREET QUEENS NY 11419	05/28/2024	05/28/2029
DOL	DOL		TARLOK SINGH		95-27 116TH STREET QUEENS NY 11419	07/12/2024	07/12/2029
DOL	DOL		TERRY THOMPSON		11371 RIDGE RD WOLCOTT NY 14590	02/03/2020	02/03/2025
DOL	DOL	****9733	TERSAL CONSTRUCTION SERVICES INC		107 FACTORY AVE P.O BOX 11070SYRACUSE NY 13208	07/16/2021	07/16/2026
DOL	DOL		TERSAL CONTRACTORS, INC.		221 GARDNER RD P.O BOX 14POMPEI NY 13138	07/16/2021	07/16/2026
DOL	DOL		TERSAL DEVELOPMENT CORP.		1935 TEALL AVENUE SYRACUSE NY 13206	07/16/2021	07/16/2026
DOL	DOL	****5766	THE COKER CORPORATION	COKER CORPORATIO N	2610 SOUTH SALINA ST SUITE 14SYRACUSE NY 13205	09/17/2020	09/17/2025
DOL	DOL	****2426	THE MATRUKH GROUP, INC.		4307 28TH AVE PO BOX 9082ASTORIA NY 11103	10/11/2024	10/11/2029
DOL	DOL		TIMOTHY PERCY		29807 ANDREWS ROAD BLACK RIVER NY 13612	10/17/2023	10/17/2028
DOL	DA	****1050	TRI STATE CONSTRUCTION OF NY CORP.		50-39 175TH PLACE FRESH MEADOWS NY 11365	03/28/2022	03/28/2027
DOL	DA	****4106	TRIPLE H CONCRETE CORP		2375 RAYNOR STREET RONKONKOMA NY 11779	08/04/2021	08/04/2026
DOL	DOL	****8210	UPSTATE CONCRETE & MASONRY CONTRACTING CO INC		449 WEST MOMBSHA ROAD MONROE NY 10950	06/06/2022	06/06/2027
DOL	DOL	****6418	VALHALLA CONSTRUCTION, LLC.		796 PHEPS ROAD FRANKLIN LAKES NJ 07417	12/01/2020	12/01/2025
DOL	NYC	****2426	VICKRAM MANGRU	VICK CONSTRUCTI ON	21 DAREWOOD LANE VALLEY STREAM NY 11581	09/17/2020	09/17/2025
DOL	NYC		VICKRAM MANGRU		21 DAREWOOD LANE VALLEY STREAM NY 11581	09/17/2020	09/17/2025

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DOL	DOL		VIKTORIA RATH		24 ELDOR AVENUE NEW CITY NY 10956	02/03/2020	02/03/2025
DOL	DOL		VINCENT CORRAO		PO BOX 393 NANUET NY 10954	09/17/2024	09/17/2029
DOL	DOL	****8266	WILLIAM CHRIS MCCLENDON	MCCLENDON ASPHALT PAVING	1646 FALLS STREET NIAGARA FALLS NY 14303	05/01/2023	05/01/2028
DOL	DOL		WILLIAM CHRIS MCCLENDON		1646 FALLS STREET NIAGARA FALLS NY 14303	05/01/2023	05/01/2028
DOL	DOL		WILLIAM G. PROERFRIEDT		85 SPRUCEWOOD ROAD WEST BABYLON NY 11704	01/19/2021	01/19/2026
DOL	DOL	****5924	WILLIAM G. PROPHY, LLC	WGP CONTRACTIN G, INC.	54 PENTAQUIT AVE BAYSHORE NY 11706	01/19/2021	01/19/2026
DOL	DOL		WILLIAM SCRIVENS		4192 SIR ANDREW CIRCLE DOYELSTOWN PA 18902	07/18/2024	07/18/2029
DOL	DOL		XENOFON EFTHIMIADIS		29-10 38TH AVENUE LONG ISLAND CITY NY 11101	10/11/2023	10/11/2028

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.
8. Miscellaneous provisions.

- B. Related Requirements:

1. 011200 "Multiple Contract Summary" for delineation of responsibilities for each Prime Contract.
2. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
3. Section 017300 "Execution" for coordination of Owner-installed products.

1.3 DEFINITIONS

- A. Work Package: A group of specifications, drawings, and schedules prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

1.4 PROJECT INFORMATION

- A. Project Identification: Water Resource Recovery Facility Improvements.

Project Location: The work of this Contract is located at The City of Rome Water Pollution Control Facility (WPCF) at 7180 East Dominick Street, Rome, NY 13440. When using GPS 7180 South Service Road provides more accurate location.

- B. Owner: City of Rome.

1. Owner's Representative: Joseph Guiliano, Commissioner of Public Works

- C. Engineer: CDM Smith NY Inc., 308 Maltbie St. Suite 101, Syracuse, NY 13204.
 - 1. Engineer's Representative: Greg Bold, boldge@cdmsmith.com, (518) 782-4507.
- D. Project Coordinator for Multiple Contracts: Owner shall serve as Project coordinator. Contracts consist of the following:
 - 1. General
 - 2. Electrical

1.5 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of the Project is defined by the Contract Documents and includes, but is not limited to, the following:
 - 1. This project consists of improving existing operational systems at the WRRF including replacement of existing pumps at the main pump station and the filtrate pump station; piping and valve replacements throughout the site; installation of a new leachate storage tank, transfer pump, and pump enclosure; and all temporary piping and pumping required to bypass the system during construction. and other Work indicated in the Contract Documents.
- B. Type of Contract:
 - 1. Project will be constructed under coordinated, concurrent multiple contracts. See Section 011200 "Multiple Contract Summary" for a list of multiple contracts, a description of work included under each of the multiple contracts, and the responsibilities of Project coordinator.

1.6 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Restricted Use of Site: Each 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 areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Driveways, Walkways and Entrances: Keep driveways loading areas, 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.

1.7 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 72 hours 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. 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.
 - 2. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.8 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 8 a.m. to 4 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
 - 1. Weekend Hours: Work shall not be permitted on the weekends without Owner's written approval. Contractor shall submit a request to the Owner and Engineer at least 48 hours

- in advance indicating the intended work, hours on site, equipment to be used, and the reason for why the work would need to be done over the weekend.
2. Early Morning Hours: Contractor shall not perform work outside of the On-site work hours listed above without Owner's written approval for each instance. Contractor shall submit a request to the Owner and Engineer at least 48 hours in advance indicating the intended work, estimated start or end time, equipment to be used, and the reason for why the work would need to be done outside of normal on-site work hours.
 3. Hours for Utility Shutdowns: Contractor shall notify the Owner and Engineer at least 72 hours in advance of a planned utility shutdown. Notice shall include the estimated start and end times.
- C. On-Site Work Day restrictions: Do not perform work resulting in utility shutdowns or resulting in noisy activity on-site during work black-out days.
- D. 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 Engineer and Owner not less than two days in advance of proposed utility interruptions.
 2. Obtain Owner's written permission before proceeding with utility interruptions.
- E. 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 Engineer and Owner not less than two days in advance of proposed disruptive operations.
 2. Obtain Owner's written permission before proceeding with disruptive operations.
- F. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Owner's property is not permitted.

1.9 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, Special 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

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SECTION 011200 - MULTIPLE CONTRACT 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 a summary of each Contract, including responsibilities for coordination and temporary facilities and controls.
- B. Specific requirements for Work of each Contract are also indicated in individual Specification Sections and on Drawings.
- C. Related Requirements:
 - 1. Section 011000 "Summary" for the Work covered by the Contract Documents, restrictions on use of Project site, coordination with occupants, and work restrictions.
 - 2. Section 013100 "Project Management and Coordination" for general coordination requirements.

1.3 DEFINITIONS

- A. Permanent Enclosure: As determined by Engineer, the condition at which roofing is insulated and weathertight; exterior walls are insulated and weathertight; and openings are closed with permanent construction or substantial temporary closures equivalent in weather protection to permanent construction.

1.4 PROJECT COORDINATOR

- A. Project coordinator shall be responsible for coordination between the General Construction Contract and Electrical Contract.
- B. Project Coordinator will be the General Construction Contractor.

1.5 PROJECT COORDINATOR RESPONSIBILITIES

- A. Project coordinator shall perform Project coordination activities for the multiple Contracts, including, but not limited to, the following:
 - 1. Provide typical overall coordination of the Work.
 - 2. Coordinate shared access to workspaces.

3. Provide overall coordination of temporary facilities and controls.
4. Coordinate, schedule, and approve interruptions of permanent and temporary utilities, including those necessary to make connections for temporary services.
5. Coordinate construction and operations of the Work with work performed by each Contract.
6. Coordinate sequencing and scheduling of the Work. Include the following:
 - a. Initial Coordination Meeting: At earliest possible date, arrange and conduct a meeting with contractors for sequencing and coordinating the Work; negotiate reasonable adjustments to schedules.
 - b. Prepare combined Contractors' Construction Schedule for entire Project. Base schedule on preliminary construction schedule. Secure time commitments for performing critical construction activities from contractors. Show activities of each Contract on a separate sheet. Prepare a simplified summary sheet indicating combined construction activities of Contracts.
 - 1) Submit schedules for approval.
 - 2) Distribute copies of approved schedules to contractors.
7. Provide photographic documentation.
8. Coordinate sequence of activities to accommodate tests and inspections, and coordinate schedule of tests and inspections.
9. Provide information necessary to adjust, move, or relocate existing utility structures affected by construction.
10. Coordinate cutting and patching.
11. Coordinate protection of the Work.
12. Coordinate firestopping.
13. Coordinate completion of interrelated punch list items.

1.6 GENERAL REQUIREMENTS OF CONTRACTS

- A. Extent of Contract: Unless the Agreement contains a more specific description of the Work of each Contract, requirements indicated on Drawings and in Specification Sections determine which contract includes a specific element of Project.
1. Unless otherwise indicated, the work described in this Section for each Contract shall be complete systems and assemblies, including products, components, accessories, and installation required by the Contract Documents.
 2. Trenches and other excavation for the work of each Contract shall be the work of each Contract for its own work.
 3. Blocking, backing panels, sleeves, and metal fabrication supports for the work of each Contract shall be the work of each Contract for its own work.
 4. Furnishing of access panels for the work of each Contract shall be the work of each Contract for its own work. Installation of access panels shall be the work of each Contract for its own work.
 5. Equipment pads for the work of each Contract shall be the work of the General Construction Contract.
 6. Roof-mounted equipment curbs for the work of each Contract shall be the work of the General Construction Contract.

7. Painting for the work of each Contract shall be the work of each Contract for its own work.
 8. Cutting and Patching: Provided under each Contract for its own work.
 9. Through-penetration firestopping for the work of each Contract shall be provided by each Contract for its own work.
- B. Substitutions: Each Contractor shall cooperate with other contractors involved to coordinate approved substitutions with remainder of the work.
1. Project coordinator shall coordinate substitutions.
- C. Temporary Facilities and Controls: In addition to specific responsibilities for temporary facilities and controls indicated in this Section and in Section 015000 "Temporary Facilities and Controls," each Contractor is responsible for the following:
1. Installation, operation, maintenance, and removal of each temporary facility necessary for its own normal construction activity, and costs and use charges associated with each facility, except as otherwise provided for in this Section.
 2. Plug-in electric power cords and extension cords, supplementary plug-in task lighting, and special lighting necessary exclusively for its own activities.
 3. Its own field office, complete with necessary furniture, utilities, and telephone service.
 4. Its own storage and fabrication sheds.
 5. Temporary enclosures for its own construction activities.
 6. Staging and scaffolding for its own construction activities.
 7. General hoisting facilities for its own construction activities, up to 2 tons.
 8. Waste disposal facilities, including collection and legal disposal of its own hazardous, dangerous, unsanitary, or other harmful waste materials.
 9. Progress cleaning of work areas affected by its operations on a daily basis.
 10. Secure lockup of its own tools, materials, and equipment.
 11. Construction aids and miscellaneous services and facilities necessary exclusively for its own construction activities.
- D. Temporary Heating, Cooling, and Ventilation: Project coordinator is responsible for temporary heating, cooling, and ventilation, including utility-use charges, temporary meters, and temporary connections.

1.7 GENERAL CONSTRUCTION CONTRACT

- A. Work of the General Contract includes, but is not limited to, the following:
1. Remaining work not identified as work under other contracts and general requirements.
 2. All work in the Main Pump Station including pump, discharge pipe and valve replacements, delegated design of pipe support system, concrete equipment bases, fiberglass grating, RAS manual and electric actuated plug valve replacements, RAS flow meter replacements, painting existing walls, floors and piping, temporary bypass pumping and piping around the Main Pump Station Wet Well to the two sets of aeration tanks during pump and pipe replacement, surface restoration including seeding and asphalt replacement at temporary pipe road crossings, exhaust fan, brick enclosure and

duct removal, new makeup air unit with supply air duct and diffusers, natural gas supply, new w.

3. All work related to the Filtrate Pump Station including pump and rail replacement with pump control panel, new shelf spare pump, wet well hatch replacement, concrete flow meter vault, underground piping to the primary clarifier influent channel, curb cut and asphalt paving adjacent to the pump station, surface restoration and seeding, asphalt pavement replacement as required and core drilling the influent channel to receive the new pipe.
 4. All work related to the Waste Holding Tank including 100,000 gallon glass lined bolted steel tank and foundation, delegated design of tank and foundation, dewatering and drainage, subsurface ground improvements as defined in the geotechnical report, tank mixing system, fiberglass pump enclosure on a concrete pad with supplier provided heat, ventilation and lights, truck unload pump and control panel with above grade suction and discharge header piping, underground piping to the leachate storage tank, underground piping from the leachate storage tank to the existing Filtrate Pump Station discharge pipe, concrete valve and flow meter vault, concrete containment area replacement at the pump enclosure, surface restoration and seeding.
 5. All work related to the Digester 2 digested sludge pipe replacement including new piping inside the Digester 2 Control Building, buried yard piping, test pits, tie-in to existing underground piping at the Solids Handling Building, surface restoration and seeding, removal and re-placing stone rip rap adjacent to the digester, core drilling building foundation wall and asphalt replacement as required.
 6. All work related to the RAS manhole valve replacements including removing the top slab, replacing the plug valves, setting a new top slab with access hatch, temporary bypass pumping and piping to the aeration tanks during valve replacements including during replacement of the RAS valves in the Main Pump Station, surface restoration and seeding, asphalt replacement at temporary pipe road crossings.
 7. Instrumentation and Controls work to be completed by AquaLogics who is the designated provider to the City of Rome.
 8. Concrete spall repairs in the Main Pump Station wet well on a per square foot basis. Engineer will inspect the wet well after it is drained and cleaned by the Contractor to mark out repair locations.
 9. Concrete crack repairs in the Main Pump Station wet well on a per linear foot basis. Engineer will inspect the wet well after it is drained and cleaned by the Contractor to mark out repair locations
- B. Temporary facilities and controls in the General Construction Contract include, but are not limited to, the following:
1. Temporary facilities and controls that are not otherwise specifically assigned to the Electrical Contract.
 2. Sediment and erosion control.

3. Unpiped sewers and drainage, including drainage ditches, dry wells, stabilization ponds, and containers.
4. Stormwater control.
5. Temporary enclosure for building exterior, except as indicated.
6. Temporary roads and paved areas.
7. Dewatering facilities and drains.
8. Excavation support and protection, unless required solely for the Work of another contract.
9. Project identification and temporary signs.
10. Environmental protection.
11. Maintenance and restoration of Owner's existing facilities used as temporary facilities.

1.8 ELECTRICAL CONTRACT

A. Work of the Electrical Contract includes, but is not limited to, the following:

1. Remaining work not identified as work under other contracts and general requirements .
2. All work related to the Main Pump Station including: MCC-10 replacement, replacing four pump VFD's and branch circuitry to four pumps and VFD's, re-feeding MCP-10 during MCC-10 replacement, demolishing branch circuitry to existing supply and exhaust fans, branch circuitry to new exhaust fan, makeup air unit, actuated plug valves and electric hoist, replace interior and exterior lighting.
3. All work related to the Filtrate Pump Station including disconnecting power and control branch circuitry from the existing control panel, re-connecting to the new control panel, underground duct bank to the pump station, underground duct bank from the control panel to the flow meter vault, terminations for all instruments in the control panel and in the PLC.
4. All work related to the Waste Holding Tank including underground duct bank to the Waste Transfer Station and tank pressure/flow indicator vault, MCC-4 modifications, branch circuitry to the Waste Transfer Station power panel and pump control panel, branch circuitry to the tank pressure/flow indicator vault, terminations at all instruments and motor and at the MCC and PLC.

B. Temporary facilities and controls in the Electrical Contract include, but are not limited to, the following:

1. Electrical connections to existing systems and temporary facilities and controls furnished by the General Construction Contract.

PART 2 - EXECUTION (NOT USED)

END OF SECTION 011200

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SECTION 012001 - PRICE AND PAYMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Lump sum prices.

1.2 LUMP SUM PRICES - GENERAL CONTRACT

- A. Payment of the lump sum price bid for GC Item No.1 shall constitute full compensation for all labor, materials, tools, equipment and incidentals necessary for general requirements including mobilization and demobilization, bonds and insurance, temporary facilities, miscellaneous work and cleanup, project closeout and all else incidental thereto as shown on the Drawings and as specified in Divisions 01 through 46, except that required under other contract bid items described herein.
- B. Payment of the lump sum price bid for Item GC No. 2 shall constitute full compensation for all labor, materials, tools, equipment and incidentals necessary to provide all work for the improvements to the Main Pump Station including new dry pit submersible pumps, piping, actuated valves and flow meters, grating, supply and exhaust fans with duct work and painting, temporary bypass pumping and piping, complete as shown on Drawings and as specified in Divisions 01 through 46, except that required under other contract bid items described herein.
- C. Payment of the lump sum price bid for Item GC No. 3 shall constitute full compensation for all labor, materials, tools, equipment and incidentals necessary to provide all work for the improvements to the Filtrate Pump Station and flow meter vault including new wet pit submersible pumps, spare pump, piping, access hatch, and access road, complete as shown on Drawings and as specified in Divisions 01 through 46, except that required under other contract bid items described herein.
- D. Payment of the lump sum price bid for Item GC No. 4 shall constitute full compensation for all labor, materials, tools, equipment and incidentals necessary to provide a new Waste Holding Tank with foundation, dewatering and drainage, subsurface ground improvements, pressure level/indicator vault, Waste Transfer Station including all new piping, valves, concrete and appurtenances, complete as shown on Drawings and as specified in Divisions 01 through 46, except that required under other contract bid items described herein.
- E. Payment of the lump sum price bid for Item GC No. 5 shall constitute full compensation for all labor, materials, tools, equipment and incidentals necessary to provide all work for the improvements to the Digester No. 2 Control Building including new interior and underground piping, valves, and fittings, complete as shown on Drawings and as specified in Divisions 01 through 46, except that required under other contract bid items described herein.
- F. Payment of the lump sum price bid for Item GC No. 6 shall constitute full compensation for all labor, materials, tools, equipment and incidentals necessary RAS manhole valve replacements with new manhole top with access hatch, and temporary bypass pumping and piping, complete

as shown on Drawings and as specified in Divisions 01 and 31 through 33, except that required under other contract bid items described herein.

- G. Payment of the lump sum price bid for Item GC No. 7 shall constitute full compensation for all labor, materials, tools, equipment and incidentals necessary to power wash and clean the Main Pump Station wet well including any scaffolding, review of repair quantities with Engineer, complete as shown on Drawings and as specified in Divisions 01 and 03, except that required under other contract bid items described herein.

1.3 UNIT PRICES – GENERAL CONTRACT

- A. Payment of the unit price bid for Item GC No. 8 shall constitute all labor, materials, tools, equipment and incidentals necessary to perform repair type A - deep spall repair in the Main Pump Station wet well as shown on the Drawings and specified in Divisions 01 and 03. Measurement for this item shall be on a square foot basis as dictated by the Engineer following the draining and inspection of the wet well.
- B. Payment of the unit price bid for Item GC No. 9 shall constitute all labor, materials, tools, equipment and incidentals necessary to perform repair type B - low depth spall repair in the Main Pump Station wet well as shown on the Drawings and specified in Divisions 01 and 03. Measurement for this item shall be on a square foot basis as dictated by the Engineer following the draining and inspection of the wet well.
- C. Payment of the unit price bid for Item GC No. 10 shall constitute all labor, materials, tools, equipment and incidentals necessary to perform crack repair with chemical grout injection in the Main Pump Station wet well as shown on the Drawings and specified in Divisions 01 and 03. Measurement for this item shall be on a linear foot basis as dictated by the Engineer following the draining and inspection of the wet well.

1.4 LUMP SUM PRICES - ELECTRICAL CONTRACT

- A. Payment of the lump sum price bid for EC Item No. 1 shall constitute full compensation for all labor, materials, tools, equipment and incidentals necessary for general requirements including mobilization and demobilization bonds and insurance, temporary facilities, miscellaneous work and cleanup, project closeout and all else incidental thereto, as shown on Drawings and as specified in Divisions 01 and 26 through 28, except that required under other contract bid items described herein.
- B. Payment of the lump sum price bid for EC Item No. 2 shall constitute full compensation for all labor, materials, tools, equipment and incidentals necessary to provide the Main Pump Station improvements complete, as shown on Drawings and as specified in Divisions 01, 02 and 26 through 28, except that required under other contract bid items described herein.
- C. Payment of the lump sum price bid for EC Item No. 3 shall constitute full compensation for all labor, materials, tools, equipment and incidentals necessary to provide electrical work for the Filtrate Pump Station and flow meter vault including duct banks, branch circuitry, and terminations at the PLC, pump control panel, pump and field instruments complete, as shown on Drawings and as specified in Divisions 01 and 26 through 28, except that required under other contract bid items described herein.

- D. Payment of the lump sum price bid for EC Item No. 4 shall constitute full compensation for all labor, materials, tools, equipment and incidentals necessary to provide electrical work for the Waste Holding Tank, pressure level/indicator vault, and Waste Transfer Station including MCC-4 modifications, duct banks, branch circuitry and terminations at the MCC, PLC, pump control panel, pump enclosure and field instruments complete, as shown on Drawings and as specified in Divisions 01 and 26 through 28, except that required under other contract bid items described herein.

1.5 EXTRA WORK

- A. Extra work, if any, will be performed in accordance with Article 11 of the General Conditions and will be paid for in accordance with the provisions of Article 13 of the General Conditions.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012000

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SECTION 012100 - ALLOWANCES

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 governing allowances.
- B. Types of allowances include the following:
 - 1. Contingency allowances.
- C. Related Requirements:
 - 1. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
 - 2. Section 014000 "Quality Requirements" for procedures governing the use of allowances for field testing by an independent testing agency.

1.3 DEFINITIONS

- A. Allowance: A quantity of work or dollar amount included in the Contract, established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1.4 ACTION SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

1.5 INFORMATIONAL SUBMITTALS

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance when requested by the Engineer.
- B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance when requested by the Engineer.

- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.6 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed by Engineer for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.
- C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit.
- D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.7 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, required maintenance materials, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
 - 3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit-cost allowances.
 - 4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs due to a change in the scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
 - 1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
 - 2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES – GENERAL CONTRACT

- A. GC Allowance No. A1: Contingency Allowance: Include a contingency allowance of \$100,000 for Owner's purposes, only as directed by the Engineer.
- B. GC Allowance No. A2: SCADA Allowance: Include an allowance of \$60,000 for the work performed by the City's SCADA integrator as shown on the Drawings, as specified in Divisions 01 through 46, and as detailed in Appendix B.

3.4 SCHEDULE OF ALLOWANCES – ELECTRICAL CONTRACT

- A. EC Allowance No. A1: Contingency Allowance: Include a contingency allowance of \$50,000 for Owner's purposes, only as directed by the Engineer.

END OF SECTION 012100

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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 012100 "Allowances" for products selected under an allowance.
 - 2. 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. Substitution Request Form: Use form acceptable to Engineer.
 - 2. 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.
 - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project.
 - j. 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.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. 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.
 - m. 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.
3. 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 the 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 the 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 and Engineer.

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 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.

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 on other form acceptable to Owner and Engineer.

1.7 WORK CHANGE DIRECTIVE

- A. Work Change Directive: Engineer may issue a Work Change Directive on EJCDC Document C-940 or on other form acceptable to Owner and Engineer. 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 the 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 an itemized account and supporting data necessary to substantiate cost and time adjustments to the 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 012100 "Allowances" for procedural requirements governing the handling and processing of allowances.
 - 2. Section 012600 "Contract Change Procedures" for administrative procedures for handling changes to the Contract.
 - 3. 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.
 - 3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
 - 4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.

- 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. Contract name and number.
 - e. Name of Engineer.
 - f. Engineer's Project number.
 - g. Contractor's name and address.
 - h. 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. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
 6. 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.
 7. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
 8. 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.

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: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Submit Application for Payment to Engineer by the day/date of the month indicated in the Agreement between the Owner and Contractor. The period covered by each Application for Payment is the period indicated in the Agreement.
 - 1. Submit draft copy of Application for Payment twenty days prior to due date for review by Engineer.
- D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- E. 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.
- F. 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.

- G. Transmittal: Submit three 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.
- H. Maintain an updated set of drawings to be used as record drawings in accordance with Section 017839. 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. Combined Contractor's construction schedule incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 5. Products list (preliminary if not final).
 6. Schedule of unit prices.
 7. Submittal schedule.
 8. List of Contractor's staff assignments.
 9. Report of preconstruction conference.
 10. Copies of building permits.
 11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
- 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.
 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.

5. Updated final statement, accounting for final changes to the Contract Sum.
6. Evidence that claims have been settled.
7. Final liquidated damages settlement statement.
8. 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 011200 "Multiple Contract Summary" for a description of the division of work among separate contracts and responsibility for coordination activities not in this Section.
 - 2. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 3. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 4. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.
 - 5. Section 019113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.3 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. 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. Post copies of list in Project meeting room, in temporary field office, and in prominent location in the facility. Keep list current at all times.

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. Coordination of Multiple Contracts: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its own operations with 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 with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- C. 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.
- D. 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 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Engineer indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 9. Review: Engineer will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Engineer determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Engineer will so inform Contractor, who shall make suitable modifications and resubmit.
 10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

- C. Coordination Drawing Process: Prepare coordination drawings in the following manner:
1. Schedule submittal and review of Fire Sprinkler, Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
 2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
 3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
 4. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
 5. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
 6. Communications and Electronic Safety and Security Installer will indicate cable trays and cabling runs and equipment in purple color. Communications and Electronic Safety and Security Installer shall forward completed drawing files to Contractor.
 7. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Architect to review and resolve conflicts on the coordination drawings.
- D. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 2. File Preparation Format: DWG, Version , operating in Microsoft Windows operating system.
 3. File Submittal Format: Submit or post coordination drawing files using PDF format.
 4. BIM File Incorporation: Develop and incorporate coordination drawing files into BIM established for Project.
 - a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Engineer.
 5. Engineer will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Engineer makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in AutoCAD DWG files.
 - c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Engineer.

1.7 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: Software-generated form with substantially the same content as indicated above, acceptable to Engineer.
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. Software log with not less than 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.

1.8 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.
 3. Digital Drawing Software Program: Contract Drawings are available in AutoCAD DWG.
 4. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Engineer.

- a. Subcontractors, and other parties granted access by Contractor to Engineer's digital data files shall execute a data licensing agreement in the form of Agreement acceptable to Owner and Engineer.
 5. The following digital data files will be furnished for each appropriate discipline:
 - a. Floor plans.
 - b. Reflected ceiling plans.
 - c. Site plans.
- B. PDF Document Preparation: Where PDFs are required to be submitted to Engineer, prepare as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 PROJECT MEETINGS

- A. General: 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 and existing buildings.
 - 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. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility requirements.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written instructions.
 - n. Warranty requirements.
 - o. Compatibility of materials.

- p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. 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: Construction Manager will 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: Construction Manager will conduct progress meetings at regular intervals.
 - 1. Coordinate dates of meetings with preparation of payment requests.
 - 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) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Status of sustainable design documentation.
 - 6) Deliveries.
 - 7) Off-site fabrication.
 - 8) Access.
 - 9) Site use.
 - 10) Temporary facilities and controls.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) Status of RFIs.
 - 16) Status of Proposal Requests.
 - 17) Pending changes.
 - 18) Status of Change Orders.
 - 19) Pending claims and disputes.
 - 20) Documentation of information for payment requests.
 - 4. Minutes: Entity responsible for conducting the meeting will record and distribute the 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 the 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) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site use.
 - 9) Temporary facilities and controls.
 - 10) Work hours.
 - 11) Hazards and risks.
 - 12) Progress cleaning.
 - 13) Quality and work standards.
 - 14) Status of RFIs.
 - 15) Proposal Requests.
 - 16) Change Orders.
 - 17) 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.

1.10 MAINTENANCE OF PLANT OPERATIONS (MOPO)

- A. Contractor shall be responsible for maintaining the full functionality of the sites throughout construction and shall not interfere with Owner's regular operations.
- B. MOPO shall include the installation of bypasses for the Main Pumping Station and the Return Activated Sludge (RAS) control and isolation valves.
- C. The bypass for the Main Pumping Station may be pumped out of the venturi structure or from MH-18, upstream of the Parshall flume, directly to the aeration tank influent distribution chamber.
 - 1. Contractor shall provide a temporary flow meter with an analog signal to the City's existing Parshall flume flow meter wiring termination point.
- D. The bypass for the RAS control and isolation valves will consist of routing the discharge from the submersible RAS pumps located at each secondary clarifier with temporary hoses to the head of the aeration tank influent distribution chamber.
 - 1. The 12-inch Waste Activated Sludge (WAS) line downstream of the manhole where valves are to be replaced will be cut into to add a tee, valve, and hose connection to allow for pumping to the thickeners during shutdowns.
 - 2. Temporary RAS hosing from two Final Sedimentation Tanks (FSTs) will be routed to tanks 1-6, one FST will be routed to tanks 7-10, and the remaining FST's RAS will be routed to the new WAS connection.
 - 3. RAS bypass pumping will be limited to one shift of operation at a time for replacement of valves in the manhole. A longer duration will be required to replace the modulating plug valves and flow meters, Contractor will discuss proposed plan with Engineer and Owner for approval.

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. Site condition reports.
6. Unusual event reports.

- B. Related Requirements:

1. Section 011200 "Multiple Contract Summary" for preparing a combined Contractor's Construction Schedule.
2. Section 012900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.
3. Section 014000 "Quality Requirements" for schedule of tests and inspections.

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. 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.
- C. Construction Schedule Updating Reports: Submit with Applications for Payment.
- D. Daily Construction Reports: Submit at weekly intervals.
- E. Site Condition Reports: Submit at time of discovery of differing conditions.
- F. Unusual Event Reports: Submit at time of unusual event.

1.5 QUALITY ASSURANCE

- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." 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 interim milestones and partial Owner occupancy.
 - 4. Review delivery dates for Owner-furnished products.
 - 5. Review schedule for work of Owner's separate contracts.
 - 6. Review submittal requirements and procedures.

7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.
12. 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. Program Description:
 1. A Critical Path Method (CPM) construction schedule shall be used to control the Work and to provide a basis for determining job progress. The construction schedule shall be prepared and maintained by the Contractor. All work shall be done in accordance with the established CPM schedule. The Contractor and all subcontractors shall cooperate fully in developing the construction schedule and in executing the work in accordance with the CPM schedule.
 2. The construction schedule shall consist of a computerized CPM network (diagram of activities) presented in a time-scaled graphic (print-out) with reports, as specified herein.
 3. For projects that involve multiple prime contractors, the general subcontractor shall prepare and maintain the overall project schedule and shall integrate scheduling from other prime contractors into a cohesive integrated plan.
- B. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
 1. Use Microsoft Project for current Windows operating system.
- C. Qualifications:
 1. The Contractor shall have the capability of preparing and utilizing the specified CPM schedule or engage the services of a specialized scheduling professional to do so. Within seven days of the award of contract, provide a résumé or qualifications statement for the individual within the Contractor's organization, or the outside consultant, who is being proposed as the responsible party for development and maintenance of the CPM schedule. The résumé or qualifications statement shall demonstrate that the proposed

responsible party has successfully developed and maintained CPM schedules for at least three construction projects of the same size or greater than this project. The proposed responsible party for the CPM schedule is subject to approval by the Engineer and Owner. If the proposed responsible party for the CPM schedule is not approved by the Engineer and/or Owner, Contractor shall resubmit a more-appropriate candidate for approval.

- D. 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.
- E. 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. Waste Holding Tank
 - b. Waste Transfer Station
 - c. Waste Transfer Pump
 - d. Main Pump Station dry pit submersible pumps.
 - e. Filtrate Pump Station wet pit submersible pump.
 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 no fewer than 15 days for startup and testing.
 6. Commissioning Time: Include no fewer than 30 days for commissioning.
 7. Substantial Completion: 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.

- F. 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. Work under More Than One Contract: Include a separate activity for each contract.
 2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 3. 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. Environmental control.
 4. 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. Deliveries.
 - e. Installation.
 - f. Tests and inspections.
 - g. Adjusting.
 - h. Curing.
 - i. Building flush-out.
 - j. Startup and placement into final use and operation.
 - k. Commissioning.
 5. 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.
- G. 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.
- H. 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.

I. Acceptability

1. Submit the CPM schedule submittals, as specified, and resubmit as needed, until they are in compliance with Contract requirements.
2. Engineer's review of 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. 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 Contractor's schedule submittals will not relieve Contractor from responsibility for complying with the Contract Scope, Contract Time or any other contract requirement. Any indication of concurrence, acceptance, or approval of Contractor's schedule will only indicate a general conformance with the Contract Requirements.
3. Engineer's review of Contractor's construction schedule submittals shall not relieve Contractor from responsibility for any deviations from the Contract Documents unless 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 Contractor of responsibility for accomplishing the Work within the Contract completion date(s).
4. Concurrence, acceptance, or approval of Contractor's CPM schedule by Engineer in no way makes 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 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 Contractor.

J. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week 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.
- K. 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.
- L. 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 Engineer may deem necessary to determine whether the Contractor is entitled to an extension of time under the provisions of this Contract. Engineer will, after receipt of such justification and supporting evidence, make findings of fact and will advise the Contractor in writing thereof. If Engineer finds that the Contractor is entitled to any extension of any contract completion date, 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.
- M. 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 commencement of the Work.
 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 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. Work 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.
- B. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- C. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.
1. Submit unusual event reports directly to Owner within one days of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013200

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.
 - 5. Preconstruction video recordings.
- B. Related Requirements:
 - 1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
 - 2. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
 - 3. Section 024119 "Selective Demolition" for photographic documentation before selective demolition operations commence.
 - 4. Section 311000 "Site Clearing" for photographic documentation before site clearing operations commence.

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 ten days of taking photographs.
 - 1. Submit photos on CD-ROM or thumb-drive. Include copy of key plan indicating each photograph's location and direction.
 - 2. Identification: Provide the following information with each image description in file metadata tag:
 - a. Date photograph was taken.
 - b. Description of location, vantage point, and direction.
 - c. Unique sequential identifier keyed to accompanying key plan.

- C. Video Recordings: Submit video recordings within ten days of recording.
 - 1. Submit video recordings on CD-ROM or thumb drive. Include copy of key plan indicating each video's location and direction.
 - 2. Identification: With each submittal, provide the following information in file metadata tag:
 - a. Date video recording was recorded.
 - b. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

1.4 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels. Use flash in low light levels or backlit conditions.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full high-definition mode with vibration-reduction technology. Provide supplemental lighting in low light levels or backlit conditions.
- C. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
- D. Metadata: Record accurate date and time from camera.
- E. File Names: Name media files with date and sequential numbering suffix.
- F. Usage Rights:
 - 1. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

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, from different vantage points, as directed by Engineer.
 - 1. Flag excavation areas before taking construction photographs.
 - 2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
 - 3. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.

4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- C. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient 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.
- D. Periodic Construction Photographs: Take 20 monthly 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 20 photographs after date of Substantial Completion for submission as Project Record Documents. Engineer will inform photographer of desired vantage points.
- F. Additional Photographs: Engineer may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
1. Three days' notice will be given, where feasible.
 2. In emergency situations, take additional photographs within 24 hours of request.
 3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Special events planned at Project site.
 - b. Immediate follow-up when on-site events result in construction damage or losses.
 - c. Photographs shall be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
 - d. Substantial Completion of a major phase or component of the Work.
 - e. Extra record photographs at time of final acceptance.
 - f. Owner's request for special publicity photographs.

1.6 CONSTRUCTION VIDEO RECORDINGS

- A. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed, recent events, and planned activities. At each change in location, describe vantage point, location, direction (by compass point), and elevation or story of construction.
1. Confirm date and time at beginning and end of recording.
 2. Begin each video recording with name of Project, Contractor's name, videographer's name, and Project location.

- B. Preconstruction Video Recording: Before starting excavation, demolition, and construction, record video recording of Project site and surrounding properties from different vantage points, as directed by Engineer.
1. Flag excavation areas before recording construction video recordings.
 2. Show existing conditions adjacent to Project site before starting the Work.
 3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of excavation, demolition, and construction.
 4. Show protection efforts by Contractor.

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 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
- 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.
- 9. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

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: 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.
 - g. Scheduled dates for installation.
 - h. Activity or event number.

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. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
8. Category and type of submittal.
9. Submittal purpose and description.
10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. 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.

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: 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.
- 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.
- 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.
 - 2. Paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.

- 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. 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 not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 5. 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.
- 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 information specified.
- 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. Insert definition of Contractor certificates here if required by individual Specification Sections. See the Evaluations.
3. 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. "
4. 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.
5. 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.
6. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
7. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
8. 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. 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.
- B. Action Submittals: Engineer will review each submittal, indicate corrections or revisions required, and return it.
 1. PDF Submittals: Engineer will indicate, via markup on each submittal, 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 a 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/Engineer harmless against costs, losses, or damage caused by presence of computer virus in files or media.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013300

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SECTION 013513 – MAINTENANCE OF PLANT OPERATION AND CONSTRUCTION CONSTRAINTS

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. Maintenance of Plant Operation constraints and guidelines.
- 2. Construction constraints pertinent to sequence of construction and scheduling.

- 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 INFORMATIONAL SUBMITTALS

- A. Submit a summary construction sequence, including an acknowledgement of each construction constraint included in this Section.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 MAINTENANCE OF PLANT OPERATION

- A. City of Rome's Wastewater Recovery Facility (WWRF) is operated 24 hours a day, seven days a week. The existing facility will be maintained in continuous operation by Owner during the entire construction period. Schedule and conduct the Work such that it will not impede any part of the treatment process, cause treatment process upsets, impede solids processing or removal, or create potential hazards to operating equipment or personnel, reduce the quality of the plant effluent, interrupt chemical and hauled waste receiving truck traffic or cause treatment process upsets. It shall be Contractor's responsibility to ensure complete compatibility with the facility operations in his working schedules and sequenced construction activities.

- B. Coordinate the Work the Plant Operating Personnel and sequence the Work in a logical order to maintain the process flow through the plant. Coordinate the Work with other contractors, if any, to allow orderly and timely completion of the Work.
- C. Maintain access for Plant Operating Personnel to all buildings and process facilities at all times.
- D. Maintain vehicular access to the WRRF at all times.
- E. Coordinate the activities in the interface or common areas with Plant Operating Personnel and other contractors, as applicable. Submit description and schedule for utilization of common areas.
- F. Various interconnections within the plant may require the closure of various valves and gates. Coordinate with Plant Operating Personnel prior to operating any valves or gates. As necessary, provide corrective measures or temporary facilities to attain the shut-off needed to perform the Work.
- G. Various interconnections within the plant may require temporary partial power shutdown. Coordinate with Plant Operating Personnel and utility authorities as applicable prior to any power shutdown. Minimize the length of shutdown period as feasible. As necessary, provide corrective measures or temporary facilities necessary to perform the Work.
- H. When the work requires an existing facility to be taken out of service, notify Owner at least one week in advance.
- I. Provide water for testing as necessary. Plant water (non-potable) may be available for limited use at Owner's discretion.
- J. During Start-Up and Testing, coordinate with equipment manufacturers to have their representatives on site for any necessary adjustments and for training.

3.2 CONSTRUCTION SEQUENCE

- A. To maintain continuous plant operations during construction, provide a phased construction sequence, considering the specific constraints outlined herein. Coordinate construction sequence with Owner and Engineer and submit for review.
- B. The detailed sequence of construction shall be based upon the schedule submitted by the and approved by Engineer as specified above. However, as a guide for bidders in the preparation of their bid, a suggested sequence of construction is described below for specific portions of the work.
- C. The order of construction shall be subject to the approval of Owner and Engineer; such approval or direction, however, shall in no way relieve 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 WRRF. Contractor shall note the requirements of this Section with regard to the operation of the facility and the phasing of construction when developing his work sequence. Contractor's work sequence must be specifically detailed in the required schedule.

- D. The following construction constraints provide for completing the construction of the project within the requirements of 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 Project Coordinator in accordance with the requirements of the approved construction sequence.
- E. Some of the tasks and constraints below may overlap one another in performance of the work. Numerical and alphabetical identification of the tasks does not necessarily conform with actual order of construction.

3.3 CONSTRUCTION CONSTRAINTS

- A. Consider the following construction constraints in completing the Work. This list does not release Contractor from the responsibility to coordinate the Work as required to complete the Work in accordance with the Contract Times.
- B. Main Pump Station Improvements:
 - 1. Contractor will coordinate with Owner regarding the isolation and draining of the Main pump Station after the temporary bypass pumping system is installed to the Owner's satisfaction.
- C. Filtrate Pump Station Improvements:
 - 1. Contractor will coordinate with Owner prior to removal of existing pump and piping. Contractor will return structure to service as quickly as is feasible or provide temporary pumping as required to maintain operations.
- D. Replacement of RAS valves:
 - 1. Contractor will demolish and replace the valves one at a time, each in a single 8-10 hour shift, depending on weather conditions. In between valve replacements, the Owner will run to waste overnight before next valve can be installed.

END OF SECTION – 013513

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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.
- C. Related Requirements:
 - 1. Section 012100 "Allowances" for testing and inspection allowances.

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 DELEGATED DESIGN

- A. Delegated-Design Services Submittal: In addition to Shop Drawings, Product Data, and other required submittals, 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. Delegated-Designer: Professionals currently registered in the State in which project work occurs.

1.7 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.

1.8 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.

1.9 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. **Professional Engineer Qualifications:** A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. 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.

1.10 QUALITY CONTROL

- A. **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.
- B. 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.
- C. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Engineer 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.
- D. 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."
- E. 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.
- F. 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.
- G. 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.

1.11 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in structural drawings and specifications, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Engineer and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Engineer with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
 6. Retesting and reinspecting corrected Work.

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 and Owner's 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. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- 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

SECTION 014200 - REFERENCES

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 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Engineer's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Engineer. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.
 - 1. AABC - Associated Air Balance Council; www.aabc.com.
 - 2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
 - 3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
 - 4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
 - 5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
 - 6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
 - 7. ABMA - American Boiler Manufacturers Association; www.abma.com.
 - 8. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org
 - 9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
 - 10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
 - 11. AF&PA - American Forest & Paper Association; www.afandpa.org.
 - 12. AGA - American Gas Association; www.aga.org.
 - 13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
 - 14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
 - 15. AI - Asphalt Institute; www.asphaltinstitute.org.
 - 16. AIA - American Institute of Architects (The); www.aia.org.
 - 17. AISC - American Institute of Steel Construction; www.aisc.org.
 - 18. AISI - American Iron and Steel Institute; www.steel.org.
 - 19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
 - 20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
 - 21. ANSI - American National Standards Institute; www.ansi.org.
 - 22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
 - 23. APA - APA - The Engineered Wood Association; www.apawood.org.
 - 24. APA - Architectural Precast Association; www.archprecast.org.
 - 25. API - American Petroleum Institute; www.api.org.
 - 26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
 - 27. ARI - American Refrigeration Institute; (See AHRI).
 - 28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
 - 29. ASCE - American Society of Civil Engineers; www.asce.org.

30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Safety Engineers (The); www.asse.org.
34. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AWEA - American Wind Energy Association; www.awea.org.
38. AWI - Architectural Woodwork Institute; www.awinet.org.
39. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
40. AWPA - American Wood Protection Association; www.awpa.com.
41. AWS - American Welding Society; www.aws.org.
42. AWWA - American Water Works Association; www.awwa.org.
43. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
44. BIA - Brick Industry Association (The); www.gobrick.com.
45. BICSI - BICSI, Inc.; www.bicsi.org.
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
47. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
49. CDA - Copper Development Association; www.copper.org.
50. CE - Conformance Europeenne; <http://ec.europa.eu/growth/single-market/ce-marking/>
51. CEA - Canadian Electricity Association; www.electricity.ca.
52. CEA - Consumer Electronics Association; www.ce.org.
53. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
54. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
55. CGA - Compressed Gas Association; www.cganet.com.
56. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
57. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
58. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
59. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
60. CPA - Composite Panel Association; www.pbmdf.com.
61. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
62. CRRC - Cool Roof Rating Council; www.coolroofs.org.
63. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
64. CSA - CSA Group; www.csagroup.com.
65. CSA - CSA International; www.csa-international.org.
66. CSI - Construction Specifications Institute (The); www.csinet.org.
67. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
68. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
69. CWC - Composite Wood Council; (See CPA).
70. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
71. DHI - Door and Hardware Institute; www.dhi.org.
72. ECA - Electronic Components Association; (See ECIA).
73. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
74. ECIA - Electronic Components Industry Association; www.eciaonline.org.

75. EIA - Electronic Industries Alliance; (See TIA).
76. EIMA - EIFS Industry Members Association; www.eima.com.
77. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
78. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
79. ESTA - Entertainment Services and Technology Association; (See PLASA).
80. ETL - Intertek (See Intertek); www.intertek.com.
81. EVO - Efficiency Valuation Organization; www.evo-world.org.
82. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
83. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
84. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
85. FM Approvals - FM Approvals LLC; www.fmglobal.com.
86. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
87. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridarroof.com.
88. FSA - Fluid Sealing Association; www.fluidsealing.com.
89. FSC - Forest Stewardship Council U.S.; www.fscus.org.
90. GA - Gypsum Association; www.gypsum.org.
91. GANA - Glass Association of North America; www.glasswebsite.com.
92. GS - Green Seal; www.greenseal.org.
93. HI - Hydraulic Institute; www.pumps.org.
94. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
95. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
96. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
97. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
98. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
99. IAS - International Accreditation Service; www.iasonline.org.
100. ICBO - International Conference of Building Officials; (See ICC).
101. ICC - International Code Council; www.iccsafe.org.
102. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
103. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
104. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
105. IEC - International Electrotechnical Commission; www.iec.ch.
106. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
107. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
108. IESNA - Illuminating Engineering Society of North America; (See IES).
109. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
110. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
111. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
112. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
113. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
114. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
115. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
116. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
117. ISO - International Organization for Standardization; www.iso.org.

118. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
119. ITU - International Telecommunication Union; www.itu.int/home.
120. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
121. LMA - Laminating Materials Association; (See CPA).
122. LPI - Lightning Protection Institute; www.lightning.org.
123. MBMA - Metal Building Manufacturers Association; www.mbma.com.
124. MCA - Metal Construction Association; www.metalconstruction.org.
125. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
126. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
127. MHIA - Material Handling Industry of America; www.mhia.org.
128. MIA - Marble Institute of America; www.marble-institute.com.
129. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
130. MPI - Master Painters Institute; www.paintinfo.com.
131. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
132. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
133. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
134. NADCA - National Air Duct Cleaners Association; www.nadca.com.
135. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
136. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
137. NBI - New Buildings Institute; www.newbuildings.org.
138. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
139. NCMA - National Concrete Masonry Association; www.ncma.org.
140. NEBB - National Environmental Balancing Bureau; www.nebb.org.
141. NECA - National Electrical Contractors Association; www.necanet.org.
142. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
143. NEMA - National Electrical Manufacturers Association; www.nema.org.
144. NETA - InterNational Electrical Testing Association; www.netaworld.org.
145. NFHS - National Federation of State High School Associations; www.nfhs.org.
146. NFPA - National Fire Protection Association; www.nfpa.org.
147. NFPA - NFPA International; (See NFPA).
148. NFRC - National Fenestration Rating Council; www.nfrc.org.
149. NHLA - National Hardwood Lumber Association; www.nhla.com.
150. NLGA - National Lumber Grades Authority; www.nlga.org.
151. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
152. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
153. NRCA - National Roofing Contractors Association; www.nrca.net.
154. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
155. NSF - NSF International; www.nsf.org.
156. NSPE - National Society of Professional Engineers; www.nspe.org.
157. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
158. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
159. NWFA - National Wood Flooring Association; www.nwfa.org.
160. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
161. PDI - Plumbing & Drainage Institute; www.pdionline.org.
162. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
163. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
164. RFCI - Resilient Floor Covering Institute; www.rfci.com.

165. RIS - Redwood Inspection Service; www.redwoodinspection.com.
166. SAE - SAE International; www.sae.org.
167. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
168. SDI - Steel Deck Institute; www.sdi.org.
169. SDI - Steel Door Institute; www.steeldoor.org.
170. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
171. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
172. SIA - Security Industry Association; www.siaonline.org.
173. SJI - Steel Joist Institute; www.steeljoist.org.
174. SMA - Screen Manufacturers Association; www.smainfo.org.
175. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
176. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
177. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
178. SPIB - Southern Pine Inspection Bureau; www.spib.org.
179. SPRI - Single Ply Roofing Industry; www.spri.org.
180. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
181. SSINA - Specialty Steel Industry of North America; www.ssina.com.
182. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
183. STI - Steel Tank Institute; www.steeltank.com.
184. SWI - Steel Window Institute; www.steelwindows.com.
185. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
186. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
187. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
188. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
189. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
190. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
191. TMS - The Masonry Society; www.masonrysociety.org.
192. TPI - Truss Plate Institute; www.tpinst.org.
193. TPI - Turfgrass Producers International; www.turfgrasssod.org.
194. TRI - Tile Roofing Institute; www.tilerroofing.org.
195. UL - Underwriters Laboratories Inc.; <http://www.ul.com>.
196. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
197. USAV - USA Volleyball; www.usavolleyball.org.
198. USGBC - U.S. Green Building Council; www.usgbc.org.
199. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
200. WA - Wallcoverings Association; www.wallcoverings.org.
201. WASTEC - Waste Equipment Technology Association; www.wastec.org.
202. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
203. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
204. WDMA - Window & Door Manufacturers Association; www.wdma.com.
205. WI - Woodwork Institute; www.wicnet.org.
206. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
207. WWPA - Western Wood Products Association; www.wwpa.org.

- C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.
1. COE - Army Corps of Engineers; www.usace.army.mil.
 2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
 3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
 4. DOD - Department of Defense; www.quicksearch.dla.mil.
 5. DOE - Department of Energy; www.energy.gov.
 6. EPA - Environmental Protection Agency; www.epa.gov.
 7. FAA - Federal Aviation Administration; www.faa.gov.
 8. FG - Federal Government Publications; www.gpo.gov/fdsys.
 9. GSA - General Services Administration; www.gsa.gov.
 10. HUD - Department of Housing and Urban Development; www.hud.gov.
 11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
 12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
 13. SD - Department of State; www.state.gov.
 14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
 15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
 16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
 17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
 18. USP - U.S. Pharmacopeial Convention; www.usp.org.
 19. USPS - United States Postal Service; www.usps.com.
- D. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 014200

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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 011200 "Multiple Contract Summary" for responsibilities for temporary facilities and controls for projects utilizing multiple contracts.
 - 3. Section 012100 "Allowances" for allowance for metered use of temporary utilities.

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 and Sewer Service from Existing System: Water from Owner's existing water system is available for use 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 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.

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 TEMPORARY FACILITIES

- A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. General Contractor's Field Office: Of sufficient size, but minimum 12-feet by 50-feet, to accommodate needs of Owner, Engineer, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections for duration of project. Keep office clean and orderly. Furnish and equip offices as follows:
 - 1. Field office trailer shall have at least one office, one conference room, one bathroom, one closet, and two exterior doors.
 - 2. Conference room shall include built-in plan table.
 - 3. Engineer's field office shall be weather-tight construction with floor, walls, and ceiling completely insulated. Each room shall have at least one operating window. Each window shall have a venetian blind and full insect screen. Furnish two sets of keys for each exterior door. Provide fully insulated skirting on all sides of the field office trailer. Provide steps, platforms, handrails, and boot scrapers for each exterior door.
 - 4. Field office trailer shall be Mobile Mini, ModSpace, Williams Scotsman, or equal. Converted storage or box containers will not be acceptable.
 - 5. Furnishings:

- a. Provide the following furnishings for the Engineer's temporary field office for the duration of the project. All furnishings shall be new – or in very good condition – subject to approval of the Engineer.
 - 1) Two 60-inch by 30-inch desks with file drawer and 5 drawers, all lockable.
 - 2) Upholstered swivel type chair with arms for each desk.
 - 3) One 30-inch by 84-inch conference table.
 - 4) Eight armless side chairs (stacking type).
 - 5) One 54-inch by 30-inch folding tables.
 - 6) One file cabinet, 4 drawer, legal size, Hon No. HN-315C, or equal.
 - 7) Two wastebaskets.
 - 8) One rolling plan storage rack, 10-stick capacity.
 - 9) One lockable storage cabinet, 72-inch high, 36-inch wide, and 18-inch deep.
 - 10) One steel bookcase units, 4 shelves high, Hon No. HN-S48 ABC, or equal.
 - 11) One electric bottled water dispenser with hot and cold outlets and refrigerator unit. Adequate water bottles shall be provided (and paid for by the Contractor) until Final Completion.
 - 12) One wall-mounted first aid kit, McMaster-Carr 9501T1 or equal.
 - 13) Two smoke detectors, with batteries.
 - 14) Two dry erase boards, aluminum frame, 36-inch by 60-inch, markers and eraser, Quartet Model No. TS-S 535 or equal.
 - 15) One 1000-watt minimum 1.4-cu.ft. microwave oven.
 - 16) One 6-cf refrigerator.
 - 17) Commercial duty cross-cut shredder with basket, designed for 3 to 5 users, Fellowes Powershred SB-125i, or equal.
 - 18) One first aid kit, OSHA (1910.151.b) and ANSI (Z308.1-2003) compliant, suitable for ten people.
6. Equipment:
 - a. Contractor shall provide all equipment for the General Contractor's temporary field office for the duration of the project.
7. Services:
 - a. Provide the following services for the duration of the project. Services shall include all costs for installation, use, maintenance, and removal of all products, services and equipment billed by each provider for each service specified herein.
 - b. Field office shall have complete and fully functional electrical, plumbing, and HVAC systems. Provide at least two smoke detectors hard-wired into the electrical system. Perform all scheduled and unscheduled maintenance for all systems and as directed by the Engineer.
 - c. Electrical System: Provide connection to temporary electric service. Comply with the electrical requirements of the furnished office trailer. Provide main circuit panel, sufficient GFCI outlets and lighting in each room, exterior lights at each exterior door, and proper grounding of entire electrical system.
 - d. HVAC System: Provide central heating and air conditioning system with programmable thermostat. System shall be capable of maintaining an interior temperature of 70 degrees F when the exterior temperature is 0 degrees F and an interior temperature of 75 degrees F when exterior temperature is 100 degrees F.

- e. Bottled water service: Provide bottled water service complete with dispenser with hot- and cold-water taps and regular bottle and cup replenishment as directed by the Engineer.
 - f. Janitorial service: Provide janitorial services (at least weekly) that include dusting, sweeping, vacuuming, mopping, disinfection, and trash removal.
 - g. Sanitary service: Provide regular pumping of waste holding tank, if applicable, as needed.
 - h. Internet Access:
 - 1) Provide a high-speed DSL data line or T1 cable line with internet access for the duration of the project.
 - i. Pay all costs for installation, maintenance, and removal of the telephone and internet service and instruments, including cellular phone service. The monthly cost of all calls made and received by the Engineer, including toll and long-distance calls, shall be paid for by the Contractor for the duration of the project.
8. Supplies: Provide the following supplies for the duration of the project: copy paper, toner, toilet paper, paper towels, soap, light bulbs, and other consumables as required by the Engineer.

2.2 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction and marked for intended location and application.

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 where shown on the Drawings or 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. Engineer's trailer shall be set up and ready for occupancy within 30 days of the Notice to Proceed.
 - 1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."
- B. Provide each facility ready for use within 30 days of the Notice to Proceed and prior to Commencement of Work at the site. Do not remove until approved by Engineer or are replaced by authorized use of completed permanent facilities.

3.3 CONTRACTOR'S FIELD OFFICE

- A. Provide a temporary field office(s) for the Contractor's use for the duration of the project. An authorized representative of the Contractor shall be present at all times while the Work is in progress. Instructions received at the Contractors field office from the Engineer shall be considered delivered to the Contractor.
- B. Locate field office(s) in accordance with approved shop drawings and as directed by the Owner.
- C. Establish and occupy field office within 30 days of the Notice to Proceed, unless otherwise approved by the Engineer or Owner.

3.4 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: If approved, connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Final Completion, restore these facilities to condition existing before initial use.
- 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 area where work is to be performed.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area, using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 - 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: Provide by Electrical Subcontractor, 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.
- G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Connect temporary service to Owner's existing power source, as directed by Owner.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- I. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Engineer and Owner.

3.5 SUPPORT FACILITIES INSTALLATION

- A. Comply with the following:
 - 1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
 - 2. Utilize designated area within existing building for temporary field offices.
 - 3. Maintain support facilities until Engineer schedules Final Completion inspection. Remove just before Final Completion.
- B. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

- C. Storage and Staging: Use designated areas of Project site for storage and staging needs.
- D. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.
- E. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 - 1. Identification Signs: Provide Project identification signs as indicated on Drawings. Signs shall be constructed of A-A Ext – APA grade plywood, 1-in thick. Posts and braces shall be of pressure treated lumber.
 - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 - 3. Maintain and touch up signs, so they are legible at all times.
- F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."
- G. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- H. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
 - 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas, so no evidence remains of correction work.

3.6 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
 - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Section 011000 "Summary."
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- F. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- G. 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.
- H. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.
- I. Weather protection shall comply with M.G.L. Chapter 149 Section 44G.

3.7 MOISTURE AND MOLD CONTROL

- A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed material from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.
 - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 - 2. Keep interior spaces reasonably clean and protected from water damage.
 - 3. Periodically collect and remove waste containing cellulose or other organic matter.
 - 4. Discard or replace water-damaged material.
 - 5. Do not install material that is wet.
 - 6. Discard and replace stored or installed material that begins to grow mold.
 - 7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
 - 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 - 2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
 - 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Engineer.
 - c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.8 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.
 - 2. Clear snow and ice from all drives, walks and stairs to maintain safe vehicle and pedestrian access to the site and facilities as directed by the Engineer.
- 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. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 - 3. 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

SECTION 015353 - TEMPORARY BYPASS PUMPING 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. Field testing and operation of temporary bypass pumping systems as proposed by the Contractor for the purpose of diverting flow around work areas as required by the provisions specified in Section 013100 "Project Management and Coordination".
2. Design and operate bypass pumping system. Submit design to Owner and Engineer for comment as part of submittal process.
3. Bypass pumping requires 24 hours per day operation during the work at the WRRF, until the systems being bypassed are substantially completed and are capable of being returned to service.
4. Maintenance of temporary bypass pumping systems throughout the required period of service.
5. Provide maintenance personnel onsite within 30 minutes of receiving notice (or overflow alarms) that there are problems associated with bypass pumping system.
6. Removal of temporary bypass pumping systems from site.
7. Manufacturer recommended preventive maintenance and on-call repair services and equipment replacement.
8. Contractor Option of Diesel Fuel: Total storage quantity of fuel allowable at the plant site to operate the temporary pumps shall not exceed the sum of the individual fuel tank capacities provided with each pump's diesel engine drive. Provide a refueling service to maintain continuous 24-hours per day, seven days per week pumping system operation.

- B. Related Requirements:

1. Section 013100 "Project Management and Coordination."

1.3 ACTION SUBMITTALS

- A. A detailed description of each proposed temporary bypass pumping system, including pumps, pump drives, piping, hoses, valves, fittings, controls, wiring and any other related accessories required to provide a complete operating system.
- B. Detailed plans and sections showing the proposed pumping system layout including dimensions and elevations. Include the following:
 1. Staging area and access requirements for all pumps.

2. Number, size, material, location and method of installation of suction piping.
 3. Number, size, material, location and method of installation of discharge piping.
 4. Pump size, capacity, number of units, diesel engine specifications, fuel tank capacity, fuel consumption requirements, and method of refueling.
 5. Calculations of static lift, pipe size selection, friction losses, flow velocity and pump selection.
 6. Pump curves showing pump operating range.
 7. Proposed method of freeze protection.
 8. Proposed method of noise control for each pump.
 9. Temporary pipe supports, anchorage, cover material and other accessories as required to stabilize the piping system.
 10. Installation schedule and maintenance schedule.
 11. Vendor phone number and pager number for 24-hour service.
 12. A minimum of five reference installations of projects with similar size in wastewater pumping applications. Include contact names and phone numbers.
 13. List of recommended spare parts to be stored on-site for emergency maintenance.
- C. Qualification Data: Information on the vendor's service staff capabilities and replacement parts inventory to show that the vendor has sufficient resources to provide emergency service and replacement equipment and/or parts to the site within 4 hours of a service call.
- D. Description of System Operation and Controls: Include a list of all alarm conditions and procedures for correcting problems including equipment replacement.
- E. Proposed Procedures for Facility Start-Up and Testing: Include description and schedule to demonstrate compliance with specified automatic operation and maintenance of a constant discharge pressure.
- F. Operations Plan for Inclement Weather: Demonstrate the ability to maintain pumping system operations throughout inclement weather events, including snow storms.
- G. Proposed Procedures for Dismantling the System: Include description, schedule, and restoration procedures to normal operations at the facility.
- H. Contractor's operational vendor will review and verify bypass pumping system design and submit system layout drawings to Engineer for review and approval.
- 1.4 QUALITY ASSURANCE
- A. Employ the services of a vendor who can demonstrate five years of recent and continuous specialization in the design, installation, operation and removal of temporary bypass pumping systems in wastewater applications. Provide complete system from a single vendor capable of providing service staff, repair parts and replacement of any deficient system component within four hours of a service call, contactable 24-hours per day, seven days per week via telephone or pager.
- B. Provide the services of the manufacturer's representative for physical checkout field testing and operation and maintenance instruction for a minimum of one person day per pumping system. See requirements in PART 3.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Rain For Rent, Avon, NY.
 2. Goodwin Pumps of America, Bridgeport, NJ.
 3. Acme Dynamics, Plant City, FL.
 4. Thompson Pump and Manufacturing Co, Port Orange, FL.
 5. Or Equal.

2.2 SYSTEM DESCRIPTION

- A. Temporary Bypass Pumping System: Provide complete system with pumps, drives, piping, piping headers, valves, flow meter, controls, and appurtenances, from a single vendor.
- B. Pumps, Drives and Controls: Design and built for 24-hour continuous service at any and all points within the required range of operation, without overheating, without cavitation, and without excessive vibration or strain. Design and proportion parts to have the strength, stability and stiffness and construction to meet the specified requirements. Provide methods for inspection, repairs, and adjustment.
- C. Mounting: Provide necessary foundation bolts, nuts, and washers.
- D. Nameplate: Provide each piece of equipment with a nameplate (with embossed data) securely mounted to the body of the equipment. Include a pump nameplate with the manufacturer's name and model number, serial number, rated flow capacity, horsepower, head, speed, input voltage, amps, number of cycles, power and service factors, and all other pertinent data.
- E. Noise: Do not exceed 85 dBA at a distance of 5 feet from any part of the system.
- F. Equipment: Suitable for outdoor operation under adverse weather conditions. Provide protection from freezing as required to maintain system operation.
- G. Pumping System Control Panels: NEMA 4 and including flow indication, a flow totalizer, indicator lamps showing which pumps are operating, selector switch for auto or manual start and stop for each pump and visual and audible alarms for indication of operation failure and alarm conditions.

2.3 PERFORMANCE REQUIREMENTS

- A. Capacities and Characteristics:
1. Pumps: Identical in every respect with all parts interchangeable; designed for the conditions of service; have a rising head capacity curve for stable pump operation from the minimum head operating point to the shut-off head.

- a. Service: Temporary Bypass Pumping.
 - b. Number of Pumps: As required by the Application, including one additional for standby.
 - c. Liquid: Raw Wastewater.
 - d. Design Capacity Total Peak (gpm): Minimum of 17 MGD or as required by the application.
 - e. Type of Drive: Diesel engine or Electric.
2. Pumping System Components:
- a. Type: Centrifugal, end suction, fully automatic self-priming units that do not require the use of foot-valves, vacuum pumps, diaphragm pumps, or isolation valves or float apparatus in the priming system.
 - b. Pump Seals: High pressure, mechanical self-adjusting type with solid carbide faces capable of withstanding suction pressures to 100 psi without the pump running. Cool and lubricate mechanical seal in an oil bath reservoir, requiring no maintenance or adjustment. Keep oil bath reservoir from contacting or leaking into the pumped water. Provide pumps capable of running dry, with no damage for extended periods of time. Provide stainless steel pump seal metal parts. Provide Viton elastomers.
 - c. Pump Drive: Diesel engine or electric motor; water cooled. If the Contractor uses electric motor driven pumps, power costs are the responsibility of the Contractor.
 - c. If using diesel driven pumps, provide skid mounted pumps and diesel engines with integral fuel tank and skid lifting bracket.
 - d. Controls: Provide automatic start/stop for the pumping system to automatically maintain system flow. Provide controls contained in a local control panel with provision to manually operate each pump. Provide indication of pump operation, and indicate the total flow being pumped.
 - e. Provide all required suction and discharge pipe and fittings, discharge manifold pipe and fittings, shutoff valves, check valves, flow meter, pressure regulating valves, insulation, freeze protection, and all required accessories.
 - f. Pipe and Fittings: Steel with flanged or quick connect coupling connections, or high-density polyethylene pipe with fused joints.
 - 1) Joints: Provide 100 percent restrained joints.
 - 2) Suction Piping: Rated for 25-in Hg vacuum.
 - 3) Discharge Piping, Fittings, Connections, Valves, and Other Discharge Piping Accessories: Rated for a minimum working pressure of 150 psi.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with the system supplier's recommendations and approved shop drawing submittals.
- B. Perform plugging or blocking of wastewater flows using linestops and/or insert valves installed by contractor's plan approved by Engineer. When plugging or blocking is no longer needed for

performance of work, remove plugs in a manner that permits wastewater flow to slowly return to normal without surge, surcharging, or causing other major disturbances downstream.

- C. Contractor is responsible and liable for wastewater overflows resulting from inadequate construction, maintenance or operation of bypass system, including reporting to the State of New York and any resulting fines.
- D. In the event of accidental spill or overflow, immediately stop discharge and take action to clean up and disinfect the spill. Promptly notify the Owner and Engineer so that required reporting can be made.
- E. Install pumping units on a firm level surface.
- F. Provide the services of the pump system supplier's representative for a minimum of one day per temporary bypass system to assist equipment installation and physical checkout.

3.2 FIELD QUALITY CONTROL

- A. Provide field in accordance with the approved shop drawing submittal. Field tests shall demonstrate conformance with system requirements.
- B. Conduct field testing in the presence of the Engineer. Provide the services of the pump system supplier's representative for a minimum of one day per temporary bypass system to conduct required testing.
- C. Demonstrate a minimum of 24-hours of continuous operation, demonstrating the ability to automatically start and stop pumps in response to changing flow conditions before taking existing facilities offline.
 - 1. Perform leakage and pressure tests of bypass pumping discharge piping using clean water prior to actual operation.
 - 2. Existing pumps can be removed from service if system operates successfully during this period.
 - 3. Make repairs/modifications and restart demonstration period, if system does not operate successfully.
- D. Remove and replace any system component that fails to perform without additional compensation.

3.3 SYSTEM OPERATION

- A. Perform all required maintenance on the equipment to maintain the system integrity and capacity as specified.
- B. Provide clean-up and disposal of contaminated material and reporting for all product spills.

3.4 EQUIPMENT REMOVAL

- A. At the completion of the period of service, disconnect all temporary piping and remove all system components from the site. Restore the work site to its original condition.

END OF SECTION 015353

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 012100 "Allowances" for products selected under an allowance.
 - 3. Section 012500 "Substitution Procedures" for requests for substitutions.
 - 4. Section 014200 "References" for applicable industry standards for products specified.
 - 5. 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.
 - 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."
 - F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.
- 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, 26, 27, 28, 40, 43, 44, and 46 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.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

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. Where products are accompanied by the term "as selected," Engineer will make selection.

5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. 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.

- 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.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "match Engineer's sample," provide a product that complies with requirements and matches Engineer's sample. Engineer's decision will be final on whether a proposed product matches.
 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Engineer from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Engineer will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
- E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.
 1. Select products for which sustainable design documentation submittals are available from manufacturer.

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.
- D. Submittal Requirements, Single-Step Process: When acceptable to Engineer, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Engineer of Contractor' request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 016000

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SECTION 017300 - EXECUTION

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 general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner's portion of the Work.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for coordination, and limits on use of Project site.
 - 2. Section 013300 "Submittal Procedures" for submitting surveys.
 - 3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.4 PREINSTALLATION MEETINGS

- A. Cutting and Patching Conference: Conduct conference at Project site.
 - 1. Prior to submitting cutting and patching plan, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and

patching work. Inform Engineer of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:

- a. Contractor's superintendent.
 - b. Trade supervisor responsible for cutting operations.
 - c. Trade supervisor(s) responsible for patching of each type of substrate.
 - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.
2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- B. Layout Conference: Conduct conference at Project site.
1. Prior to establishing layout of new perimeter and structural column grid(s), review building location requirements. Review benchmark, control point, and layout and dimension requirements. Inform Engineer of scheduled meeting. Require representatives of each entity directly concerned with Project layout to attend, including the following:
 - a. Contractor's superintendent.
 - b. Professional surveyor responsible for performing Project surveying and layout.
 2. Review meanings and intent of dimensions, notes, terms, graphic symbols, and other layout information indicated on the Drawings.
 3. Review requirements for including layouts on Shop Drawings and other submittals.
 4. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 4. Dates: Indicate when cutting and patching will be performed.
 5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

- C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.6 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

- 1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements, whose structural function is not known, notify Engineer of locations and details of cutting and await directions from Engineer before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.

- 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:

- a. Primary operational systems and equipment.
- b. Fire separation assemblies.
- c. Air or smoke barriers.
- d. Fire-suppression systems.
- e. Plumbing piping systems.
- f. Mechanical systems piping and ducts.
- g. Control systems.
- h. Communication systems.
- i. Fire-detection and -alarm systems.
- j. Conveying systems.
- k. Electrical wiring systems.
- l. Operating systems of special construction.

- 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:

- a. Water, moisture, or vapor barriers.
- b. Membranes and flashings.
- c. Exterior curtain-wall construction.
- d. Sprayed fire-resistive material.
- e. Equipment supports.
- f. Piping, ductwork, vessels, and equipment.
- g. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Engineer for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. 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.
1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Engineer in accordance to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Engineer promptly.
- B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.

5. Check the location, level and plumb, of every major element as the Work progresses.
 6. Notify Engineer when deviations from required lines and levels exceed allowable tolerances.
 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer.

3.4 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Engineer. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items onsite and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. 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.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Engineer. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
 - 1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.5 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."

- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Engineer. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.

5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 COORDINATION OF OWNER'S PORTION OF THE WORK

- A. Site Access: Provide access to Project site for Owner's construction personnel.
 1. Refer to Section 011000 "Summary" for other requirements for and Owner-furnished, Owner-installed work.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel .
 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.

3.7 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
 1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

- D. **Installed Work:** Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. **Concealed Spaces:** Remove debris from concealed spaces before enclosing the space.
- F. **Exposed Surfaces:** Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. **Waste Disposal:** Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls." and Section 017419 "Construction Waste Management and Disposal."
- H. **During handling and installation,** clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. **Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period.** Adjust and lubricate operable components to ensure operability without damaging effects.
- J. **Limiting Exposures:** Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

- A. **Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."**
- B. **Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.**
- C. **Adjust equipment for proper operation. Adjust operating components for proper operation without binding.**
- D. **Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.**
- E. **Manufacturer's Field Service:** Comply with qualification requirements in Section 014000 "Quality Requirements."

3.9 PROTECTION AND REPAIR OF INSTALLED CONSTRUCTION

- A. **Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.**

- B. Repair Work previously completed and subsequently damaged during construction period
Repair to like-new condition.
- C. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- D. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

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SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

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. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
 - 1. Section 011200 "Multiple Contract Summary" for coordination of responsibilities for waste management.
 - 2. Section 311000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within **7** days of date established for the Notice to Proceed.

1.6 INFORMATIONAL SUBMITTALS

- A. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- B. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- C. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- D. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.7 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements. Superintendent may serve as Waste Management Coordinator.
- B. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

PART 2 - EXECUTION

2.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 - 1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."
- B. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
 - 2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

2.2 SALVAGING DEMOLITION WASTE

- A. Comply with requirements in Section 024119 "Selective Demolition" for salvaging demolition waste.
- B. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 3. Store items in a secure area until installation.
 - 4. Protect items from damage during transport and storage.
 - 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 3. Store items in a secure area until delivery to Owner.
 - 4. Transport items to Owner's storage area designated by Owner.
 - 5. Protect items from damage during transport and storage.
- D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

- E. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- F. Plumbing Fixtures: Separate by type and size.
- G. Lighting Fixtures: Separate lamps by type and protect from breakage.
- H. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

2.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

2.4 RECYCLING DEMOLITION WASTE

- A. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.
- B. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- C. Metals: Separate metals by type.
 - 1. Structural Steel: Stack members according to size, type of member, and length.

2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- D. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.
- E. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- F. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- G. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.
- H. Conduit: Reduce conduit to straight lengths and store by material and size.
- I. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

2.5 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner's property.
- C. Burning: Do not burn waste materials.

END OF SECTION 017419

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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.
 - 5. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

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.

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.
- C. Field Report: For pest-control inspection.

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 Engineer'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. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, 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 pest-control final inspection report.
5. 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, starting with exterior areas first proceeding from lowest floor to highest floor, 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.

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. 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.

- E. 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.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 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. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. 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.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Clean flooring, removing debris, dirt, and staining: clean according to manufacturer's recommendations.
 - i. Vacuum and mop concrete.

- j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - k. 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.
 - l. Remove labels that are not permanent.
 - m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - p. Clean ducts, blowers, and coils.
 - 1) Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.
 - q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
 - r. Clean strainers.
 - s. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls." and Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations required by Section 017300 "Execution" 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 documentation directory 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 011200 "Multiple Contract Summary" for coordinating operation and maintenance manuals covering the Work of multiple contracts.
 - 2. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 3. Section 019113 "General Commissioning Requirements" for verification and compilation of data into 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 on digital media acceptable to Engineer. Enable reviewer comments on draft submittals.
 2. Submit three paper copies. Engineer will return one copy.
- C. Initial Manual Submittal: Submit 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.
- 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. Engineer will return copy with comments.
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.
- 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.

1.6 REQUIREMENTS FOR 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 the documentation directory and 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 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.

1.8 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.

1.9 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

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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 Product Data.
 - 3. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 011200 "Multiple Contract Summary" for coordinating Project Record Documents covering the Work of multiple contracts.
 - 2. Section 012900 "Payment Procedures" for maintaining and exhibiting project record documents as a prerequisite for progress payments.
 - 3. Section 017300 "Execution"
 - 4. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 5. 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 and one set of file 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.

- 2) Print each drawing, whether or not changes and additional information were recorded.

B. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

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 Change Order or 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 with comment function enabled.
 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. See Section 013100 "Project Management and Coordination" for requirements related to use of Engineer's digital data files.
 - b. 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 with comment function enabled.
 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 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 manufacturer's 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.
 - 1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.6 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 017900 - DEMONSTRATION AND TRAINING

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 instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 - 2. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For instructor.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Engineer.

- d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Date of video recording.
2. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
 3. At completion of training, submit complete training manual(s) for Owner's use prepared in same PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.5 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Engineer.

1.7 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.

- f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.
 - f. Identification systems.
 - g. Warranties and bonds.
 - h. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.

7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning.
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.

8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

1.8 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.9 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 1. Engineer will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 2. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 1. Schedule training with Owner with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
- F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.10 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode.
 - 1. Submit video recordings on CD-ROM or thumb drive.
 - 2. File Hierarchy: Organize folder structure and file locations according to Project Manual table of contents. Provide complete screen-based menu.
 - 3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
 - 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged according to Project Manual table of contents:
 - a. Name of Contractor/Installer.
 - b. Business address.
 - c. Business phone number.
 - d. Point of contact.
 - e. Email address.
- B. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
 - 1. Film training session(s) in segments not to exceed 15 minutes.
 - a. Produce segments to present a single significant piece of equipment per segment.
 - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- C. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
 - 1. Furnish additional portable lighting as required.
- D. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

- E. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017900

SECTION 019113 - GENERAL COMMISSIONING 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.
- B. Owner's Project Requirements and Basis-of-Design Document are included by reference for information only.

1.2 SUMMARY

A. Section Includes:

1. General requirements for coordinating and scheduling commissioning activities.
2. Commissioning meetings.
3. Commissioning reports.
4. Use of commissioning process test equipment, instrumentation, and tools.
5. Construction checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
6. Commissioning tests and commissioning test demonstration.
7. Adjusting, verifying, and documenting identified systems and assemblies.

B. Related Requirements:

1. Section 011000 "Summary" for Commissioning Authority responsibilities.
2. Section 011200 "Multiple Contract Summary" for Commissioning Authority responsibilities.
3. Section 013300 "Submittal Procedures" for submittal procedure requirements for commissioning process.
4. Section 017700 "Closeout Procedures" for Certificate of Construction-Phase Commissioning Process Completion submittal requirements.
5. Section 017823 "Operation and Maintenance Data" for preliminary operation and maintenance data submittal requirements.
6. Section 408000 "Commissioning of Process Systems" for technical commissioning requirements for process systems.

1.3 DEFINITIONS

- A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, construction checklists, performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.

- B. **Basis-of-Design Document:** A document prepared by Engineer that records concepts, calculations, decisions, and product selections used to comply with Owner's Project Requirements and to suit applicable regulatory requirements, standards, and guidelines.
- C. **Commissioning:** A quality-focused process for verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, and tested to comply with Owner's Project Requirements. The requirements specified here are limited to the construction phase commissioning activities. The scope of the commissioning process is defined in Section 011200 "Multiple Contract Summary."
- D. **Construction-Phase Commissioning-Process Completion:** The stage of completion and acceptance of commissioning process when resolution of deficient conditions and issues discovered during commissioning process and retesting until acceptable results are obtained has been accomplished. Owner will establish in writing the date construction-phase commissioning-process completion is achieved. See Section 017700 "Closeout Procedures" for Certificate of Construction-Phase Commissioning Process Completion submittal requirements.
 - 1. Commissioning process is complete when the Work specified of this Section and related Sections has been completed and accepted, including, but not limited to, the following:
 - a. Completion of tests and acceptance of test results.
 - b. Resolution of issues, as verified by retests performed and documented with acceptance of retest results.
 - c. Comply with requirements in Section 017900 "Demonstration and Training."
 - d. Completion and acceptance of submittals and reports.
- E. **Owner's Project Requirements:** A document that details the functional requirements of a project and the expectations of how it will be used and operated, including Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. This document is prepared either by the Owner or for the Owner by the Engineer or Commissioning Authority.
- F. **Owner's Witness:** Commissioning Authority, Owner's Project Manager, or Engineer-designated witness authorized to authenticate test demonstration data and to sign completed test data forms.
- G. **"Systems," "Assemblies," "Subsystems," "Equipment," and "Components":** Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.
- H. **Test:** Performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.
- I. **Sampling Procedures and Tables for Inspection by Attributes:** As defined in ASQ Z1.4.

1.4 COMPENSATION

- A. If Engineer, other Owner's witness, or Owner's staff perform additional services or incur additional expenses due to actions of Contractor listed below, compensate Owner for such additional services and expenses.

1. Failure to provide timely notice of commissioning activities schedule changes.
2. Failure to meet acceptance criteria for test demonstrations.

1.5 COMMISSIONING TEAM

A. Members Appointed by Contractor(s):

1. Commissioning Coordinator: A person or entity employed by Contractor to manage, schedule, and coordinate commissioning process.
2. Project superintendent and other employees that Contractor may deem appropriate for a particular portion of the commissioning process.
3. Subcontractors, installers, suppliers, and specialists that Contractor may deem appropriate for a particular portion of the commissioning process.
4. Appointed team members shall have the authority to act on behalf of the entity they represent.

B. Members Appointed by Owner:

1. Owner representative(s), facility operations and maintenance personnel, plus other employees, separate contractors, and consultants that Owner may deem appropriate for a particular portion of the commissioning process.
2. Engineer, plus employees and consultants that Engineer may deem appropriate for a particular portion of the commissioning process.

1.6 INFORMATIONAL SUBMITTALS

A. Comply with requirements in Section 013300 "Submittal Procedures" for submittal procedure general requirements for commissioning process.

B. Commissioning Plan Information:

1. List of Contractor-appointed commissioning team members to include specific personnel and subcontractors performing the various commissioning requirements.
2. Schedule of commissioning activities, integrated with the Construction Schedule. Comply with requirements in Section 013200 "Construction Progress Documentation" for the Construction Schedule general requirements for commissioning process.
3. Contractor personnel and subcontractors participating in each test.
4. List of instrumentation required for each test to include identification of parties that will provide instrumentation for each test.

C. Commissioning schedule.

D. Two-week look-ahead schedules.

E. Commissioning Coordinator Qualification Data: For entity coordinating Contractor's commissioning activities to demonstrate their capabilities and experience.

1. Experienced: When used with an entity or individual, "experienced" 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.

F. List test instrumentation, equipment, and monitoring devices. Include the following information:

1. Make, model, serial number, and application for each instrument, equipment, and monitoring device.
2. Brief description of intended use.
3. Calibration record showing the following:
 - a. Calibration agency, including name and contact information.
 - b. Last date of calibration.
 - c. Range of values for which calibration is valid.
 - d. Certification of accuracy.
 - e. Certification for calibration equipment traceable to NIST.
 - f. Due date of the next calibration.

G. Test Reports:

1. Pre-Startup Report: Prior to startup of equipment or a system, submit signed, completed construction checklists.
2. Test Data Reports: At the end of each day in which tests are conducted, submit test data for tests performed.
3. Commissioning Issue Reports: Daily, at the end of each day in which tests are conducted, submit commissioning issue reports for tests for which acceptable results were not achieved.
4. Weekly Progress Report: Weekly, at the end of each week in which tests are conducted, submit a progress report.
5. Data Trend Logs: Submit data trend logs at the end of the trend log period.
6. System Alarm Logs: Daily, at the start of days following a day in which tests were performed, submit printout of log of alarms that occurred since the last log was printed.

H. Construction Checklists:

1. Material checks.
2. Installation checks.
3. Startup procedures, where required.

1.7 CLOSEOUT SUBMITTALS

A. Commissioning Report:

1. At Construction-Phase Commissioning Completion, include the following:
 - a. Pre-startup reports.
 - b. Approved test procedures.
 - c. Test data forms completed and signed.
 - d. Progress reports.
 - e. Commissioning issue report log.

- f. Commissioning issue reports showing resolution of issues.
 - g. Correspondence or other documents related to resolution of issues.
 - h. Other reports required by commissioning process.
 - i. List unresolved issues and reasons they remain unresolved and should be exempted from the requirements for Construction-Phase Commissioning Completion.
 - j. Report shall include commissioning work of Contractor.
- B. Request for Certificate of Construction-Phase Commissioning Process Completion.
- C. Operation and Maintenance Data: For proprietary test equipment, instrumentation, and tools to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

- A. Test equipment and instrumentation required to perform the commissioning process shall remain the property of Contractor unless otherwise indicated.
- B. Test equipment and instrumentation required to perform commissioning process shall comply with the following criteria:
- 1. Be manufactured for the purpose of testing and measuring tests for which they are being used and have an accuracy to test and measure system performance within the tolerances required to determine acceptable performance.
 - 2. Calibrated and certified.
 - a. Calibration performed and documented by a qualified calibration agency according to national standards applicable to the tools and instrumentation being calibrated. Calibration shall be current according to national standards or within test equipment and instrumentation manufacturer's recommended intervals, whichever is more frequent, but not less than within six months of initial use on Project. Calibration tags shall be permanently affixed.
 - b. Repair and recalibrate test equipment and instrumentation if dismantled, dropped, or damaged since last calibrated.
 - 3. Maintain test equipment and instrumentation.
 - 4. Use test equipment and instrumentation only for testing or monitoring Work for which they are designed.

2.2 PROPRIETARY TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

- A. Proprietary test equipment, instrumentation, and tools are those manufactured or prescribed by tested equipment manufacturer and required for work on its equipment as a condition of equipment warranty, or as otherwise required to service, repair, adjust, calibrate, or perform work on its equipment.

1. Identify proprietary test equipment, instrumentation, and tools required in the test equipment identification list submittal.
2. Proprietary test equipment, instrumentation, and tools shall become the property of Owner at Substantial Completion.

2.3 REPORT FORMAT AND ORGANIZATION

A. General Format and Organization:

1. Record report on compact disk.
2. Electronic Data: Portable document format (PDF); a single file with outline-organized bookmarks for major and minor tabs and tab contents itemized for specific reports.

B. Commissioning Report:

1. Include a table of contents and an index to each test.
2. Include major tabs for each Specification Section.
3. Include minor tabs for each test.
4. Within each minor tab, include the following:
 - a. Test specification.
 - b. Pre-startup reports.
 - c. Approved test procedures.
 - d. Test data forms completed and signed.
 - e. Commissioning issue reports, showing resolution of issues, and documentation related to resolution of issues pertaining to a single test. Group data forms, commissioning issue reports showing resolution of issues, and documentation related to resolution of issues for each test repetition together within the minor tab, in reverse chronological order (most recent on top).

PART 3 - EXECUTION

3.1 PREPARATION

- A. Review preliminary construction checklists and preliminary test procedures and data forms.

3.2 CONSTRUCTION CHECKLISTS

- A. Construction checklists cannot modify or conflict with the Contract Documents.
- B. Create construction checklists based on actual systems and equipment to be included in Project.
- C. Material Checks: Compare specified characteristics and approved submittals with materials as received. Include factory tests and other evaluations, adjustments, and tests performed prior to shipment if applicable.
 1. Service connection requirements, including configuration, size, location, and other pertinent characteristics.

2. Included optional features.
3. Delivery Receipt Check: Inspect and record physical condition of materials and equipment on delivery to Project site, including agreement with approved submittals, cleanliness, and lack of damage.
4. Installation Checks:
 - a. Location according to Drawings and approved Shop Drawings.
 - b. Configuration.
 - c. Compliance with manufacturers' written installation instructions.
 - d. Attachment to structure.
 - e. Access clearance to allow for maintenance, service, repair, removal, and replacement without the need to disassemble or remove other equipment or building elements. Access coordinated with other building elements and equipment, including, but not limited to, ceiling and wall access panels, in a manner consistent with OSHA fall-protection regulations and safe work practices.
 - f. Utility connections are of the correct characteristics, as applicable.
 - g. Correct labeling and identification.
 - h. Startup Checks: Verify readiness of equipment to be energized. Include manufacturer's standard startup procedures and forms.
- D. Startup: Perform and document initial operation of equipment to prove that it is installed properly and operates as intended according to manufacturer's standard startup procedures, at minimum.
- E. Performance Tests:
 1. Static Tests: As specified elsewhere, including, but not limited to, duct and pipe leakage tests, insulation-resistance tests, and water-penetration tests.
 2. Component Performance Tests: Tests evaluate the performance of an input or output of components under a full range of operating conditions.
 3. Equipment and Assembly Performance Tests: Test and evaluate performance of equipment and assemblies under a full range of operating conditions and loads.
 4. System Performance Tests: Test and evaluate performance of systems under a full range of operating conditions and loads.
 5. Intersystem Performance Tests: Test and evaluate the interface of different systems under a full range of operating conditions and loads.
- F. Deferred Construction Checklists: Obtain Owner approval of proposed deferral of construction checklists, including proposed schedule of completion of each deferred construction checklist, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. When approved, deferred construction checklists may be completed after date of Construction-Phase Commissioning Completion. Include the following in a request for Certificate of Construction-Phase Commissioning Process Completion:
 1. Identify deferred construction checklists by number and title.
 2. Provide a target schedule for completion of deferred construction checklists.
 3. Written approval of proposed deferred construction checklists, including approved schedule of completion of each deferred construction checklist.
- G. Delayed Construction Checklists: Obtain Owner approval of proposed delayed construction checklists, including proposed schedule of completion of each delayed construction checklist,

before submitting request for Certificate of Construction-Phase Commissioning Process Completion. When approved, delayed construction checklists may be completed after date of Construction-Phase Commissioning Completion. Include the following in a request for Certificate of Construction-Phase Commissioning Process Completion:

1. Identify delayed construction checklist by construction checklist number and title.
2. Provide a target schedule for completion of delayed construction checklists.
3. Written approval of proposed delayed construction checklists, including approved schedule of completion of each delayed construction checklist.

3.3 GENERAL EXECUTION REQUIREMENTS

- A. Schedule and coordinate commissioning process with the Construction Schedule.
- B. Perform activities identified in construction checklists, including tests, and document results of actions as construction proceeds.
- C. Perform test demonstrations for Owner's witness. Unless otherwise indicated, demonstrate tests for 100 percent of work to which the test applies. In some instances, demonstration of a random sample of other than 100 percent of the results of a test is specified.
 1. Where sampling is specified, the sampling plan and procedure for the test demonstration shall be determined using ASQ Z1.4.
 2. The "lot size" in ASQ Z1.4 is the sum of the number of items to which the test demonstration applies, as described in the scope subparagraph of each test.
 3. On determination of the sample size, the samples shall be selected randomly by Owner's witness at the time of the test demonstration.
 4. Include in the Commissioning Plan a detailed list of the test demonstrations with lot and sample quantities for each test.
- D. Report test data and commissioning issue resolutions.
- E. Schedule personnel to participate in and perform Commissioning-Process Work.
- F. Installing contractors' commissioning responsibilities include, but are not limited to, the following:
 1. Operating the equipment and systems they install during tests.
 2. In addition, installing contractors may be required to assist in tests of equipment and systems with which their work interfaces.

3.4 COMMISSIONING COORDINATOR RESPONSIBILITIES

- A. Management and Coordination: Manage, schedule, and coordinate commissioning process, including, but not limited to, the following:
 1. Coordinate with subcontractors on their commissioning responsibilities and activities.
 2. Obtain, assemble, and submit commissioning documentation.

3. Conduct periodic on-site commissioning meetings. Comply with requirements in Section 013100 "Project Management and Coordination."
4. Develop and maintain the commissioning schedule. Integrate commissioning schedule into the Construction Schedule. Update Construction Schedule at specified intervals.
5. Review and comment on preliminary test procedures and data forms.
6. Report inconsistencies and issues in system operations.
7. Verify that tests have been completed and results comply with acceptance criteria, and that equipment and systems are ready before scheduling test demonstrations.
8. Direct and coordinate test demonstrations.
9. Coordinate witnessing of test demonstrations by Owner's witness.
10. Coordinate and manage training. Be present during training sessions to direct video recording, present training, and direct the training presentations of others. Comply with requirements in Section 017900 "Demonstration and Training."
11. Prepare and submit specified commissioning reports.
12. Track commissioning issues until resolution and retesting is successfully completed.
13. Retain original records of Commissioning-Process Work, organized as required for the commissioning report. Provide Owner's representative access to these records on request.
14. Assemble and submit commissioning report.

3.5 COMMISSIONING TESTING

- A. Quality Control: Construction checklists, including tests, are quality-control tools designed to improve the functional quality of Project. Test demonstrations evaluate the effectiveness of Contractor's quality-control process.
- B. Owner's witness will be present to witness commissioning work requiring the signature of an owner's witness, including, but not limited to, test demonstrations. Owner's project manager will coordinate attendance by Owner's witness with Contractor's published Commissioning Schedule. Owner's witness will provide no labor or materials in the commissioning work. The only function of Owner's witness will be to observe and comment on the progress and results of commissioning process.
- C. Construction Checklists:
 1. Complete construction checklists as Work is completed.
 2. Distribute construction checklists to installing contractors before they start work.
 3. Installers:
 - a. Verify installation using approved construction checklists as Work proceeds.
 - b. Complete and sign construction checklists weekly for work performed during the preceding week.
 4. Provide Commissioning Authority access to construction checklists.
- D. Installation Compliance Issues: Record as an installation compliance issue Work found to be incomplete, inaccessible, at variance with the Contract Documents, nonfunctional, or that does not comply with construction checklists. Record installation compliance issues on the construction checklist at the time they are identified. Record corrective action and how future Work should be modified before signing off the construction checklist.

- E. Pre-Startup Audit: Prior to executing startup procedures, review completed installation checks to determine readiness for startup and operation. Report conditions, which, if left uncorrected, adversely impact the ability of systems or equipment to operate satisfactorily or to comply with acceptance criteria. Prepare pre-startup report for each system.
- F. Test Procedures and Test Data Forms:
1. Test procedures shall define the step-by-step procedures to be used to execute tests and test demonstrations.
 2. Test procedures shall be specific to the make, model, and application of the equipment and systems being tested.
 3. Completed test data forms are the official records of the test results.
 4. Commissioning Authority will provide to Contractor preliminary test procedures and test data forms for performance tests and commissioning tests after approval of Product Data, Shop Drawings, and preliminary operation and maintenance manual.
 5. Review preliminary test procedures and test data forms, and provide comments within 14 days of receipt from Commissioning Authority. Review shall address the following:
 - a. Equipment protection and warranty issues, including, but not limited to, manufacturers' installation and startup recommendations, and operation and maintenance instructions.
 - b. Applicability of the procedure to the specific software, equipment, and systems approved for installation.
 6. After Contractor has reviewed and commented on the preliminary test procedures and test data forms, Commissioning Authority will revise and reissue the approved revised test procedures and test data forms marked "Approved for Testing."
 7. Use only approved test procedures and test data forms marked "Approved for Testing" to perform and document tests and test demonstrations.
- G. Performance of Tests:
1. The sampling rate for tests is 100 percent. The sampling rate for test demonstrations is 100 percent unless otherwise indicated.
 2. Perform and complete each step of the approved test procedures in the order listed.
 3. Record data observed during performance of tests on approved data forms at the time of test performance and when the results are observed.
 4. Record test results that are not within the range of acceptable results on commissioning issue report forms in addition to recording the results on approved test procedures and data forms according to the "Commissioning Compliance Issues" Paragraph in this Article.
 5. On completion of a test, sign the completed test procedure and data form. Tests for which test procedures and data forms are incomplete, not signed, or which indicate performance that does not comply with acceptance criteria will be rejected. Tests for which test procedures and data forms are rejected shall be repeated and results resubmitted.
- H. Performance of Test Demonstration:
1. Perform test demonstrations on a sample of tests after test data submittals are approved. The sampling rate for test demonstrations shall be 100 percent unless otherwise indicated in the individual test specification.

2. Notify Owner's witness at least three days in advance of each test demonstration.
3. Perform and complete each step of the approved test procedures in the order listed.
4. Record data observed during performance of test demonstrations on approved data forms at the time of demonstration and when the results are observed.
5. Provide full access to Owner's witness to directly observe the performance of all aspects of system response during the test demonstration. On completion of a test demonstration, sign the completed data form and obtain signature of Owner's witness at the time of the test to authenticate the reported results.
6. Test demonstration data forms not signed by Contractor and Owner's witness at the time of the completion of the procedure will be rejected. Test demonstrations for which data forms are rejected shall be repeated and results shall be resubmitted.
 - a. Exception for Failure of Owner's Witness to Attend: Failure of Owner's witness to be present for agreed-on schedule of test demonstration shall not delay Contractor. If Owner's witness fails to attend a scheduled test, Contractor shall proceed with the scheduled test. On completion, Contractor shall sign the data form for Contractor and for Owner's witness and shall note the absence of Owner's witness at the scheduled time and place.

I. Deferred Tests:

1. Deferred Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed deferred tests or other tests approved for deferral until specified seasonal or other conditions are available. When approved, deferred tests may be completed after the date of Construction-Phase Commissioning Completion. Identify proposed deferred tests in the request for Certificate of Construction-Phase Commissioning Process Completion as follows:
 - a. Identify deferred tests by number and title.
 - b. Provide a target schedule for completion of deferred tests.
2. Schedule and coordinate deferred tests. Schedule deferred tests when specified conditions are available. Notify Engineer at least three working days (minimum) in advance of tests.
3. Where deferred tests are specified, coordinate participation of necessary personnel and of Engineer, Commissioning Authority, and Owner's witness. Schedule deferred tests to minimize occupant and facility impact. Obtain Engineer's approval of the proposed schedule.

J. Delayed Tests:

1. Delayed Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed delayed tests. Obtain Owner approval of proposed delayed tests, including proposed schedule of completion of each delayed test, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. Include the following in the request for Certificate of Construction-Phase Commissioning Process Completion:
 - a. Identify delayed tests by test number and title.
 - b. Written approval of proposed delayed tests, including approved schedule of completion of delayed tests.

2. Schedule and coordinate delayed tests. Schedule delayed tests when conditions that caused the delay have been rectified. Notify Engineer and Commissioning Authority at least three working days (minimum) in advance of tests.
3. Where delayed tests are approved, coordinate participation of necessary personnel and of Engineer, Commissioning Authority, and Owner's witness. Schedule delayed tests to minimize occupant and facility impact. Obtain Engineer's approval of the proposed schedule.

K. Commissioning Compliance Issues:

1. Test results that are not within the range of acceptable results are commissioning compliance issues.
2. Track and report commissioning compliance issues until resolution and retesting are successfully completed.
3. If a test demonstration fails, determine the cause of failure. Direct timely resolution of issue and then repeat the demonstration. If a test demonstration must be repeated due to failure caused by Contractor work or materials, reimburse Owner for billed costs for the participation in the repeated demonstration.
4. Test Results: If a test demonstration fails to meet the acceptance criteria, perform the following:
 - a. Complete a commissioning compliance issue report form promptly on discovery of test results that do not comply with acceptance criteria.
 - b. Submit commissioning compliance issue report form within 24 hours of the test.
 - c. Determine the cause of the failure.
 - d. Establish responsibility for corrective action if the failure is due to conditions found to be Contractor's responsibility.
5. Commissioning Compliance Issue Report: Provide a commissioning compliance issue report for each issue. Do not report multiple issues on the same commissioning compliance issue report.
 - a. Exception: If an entire class of devices is determined to exhibit the identical issue, they may be reported on a single commissioning compliance issue report. (For example, if all return-air damper actuators that are specified to fail to the open position are found to fail to the closed position, they may be reported on a single commissioning issue report. If a single commissioning issue report is used for multiple commissioning compliance issues, each device shall be identified in the report, and the total number of devices at issue shall be identified.
 - b. Complete and submit Part 1 of the commissioning compliance issue report immediately when the condition is observed.
 - c. Record the commissioning compliance issue report number and describe the deficient condition on the data form.
 - d. Resolve commissioning compliance issues promptly. Complete and submit Part 2 of the commissioning compliance issue report when issues are resolved.
6. Diagnose and correct failed test demonstrations as follows:
 - a. Perform diagnostic tests and activities required to determine the fundamental cause of issues observed.

- b. Record each step of the diagnostic procedure prior to performing the procedure. Update written procedure as changes become necessary.
 - c. Record the results of each step of the diagnostic procedure.
 - d. Record the conclusion of the diagnostic procedure on the fundamental cause of the issue.
 - e. Determine and record corrective measures.
 - f. Include diagnosis of fundamental cause of issues in commissioning compliance issue report.
7. Retest:
- a. Schedule and repeat the complete test procedure for each test demonstration for which acceptable results are not achieved. Obtain signature of Owner's witness on retest data forms. Repeat test demonstration until acceptable results are achieved. Except for issues that are determined to result from design errors or omissions, or other conditions beyond Contractor's responsibility, compensate Owner for direct costs incurred as the result of repeated test demonstrations to achieve acceptable results.
 - b. For each repeated test demonstration, submit a new test data form, marked "Retest."
8. Do not correct commissioning compliance issues during test demonstrations.
- a. Exceptions will be allowed if the cause of the issue is obvious and resolution can be completed in less than five minutes. If corrections are made under this exception, note the deficient conditions on the test data form and issue a commissioning compliance issue report. A new test data form, marked "Retest," shall be initiated after the resolution has been completed.

3.6 SEQUENCING

- A. Sequencing of Commissioning Verification Activities: For a particular material, item of equipment, assembly, or system, perform the following in the order listed unless otherwise indicated:
1. Construction Checklists:
 - a. Material checks.
 - b. Installation checks.
 - c. Startup, as appropriate. Some startup may depend on component performance. Such startup may follow component performance tests on which the startup depends.
 - d. Performance Tests:
 - 1) Static tests, as appropriate.
 - 2) Component performance tests. Some component performance tests may depend on completion of startup. Such component performance tests may follow startup.
 - 3) Equipment and assembly performance tests.
 - 4) System performance tests.

5) Intersystem performance tests.

2. Commissioning tests.

- B. Before performing commissioning tests, verify that materials, equipment, assemblies, and systems are delivered, installed, started, and adjusted to perform according to construction checklists.
- C. Verify readiness of materials, equipment, assemblies, and systems by performing tests prior to performing test demonstrations. Notify Engineer if acceptable results cannot be achieved due to conditions beyond Contractor's control or responsibility.
- D. Commence tests as soon as installation checks for materials, equipment, assemblies, or systems are satisfactorily completed. Tests of a particular system may proceed prior to completion of other systems, provided the incomplete work does not interfere with successful execution of test.

3.7 SCHEDULING

- A. Commence commissioning process as early in the construction period as possible.
- B. Commissioning Schedule: Integrate commissioning activities into Construction Schedule. See Section 013200 "Construction Progress Documentation."
 - 1. Include detailed commissioning activities in monthly updated Construction Schedule and short-interval schedule submittals.
 - 2. Schedule the start date and duration for the following commissioning activities:
 - a. Submittals.
 - b. Preliminary operation and maintenance manual submittals.
 - c. Installation checks.
 - d. Startup, where required.
 - e. Performance tests.
 - f. Performance test demonstrations.
 - g. Commissioning tests.
 - h. Commissioning test demonstrations.
 - 3. Schedule shall include a line item for each installation check, startup, and test activity specific to the equipment or systems involved.
 - 4. Determine milestones and prerequisites for commissioning process. Show commissioning milestones, prerequisites, and dependencies in monthly updated critical-path-method construction schedule and short-interval schedule submittals.
- C. Two-Week Look-Ahead Commissioning Schedule:
 - 1. Two weeks prior to the beginning of tests, submit a detailed two-week look-ahead schedule. Thereafter, submit updated two-week look-ahead schedules weekly for the duration of commissioning process.
 - 2. Two-week look-ahead schedules shall identify the date, time, beginning location, Contractor personnel required, and anticipated duration for each startup or test activity.

3. Use two-week look-ahead schedules to notify and coordinate participation of Owner's witnesses.

D. Owner's Witness Coordination:

1. Coordinate Owner's witness participation via Engineer.
2. Notify Engineer of commissioning schedule changes at least two work days in advance for activities requiring the participation of Owner's witness.

3.8 COMMISSIONING REPORTS

A. Test Reports:

1. Pre-startup reports include observations of the conditions of installation, organized into the following sections:
 - a. Equipment Model Verification: Compare contract requirements, approved submittals, and provided equipment. Note inconsistencies.
 - b. Preinstallation Physical Condition Checks: Observe physical condition of equipment prior to installation. Note conditions including, but not limited to, physical damage, corrosion, water damage, or other contamination or dirt.
 - c. Preinstallation Component Verification Checks: Verify components supplied with the equipment, preinstalled or field installed, are correctly installed and functional. Verify external components required for proper operation of equipment correctly installed and functional. Note missing, improperly configured, improperly installed, or nonfunctional components.
 - d. Summary of Installation Compliance Issues and Corrective Actions: Identify installation compliance issues and the corrective actions for each. Verify that issues noted have been corrected.
 - e. Evaluation of System Readiness for Startup: For each item of equipment for each system for which startup is anticipated, document in summary form acceptable to Owner completion of equipment model verification, preinstallation physical condition checks, preinstallation component verification checks, and completion of corrective actions for installation compliance issues.
2. Test data reports include the following:
 - a. "As-tested" system configuration. Complete record of conditions under which the test was performed, including, but not limited to, the status of equipment, systems, and assemblies; temporary adjustments and settings; and ambient conditions.
 - b. Data and observations, including, but not limited to, data trend logs, recorded during the tests.
 - c. Signatures of individuals performing and witnessing tests.
 - d. Data trend logs accumulated overnight from the previous day of testing.
3. Commissioning Compliance Issue Reports: Report as commissioning compliance issues results of tests and test demonstrations that do not comply with acceptance criteria. Report only one issue per commissioning compliance issue report. Use sequentially numbered facsimiles of commissioning compliance issue report form included in this

Section, or other form approved by Owner. Distribute commissioning compliance issue reports to parties responsible for taking corrective action. Identify the following:

- a. Commissioning compliance issue report number. Assign unique, sequential numbers to individual commissioning compliance issue reports when they are created, to be used for tracking.
 - b. Action distribution list.
 - c. Report date.
 - d. Test number and description.
 - e. Equipment identification and location.
 - f. Briefly describe observations about the performance associated with failure to achieve acceptable results. Identify the cause of failure if apparent.
 - g. Diagnostic procedure or plan to determine the cause (include in initial submittal)
 - h. Diagnosis of fundamental cause of issues as specified below (include in resubmittal).
 - i. Fundamental cause of unacceptable performance as determined by diagnostic tests and activities.
 - j. When issues have been resolved, update and resubmit the commissioning issue report forms by completing Part 2. Identify resolution taken and the dates and initials of the persons making the entries.
 - k. Schedule for retesting.
4. Weekly progress reports include information for tests conducted since the preceding report and the following:
- a. Completed data forms.
 - b. Equipment or system tested, including test number, system or equipment tag number and location, and notation about the apparent acceptability of results.
 - c. Activities scheduled but not conducted per schedule.
 - d. Commissioning compliance issue report log.
 - e. Schedule changes for remaining Commissioning-Process Work, if any.
5. Data trend logs shall be initiated and running prior to the time scheduled for the test demonstration.
- a. Trend log data format shall be multiple data series graphs. Where multiple data series are trend logged concurrently, present the data on a common horizontal time axis. Individual data series may be presented on a segmented vertical axis to avoid interference of one data series with another, and to accommodate different axis scale values. Graphs shall be sufficiently clear to interpret data within the accuracy required by the acceptance criteria.
 - b. Attach to the data form printed trend log data collected during the test or test demonstration.
 - c. Record, print out, and attach to the data form operator activity during the time the trend log is running. During the time the trend log is running, operator intervention not directed by the test procedure invalidates the test results.
6. System Alarm Logs: Record and print out a log of alarms that occurred since the last log was printed. Evaluate alarms to determine if the previous day's work resulted in any conditions that are not considered "normal operation."

- a. Conditions that are not considered "normal operation" shall be reported on a commissioning issue report attached to the alarm log. Resolve as necessary. The intent of this requirement is to discover control system points or sequences left in manual or disabled conditions, equipment left disconnected, set points left with abnormal values, or similar conditions that may have resulted from failure to fully restore systems to normal, automatic control after test completion.

3.9 CERTIFICATE OF CONSTRUCTION-PHASE COMMISSIONING PROCESS COMPLETION

- A. When Contractor considers that construction-phase commissioning process, or a portion thereof which Owner agrees to accept separately, is complete, Contractor shall prepare and submit to Engineer a comprehensive list of items to be completed or corrected. Failure to include an item on such list does not alter Contractor's responsibility to complete commissioning process.
- B. On receipt of Contractor's list, Engineer will make an inspection to determine whether the construction-phase commissioning process or designated portion thereof is complete. If the Engineer's inspection discloses items, whether included on Contractor's list, which is not sufficiently complete as defined in "Construction-Phase Commissioning Process Completion" Paragraph in the "Definitions" Article, Contractor shall, before issuance of the Certificate of Construction-Phase Commissioning Process Completion, complete or correct such items on notification by the Engineer. In such case, Contractor shall then submit a request for another inspection by the Engineer to determine construction-phase commissioning process completion.
- C. Contractor shall promptly correct deficient conditions and issues discovered during commissioning process. Costs of correcting such deficient conditions and issues, including additional testing and inspections, the cost of uncovering and replacement, and compensation for Engineer's services and expenses made necessary thereby, shall be at Contractor's expense.
- D. When construction-phase commissioning process or designated portion is complete, Engineer will prepare a Certificate of Construction-Phase Commissioning Process Completion that shall establish the date of completion of construction-phase commissioning process. Certificate of Construction-Phase Commissioning Process Completion shall be submitted prior to requesting inspection for determining date of Substantial Completion.

END OF SECTION 019113

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SECTION 024119 - SELECTIVE DEMOLITION

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. Demolition and removal of selected portions of building or structure.
- 2. Demolition and removal of selected site elements.
- 3. Salvage of existing items to be reused or recycled.

- B. Related Requirements:

- 1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
- 2. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
- 3. Section 017300 "Execution" for cutting and patching procedures.
- 4. Section 013516 "Alteration Project Procedures" for general protection and work procedures for alteration projects.
- 5. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove Hazardous Materials: Isolate and remove hazardous materials from existing construction and properly dispose as required by existing regulations.
- C. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and store.
- D. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- E. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

- F. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- C. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
 - 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.
- E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- F. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.6 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.7 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.8 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 1. Before selective demolition, Owner will remove any necessary items:
- C. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Engineer and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties.
- B. Notify warrantor on completion of selective demolition and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.10 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Survey of Existing Conditions: Record existing conditions by use of measured drawings and preconstruction photographs or video.
 - 1. Comply with requirements specified in Section 013233 "Photographic Documentation."
 - 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
 - 3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Arrange to shut off utilities with utility companies.
 - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 - 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 - 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and

finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and for at least 2 hours after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. Dispose of demolished items and materials promptly.

- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

- C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

- D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition, cleaned, and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings."

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn demolished materials.

3.8 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 030100.61 - CONCRETE REPAIRS

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 concrete repair consisting of the following:
 - 1. Removal of existing concrete.
 - 2. Bonding new concrete.
 - 3. Repair mortar.
 - 4. Crack and leaking construction joint repair (polyurethane chemical grout injection).
 - 5. Crack repair (epoxy adhesive injection).
 - 6. Spalled, deteriorated, and disintegrated concrete repair.

- B. Related Requirements:
 - 1. Section 031000 "Concrete Forming and Accessories" for concrete formwork.
 - 2. Section 031500 "Concrete Joints and Accessories" for concrete joints and joint accessories.
 - 3. Section 033000 "Cast-in-Place Concrete for ground and elevated cast concrete.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Including manufacturers printed performance criteria, product life, working time after mixing, surface preparation and application requirements and procedures, curing, and volatile organic compound data.
 - 2. Storage requirements including temperature, humidity, and ventilation.
 - 3. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for:
 - a. Polyurethane chemical grout.
 - b. Crack repair epoxy adhesive.
 - c. Epoxy bonding agent.
 - d. Adhesive anchor system.
 - e. Repair mortars.
 - f. Epoxy adhesive paste.

4. Include rated capacities, operating characteristics, and accessories.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company with a minimum of 10 years' documented experience and having an ongoing program to train, certify, and technically support installers.
- B. Installer Qualifications: Fabricator of products.
- C. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- D. Contractor's Supervisor: Having attended a training program sponsored by manufacturer supplying project approved materials.
- E. Testing Agency Qualifications: Qualified according to ASTM C 1021 and ASTM C 1093 for testing indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Deliver materials in original, new, and unopened packages and containers clearly labeled with information referenced in Division 01 and the following information:
 1. Manufacturer's stock number and batch number.
 2. Date of manufacture.
 3. Expiration or use-by date.
- B. Storage of Materials:
 1. Store only approved materials on site.

1.6 FIELD CONDITIONS

- A. Conform to temperatures and other environmental factors as stated within manufacturer's published installation instructions for storage, substrate conditions, application, curing, and other procedures required by work of this Section.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace any product(s) that fail(s) in materials or workmanship within specified warranty period.
 1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM PERFORMANCE

- A. Use materials in compliance with state and local regulations.

2.2 MATERIALS

A. Polyurethane Chemical Grout:

1. Single component, expanding, moisture reactive polyurethane grout designed to seal cracks and open joints in concrete. Provide cured chemical grout that forms a compressed closed cell urethane foam that completely fills the crack or joint.
2. Accelerator: May be used if recommended by approved polyurethane chemical grout manufacturer.
3. Provide injection packers for application of polyurethane chemical grout.
4. Acceptable Manufacturers and Products: Provide one of the following or equal:
 - a. BASF Corporation: Concrevice 1210 IUG.
 - b. Sika Corporation: SikaFix HH.
 - c. W. R. Grace & Co.: HA Multigel NF, by De Neef.

B. Crack Repair Epoxy Adhesive:

1. ASTM C 881/ C 881M, Type V, Grade 2, Class C; two-component, solvent-free, moisture insensitive epoxy resin material suitable for repairing cracks in concrete by injection or gravity feed; formulated for specific size of opening or crack being injected.
2. Acceptable Manufacturers and Products: Provide one of the following or equal:
 - a. Euclid Chemical Company: EUCO #452.
 - b. Five Star Products Inc.: Bonding Adhesive.
 - c. Sika Corporation: Sikadur 32, Hi Mod.

C. Epoxy Bonding Agent:

1. Two-component, solvent-free, asbestos-free moisture insensitive epoxy resin material used to bind plastic concrete to hardened concrete and complying with requirements of ASTM C 881, Type V, Grade 2, Class C.
2. Acceptable Manufacturers and Products: Provide one of the following or equal:
 - a. Euclid Chemical Company: Dural 452 MV.
 - b. Sika Corporation: Sikadur 32, Hi Mod.
 - c. Simpson Strong-Tie Company Inc.: FX-762.

- D. Adhesive Anchor System: A system utilizing an injection adhesive manufactured for installation of drilled-in reinforcing steel dowels.

1. Injection Adhesive: Two-component epoxy system including a hardener and a resin, furnished in pre-measured side-by-side cartridges which keep both components separate. Provide side-by-side cartridges designed to accept a static mixing nozzle which thoroughly blends both components and allows injection directly into a drilled hole.
 2. Acceptable Manufacturers and Products: Provide one of the following or equal:
 - a. Hilti: HIT-RE 500-SD; referenced as Basis-of-Design materials, unless otherwise noted.
 - b. Redhead: G5.
 - c. Simpson Strong: Tie Epoxy SET-XP.
- E. Horizontal Repair Mortars - Polymer-Modified Portland Cement Mortar:
1. Two-component polymer-modified, portland cement-based mortar used to repair horizontal surfaces with a migrating corrosion inhibitor and having a minimum compressive strength of 7,000 psi (48.3 MPa) at 28 days tested in accordance with ASTM C 881 or ASTM C 109.
 2. Acceptable Manufacturers and Products: Provide one of the following or equal:
 - a. BASF Corporation: MasterEmaco T 310CI.
 - b. Euclid Chemical Company: DuralTop Flowable Mortar.
 - c. Sika Corporation: SikaTop 122 Plus.
- F. Vertical and Overhead Repair Mortars - Polymer-Modified Portland Cement Mortar:
1. Two-component polymer-modified, portland cement based, fast setting, non-sag mortar used to repair vertical and overhead surfaces with a migrating corrosion inhibitor and having a minimum compressive strength of 5,000 psi (34.5 MPa) at 28 days tested in accordance with ASTM C 881 or ASTM C109..
 2. Acceptable Manufacturers and Products: Provide one of the following or equal:
 - a. Euclid Chemical Company: DuralTop Gel.
 - b. Sika Corporation: SikaTop 123 Plus.
 - c. US MIX Company: US SPEC H2.
 3. Properties of Cured Epoxy Resin Adhesive:
 - a. Tensile Properties at 14 days according to ASTM D 638:
 - 1) Tensile Strength: 3,600 psi (24.8 MPa).
 - 2) Elongation at Break: 0.4 percent.
 - 3) Modulus of Elasticity: 7.5×10^5 psi (51.71×10^5 kPa).
 - b. Compressive Properties at 28 days according to ASTM D 695:
 - 1) Compressive Strength: 12,000 psi (82.7 MPa).
 - 2) Modulus of Elasticity: 3.9×10^5 psi (26.89×10^5 kPa).
 - c. Flexural Properties (ASTM D 790) at 14 days:
 - 1) Flexural Strength (Modulus of Rupture): 4,400 psi (30.3 MPa).

- 2) Tangent Modulus of Elasticity in Bending: 1.0×10^6 psi (6.89×10^6 kPa).
 - d. Shear Strength at 14 days: 3,400 psi (23.4 MPa) according to ASTM D 732.
 - e. Water Absorption (ASTM D 570) at 1 day: 0.79 percent.
 - f. Bond Strength (ASTM C 882/C 882M) Hardened Concrete to Hardened Concrete:
 - 1) Dry Cure: 3,300 psi (22.7 MPa), 2 days.
 - 2) Moist Cure: 2,400 psi (16.5 MPa), 14 days.
 - g. Epoxy Resin: ASTM C 881/C 881M.
 4. Acceptable Manufacturers and Products: Provide following or equal:
 - a. Sika Corporation: Sikadur Combiflex.
- G. Epoxy Paste Adhesive:
1. Two-component, solvent-free, moisture insensitive epoxy resin material used as an adhesive for mating surfaces where the glue line is 1/8 inch (3.2 mm) or less and to bond fresh, plastic concrete to clean, sound hardened concrete and complying with requirements of ASTM C 881, Type IV, Grade 3, Class C.
 2. Test Data: Base test upon material and curing condition of 73 plus/minus two degrees F and 50 plus/minus five percent Relative Humidity.
 3. Acceptable Manufacturers and Products: Provide one of the following or equal:
 - a. Sika Corporation: Sikadur 31 Hi-Mod Gel.
 - b. Euclid Chemical Company: Dural 452 Gel.
 - c. BASF Corporation: MasterEmaco ADH 1420.

2.3 ACCESSORY MATERIALS

A. Backer Rods:

1. Open Cell Backer Rod: Extruded, open cell polyurethane foam. Diameter shall not be less than 200 percent of the joint width dimension.
2. Closed Cell Backer Rod: Extruded, non-staining, resilient closed cell polyethylene foam, compatible with sealant. Diameter shall not be less than 25 percent greater than the joint width. Sealant shall not adhere to backer rod.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content and installation tolerances affecting performance of the Work.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Manufacturer's Representative: Be present for first three days of installation to give instructions to installation crew and then make periodic site visits to ensure products are being installed in accordance with published instructions.
- B. When removing materials or portions of existing structures and when making openings in existing structures, erect barriers, shoring and bracing, and other protective devices to prevent damage to structures beyond the limits of new work, protect personnel, control dust, and prevent damage by falling or flying debris. Comply with requirements of Section 015000 "Temporary Facilities and Controls."

3.3 GENERAL

- A. Store, mix, apply, and cure materials for each repair system in strict compliance with manufacturer's installation instructions. Make repairs necessary, without additional compensation, so completed work complies with Contract Document work scopes.
- B. Where concrete is repaired near an expansion joint or control joint, preserve isolation between components on either side of the joint.
- C. Identify reinforcing locations prior to drilling using reinforcing bar locators so that drill hole locations may be adjusted to avoid reinforcing interference. When drilling holes for dowels and bolts, stop drilling if reinforcing is encountered. Relocate hole to avoid reinforcing as approved by the Engineer. Do not cut reinforcing without prior approval by the Engineer.
- D. Concrete designated to be removed to specific limits indicated or directed by the Engineer, shall be done by saw cutting (1 inch (25 mm) deep) at limits of removal followed by line drilling, chipping, sandblasting, or airblasting, as appropriate in areas where deteriorated, damaged, or unsound concrete is to be removed. Remove concrete such that surrounding concrete and existing reinforcing to be left in place and existing in place equipment are not damaged.
 - 1. Perform full thickness saw-cutting at limits of concrete to be removed only if indicated, specified, or after obtaining written approval from the Engineer.
- E. Saw-cut edges straight for vertically and horizontally repair areas. Make intersecting cuts perpendicular to each other.
- F. Stop saw cutting if reinforcing is encountered. Do not cut reinforcing without prior approval by the Engineer. Identify reinforcing locations within one foot of saw cut locations in any direction prior to saw cutting using reinforcing bar locators.
- G. Clean concrete surfaces of efflorescence, deteriorated concrete, dirt, laitance, and existing repair materials such as liners, adhesives, and epoxies. Remove foreign matter and deleterious films by sandblasting, airblasting, scarifying or other mechanical means to sound original concrete.
- H. Thoroughly clean repair area with oil-free compressed air, then install bonding agent. Place repair materials within open time of epoxy bonding agent.
- I. Consolidate repair material, completely filling all portions of area to be filled.

- J. Bring finished repair surfaces into alignment with adjacent existing surfaces to provide a uniform, flush, and even surface. Match repair surfaces to adjacent existing surfaces in texture, including any coatings or surface treatments that had been provided for existing surface.
- K. Remove excess material from faces of materials being repaired and adjacent walls, floors, and slabs. Leave exposed faces of surface materials clean and ready to accept subsequent work.
- L. Repair or replace concrete indicated or specified to be left in place, but that is damaged because of the work of this Section. Perform work by approved means and methods.

3.4 CRACK AND CONSTRUCTION JOINT REPAIR (POLYURETHANE CHEMICAL GROUT)

- A. Apply polyurethane chemical grout to leaking cracks, joints, and voids in existing concrete.
- B. Install polyurethane chemical grout through drilled-in injection ports installed as recommended by polyurethane chemical grout manufacturer. Install and cure polyurethane repair materials in accordance with manufacturer's requirements.
- C. Remove injection ports and seal with grout. Leave repair area flush with surrounding concrete surfaces.

3.5 CRACK REPAIR (EPOXY ADHESIVE INJECTION)

- A. Repair cracks on horizontal surfaces by gravity feeding crack repair epoxy adhesive into cracks. Pressure inject cracks less than 1/16 inch (1.6 mm) in thickness.
- B. Repair cracks on vertical surfaces by pressure injecting crack repair epoxy adhesive through injection ports sealed to surface with crack repair epoxy adhesive.
- C. Clean cracks by sandblasting, water jet, or high-pressure oil free air to remove loose matter, dirt, laitance, oil, grease or other contaminants. Prior to injection of the crack apply a surface seal of epoxy paste to crack faces.
 - 1. Establish openings in surface seal (injection ports) along the crack. Do not allow distance between injection ports to be greater than slab or wall thickness.
 - 2. Begin injection at first port at one end of the crack. For vertical or inclined surfaces begin injection at lowest point of the crack. Continue injection at first port until injected epoxy begins to flow out of second port in line.
 - 3. Plug first port and continue injection from second port. Inject entire crack following same sequence. Continue injecting crack and do not stop until crack is completely injected.
 - 4. After injected epoxy has cured, remove or cut off ports and grind flush with adjacent concrete surface. Do not allow indentations or protrusions caused by port placements.

3.6 SPALLED/DETERIORATED CONCRETE REPAIR

- A. Only use polymer-modified cementitious repair mortar for surface repair of spalled or deteriorated concrete.

- B. Comply with manufacturer's recommendations for concrete removal, surface preparation, mixing, application, lift thickness, finishing, moist curing, and form removal.
- C. Saw cut perimeter of deteriorated concrete to form a rectangle with straight edges to depth indicated. Remove fractured, loose, broken, softened, and deteriorated concrete by abrasive blasting, chipping, or other appropriate means to sound concrete. Chip concrete substrate to obtain a surface profile with a new fractured aggregate surface.
- D. Remove dirt, oil, grease, and other bond inhibiting materials from surface by dry mechanical means such as sand blasting, chipping, or wire brushing. Thoroughly clean surface of loose or weakened material and dust by dry mechanical means such as oil-free air blast. Follow recommendations of repair mortar manufacturer for additional surface preparation.
- E. Do not damage reinforcing steel that is to be incorporated into new concrete. Where reinforcing steel with active corrosion is encountered, use following procedure:
 - 1. Use dry mechanical means to remove loose material, contaminants and rust from exposed reinforcing steel.
 - 2. When more than half of reinforcing bar diameter is exposed, chip out behind reinforcing steel, 1 inch (25 mm) minimum.
 - 3. Make distance chipped behind a reinforcing bar equal to or exceed minimum placement depth of material being used, 1 inch (25 mm) minimum.
 - 4. If existing reinforcing steel has lost more than 15 percent of its original cross-sectional area, splice in new reinforcing as shown on Drawings.
- F. Repair cracks encountered in substrate area of spalled or deteriorated concrete repair as specified directed by the Engineer.
- G. Repair Mortar Placement:
 - 1. Follow procedures recommended by manufacturer for mixing and placement of repair mortar.
 - 2. After initial mixing of repair mortar, do not add water to change the consistency, should the mix begin to stiffen.
 - 3. Saturate substrate surface dry (SSD) with no standing water during application.
 - 4. Apply scrub coat to substrate, filling all pores and voids.
 - 5. While scrub coat is still plastic, apply polymer-modified repair mortar. Place repair mortar to an even, uniform plane to restore the member to its original surface.
 - 6. For applications greater than 1 inch (25 mm) in depth, apply repair mortar in lifts. Score exposed surface of each lift to produce a roughened surface before applying the next lift. Allow lift to reach final set before proceeding with subsequent lift.
- H. Finishing:
 - 1. Apply repair mortar with a smooth, steel trowel finish, unless otherwise noted.
 - 2. Have no sharp edges when repair is completed. Make exterior corners, such as at penetrations, with a 1 inch (25 mm) radius. Make interior corners square.
- I. Curing: Perform as recommended by repair mortar manufacturer, except that cure period shall be at least 24 hours and done by means of a continuous fog spray or moist cure with wet burlap.

J. Repairs Requiring Formwork:

1. Remove fractured, loose, deteriorated, and unsound concrete by bush hammering, chipping, high pressure water blast, or other appropriate dry mechanical means. Remove dirt, oil, grease, and other bond inhibiting materials from concrete surface.
2. Treat existing anchor bolts, exposed reinforcing steel, and reinforcing to be incorporated into repair mortar, as specified below.
3. Construct leakproof forms as required by project conditions. Line or coat forms with release agents recommended by repair mortar manufacturer. Provide forms of adequate strength, securely anchored in place and shored to resist the forces imposed by repair mortar and its placement.
4. Saturate existing concrete surfaces with water, with no standing water during application. Prime concrete surface with a scrub coat of repair mortar. Restore area to original limits or as shown using repair mortar before scrub coat dries. Extend repair mortar with 3/8 inch (9.53 mm) aggregate only as recommended by manufacturer of repair mortar.

3.7 SURFACE WATERSTOP REPAIR TYPE "D"– ELASTOMERIC COATING SYSTEM

A. Surface Preparation of Existing Concrete Substrates:

1. Abrasive blast-clean previously coated concrete surfaces to remove existing protective coating materials, degraded concrete, and to produce a sound and clean substrate free of laitance, surface contaminants, loose materials, or other deleterious substances that would reduce or prevent bond. Clean substrate in accordance with SSPC-SP-13/NACE.
2. Roughen existing concrete surfaces to produce a minimum, uniform substrate anchor pattern or profile similar to CSP 4 to 6 in accordance with ICRI 03732.
3. If cleaning does not remove degraded concrete, use chipping or other abrading tools to remove deteriorated concrete until a sound and clean substrate is achieved, which is free of calcium sulfate, loose coarse or fine aggregate, laitance, loose hydrated cement paste, and other deleterious substances that would reduce or prevent bond.
 - a. Use abrasive blast cleaning or other means necessary to open air voids or bugholes to expose their complete perimeter. Do not leave shelled over or hidden air voids beneath the exposed concrete surface.
 - b. Leave concrete substrate dry prior to application of surface filler or coating materials.
4. Following inspection of concrete surface preparation and acceptance by the Engineer, thoroughly vacuum clean concrete surfaces to be coated to remove loose dust, dirt, and spent abrasive leaving a dust free and sound concrete substrate. Remove debris produced by blast cleaning and dispose. Reinspect and if specified conditions are met, the Engineer will accept the substrate prior to commencement of coating installation.

B. Control of Ambient Conditions in Tank Structures to be Coated:

1. Control ambient conditions in tank structures to be coated, and provide protective enclosures during surface preparation, application, and curing, to meet the manufacturer's recommendations. Continue control work throughout coating system installation and curing.
2. Do not apply coating materials when dust is being generated.

3. Verify that temporary lighting during the work as provided under Division 26 is equivalent to a minimum of one 200-watt explosion proof incandescent lamp per 100 square feet of work area.

C. Installation of Coating System:

1. Install coating system to provide a watertight seal at construction joints indicated. Install in strict compliance with coating system manufacturer's instructions.
2. Repair deep voids or damaged areas of concrete substrates to be coated as indicated.
3. Apply binder coat or primer coat required by coating system manufacturer's instructions only to areas where elastomeric system is intended. Protect adjacent surfaces with tape prior to application of system.
4. Trowel, roll, or spray apply approved coating material evenly over concrete surfaces as recommended and instructed by coating manufacturer to a minimum total dry film thickness of 60 mils (1.52 mm) above prepared profile, filled air voids, and bugholes. Install more than one application of coating material if necessary to achieve total dry film thickness. To ensure a pinhole free coating surface and to remove sags or trowel marks, roll or otherwise treat wet coating to leave a relatively smooth coating surface free of excessive trowel marks, sags, or other variations in thickness. Force coating material into surface profile or roughness of substrate.
5. When concrete substrates surface temperatures are rising or when these substrates are in direct sunlight, out-gassing of air from concrete will result in bubbling, pinhole formations, or blistering in coating or resurfacing materials. When this occurs, postpone coating application until cooler evening hours or take other measures to prevent such rising substrate temperatures. Repair bubbles, pinholes, or discontinuities in applied materials, as recommended by the manufacturer.
6. Smooth sloughs, sags, ridges, runs, or other surface irregularities by means and methods approved by the manufacturer prior to application of successive coats and prior to cure of coating material.
7. Provide completed cured elastomeric coating that is smooth, free of cracks, pinholes or other defects adversely affecting the waterproofing characteristics of the material, and free of seams or cold joints. The Engineer may authorize repairs of defects in elastomeric coating by approved methods.

3.8 FIELD QUALITY CONTROL

- A. At completion of repairs, Contractor, Engineer, and material Installer shall meet to inspect installed work. Repair leaking joints, cracks, or voids in accordance with manufacturer's instructions. At completion of various repairs, Contractor, Engineer, and Installer shall reinspect repaired problem areas. Make subsequent repairs until work is in conformance with Contract Documents.
- B. Special Inspections: Owner will engage a qualified special inspector to perform special inspections:
- C. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections..

- D. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections..
- E. Crack Repair Epoxy Adhesive: The Engineer may take random 2 inches diameter core samples for visual inspection and strength testing to verify adequacy of repairs.

END OF SECTION 030100.61

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SECTION 031000 - CONCRETE FORMING AND 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. Shoring, bracing, and anchorage.
- 2. Form accessories.
- 3. Form stripping.

- B. Related Requirements:

- 1. Section 032000 "Concrete Reinforcing": Reinforcing steel and required supports for cast-in-place concrete.
- 2. Section 033000 "Cast-in-Place Concrete": Cast-in-place concrete.

1.3 COORDINATION

- A. Coordinate Work of this Section with other Sections of Work in forming and placing openings, slots, sleeves, bolts, anchors, other inserts, and components of other Work.

1.4 ACTION SUBMITTALS

- A. Shop Drawings:

- 1. Indicate:
 - a. Formwork, shoring, and reshoring.
 - b. Pertinent dimensions, openings, details of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding and bracing, and temporary supports.
 - c. Means of leakage prevention for concrete exposed to view in finished construction.
 - d. Notes to formwork erector showing size and location of conduits and piping embedded in concrete according to ACI 318.
 - e. Procedure and schedule for removal of shores and installation and removal of reshores.
 - f. Location and sequence of concrete placement.
 - g. Form release agent.

- h. Form ties.
- i. Bond breakers.

- B. Review of submittals will be for appearance, performance, and strength of completed structure only. Approval by the Engineer will not relieve Contractor of responsibility for the strength, safety, or correctness of methods used, the adequacy of equipment, or from carrying out the work as shown on Contract Documents.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- B. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- C. Certify that form release agent complies with Federal, State and local VOC limitations.

1.6 QUALITY ASSURANCE

- A. Perform Work according to ACI 347, 301, and 318.
- B. For wood products furnished for Work of this Section, comply with AF&PA.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

PART 2 - PRODUCTS

2.1 FORMS, GENERAL

- A. Make forms for cast-in-place concrete of wood, steel, or other approved materials. Design and construct all forms to provide a flat, uniform concrete surface requiring no grinding, repairs, or finishing.
 - 1. Construct wood forms of sound lumber or plywood free from knotholes and loose knots.
 - 2. Construct steel forms to produce surfaces equivalent in smoothness and appearance to those produced by new plywood panels.
- B. Provide rigid forms that will not deflect, move, or leak. Design forms to withstand high hydraulic pressures resulting from rapid filling of forms and heavy high frequency vibration of the concrete. Limit deflection to 1/400 of each component span. Lay out form joints in a uniform pattern or as indicated on Drawings.
- C. Dress and match boards. Sand plywood smooth and fit adjacent panels with tight joints. Tape, gasket, plug, or caulk joints and gaps in forms to provide watertight joints that will withstand placing pressures without exceeding specified deflection limit or creating surface patterns.

- D. Provide 3/4 inch chamfer on form corners unless otherwise indicated.

2.2 FORMS FOR STRUCTURAL CONCRETE

A. Plywood Forms:

1. Make forms for exposed and non-submerged exterior and interior concrete of new and unused exterior grade plywood panels.
2. Grade: Select sheathing.
3. Exposed Concrete:
 - a. Comply with APA/EWA PS 1.
 - b. Label each panel with grade trademark of APA/EWA
4. Design and construct forms to provide a flat, uniform concrete surface requiring no grinding, repairs, or finishing.

B. Lumber Forms:

1. Applications: Edge forms and unexposed finish concrete.
2. Description:
 - a. Surface boards on four sides.
3. Material: Standard grade, Douglas fir according to WCLIB Standard No. 17.

C. Preformed Steel Forms:

1. Description: Matched, tightly fitted, and stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
2. Minimum Thickness: 16 gage.

2.3 FORMWORK ACCESSORIES

A. Form Ties:

1. Material: Galvanized.
2. Manufacturers:
 - a. Heckmann Building Products, Inc.
 - b. Symons by Dayton Superior.
 - c. Wall-Ties & Forms, Inc.
3. Coil and Wire Ties: Provide ties manufactured so that after removal of projecting part, no metal remains within 1-1/2 inch of concrete face. The part of the tie to be removed shall be at least 1/2-in diameter or be provided with a plastic or wooden cone at least 1/2 inch 1/2-in diameter and 1-1/2 inch long. Provide cone washer type form ties in concrete exposed to view.
4. Flat Bar Ties for Panel Forms: Provide ties that have plastic or rubber inserts with a minimum depth of 1-1/2 inch and manufactured to permit patching of the tie hole.

5. Provide ties for liquid retaining structures that have a steel waterstop tightly attached to each strut or that have a neoprene rubber washer on each strut.
- B. Form Release Agent:
1. Description: Colorless form coating that will not stain concrete or absorb moisture.
 2. Manufacturers:
 - a. Architectural Concrete Chemicals, LLC.
 - b. Nox-Crete Products Group.
 3. Form Release Agent. Coat form surfaces in contact with concrete with an effective, non-staining, non-residual, water based, bond-breaking form coating, unless otherwise indicated or specified.
- C. Bond Breaker:
1. Bond breakers for precast and tilt-up construction when cast against concrete shall be a non-staining, non-residual type, which will provide a positive bond prevention.
 2. Acceptable Manufacturers: One of the following or equal:
 - a. Dayton Superior Specialty Chemical Corporation: Sure-Lift (J-6).
 - b. Universal Form Clamp Co: Super Clean and Tilt.
 - c. Nox-Crete Products Group: Silcoseal Select.
- D. Nails, Spikes, Lag Bolts, Anchorages: Size, strength, and character to maintain formwork in place while placing concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify lines, levels, and centers before proceeding with formwork.
- B. Verify that dimensions agree with Drawings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Earth Forms: Not permitted.
- B. Formwork:
 1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.

2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
3. Positioning:
 - a. Carefully verify horizontal and vertical positions of forms.
 - b. Correct misaligned or misplaced forms before placing concrete.
4. Complete wedging and bracing before placing concrete.
5. Erect formwork, shoring, and bracing according to ACI 301.
6. Obtain approval of Engineer before framing openings in structural members not indicated on Drawings.
7. Form Release Agent:
 - a. Apply according to manufacturer instructions.
 - b. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
 - c. Do not apply form release agent if concrete surfaces are indicated to receive special finishes or applied coverings that may be affected by agent.
 - d. Soak inside surfaces of untreated forms with clean water, and keep surfaces coated prior to placement of concrete.
 - e. Apply form coatings before placing reinforcing steel.
8. Leave forms in place for minimum number of days according to ACI 347.
9. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and until the concrete has attained a strength of at least 70 percent of its specified design strength for beams and slabs and at least 30 percent of its specified design strength for walls and vertical surfaces.
10. Do not remove shores until concrete has attained at least 70 percent of its specified design strength and also sufficient to support safely its own weight and the construction live load on it.
11. Loosen forms carefully; do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
12. Stripping:
 - a. Arrange and assemble formwork to permit dismantling and stripping.
 - b. Do not damage concrete during stripping.
 - c. Permit removal of remaining principal shores.
13. Be responsible for damage resulting from removal of forms and make repairs at no additional compensation. Leave in place forms and shoring for horizontal structural members in accordance with ACI 301 and ACI 347. Conform to requirements for form removal specified in Section 033000 "Cast-in-Place Concrete."
14. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged.
15. Discard damaged forms.
16. Reuse and Coating of Forms:
 - a. Thoroughly clean forms and reapply form coating before each reuse.
 - b. For exposed Work, do not reuse forms with damaged faces or edges.
 - c. Apply form coating to forms according to manufacturer instructions.

- d. Do not coat forms for concrete indicated to receive "scored finish."
17. Do not reuse wood formwork more than 2 times for concrete surfaces to be exposed to view.
 18. Do not patch formwork.
 19. Form Cleaning:
 - a. Clean forms as erection proceeds to remove foreign matter within forms.
 - b. Clean formed cavities of debris prior to placing concrete.
 - c. Flush with water or use compressed air to remove remaining foreign matter.
 - d. Ensure that water and debris drain to exterior through cleanout ports.
 - e. Cold Weather:
 - 1) During cold weather, remove ice and snow from within forms.
 - 2) Do not use de-icing salts.
 - 3) Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure; use compressed air or other dry method to remove foreign matter.
- C. Forms for Smooth Finish Concrete:
1. Use steel, plywood, or lined-board forms.
 2. Use clean and smooth plywood and smooth sheet form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
 3. Install smooth sheet form lining with close-fitting square joints between separate sheets without springing into place.
 4. Use full-sized sheets of smooth sheet form liners and plywood wherever possible.
 5. Tape joints to prevent protrusions in concrete.
 6. Apply forming and strip wood forms in a manner to protect corners and edges.
 7. Level and continue horizontal joints.
- D. Inserts, Embedded Parts, and Openings:
1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, waterstops, and other features.
 2. Do not embed wood or uncoated aluminum in concrete.
 3. Obtain installation and setting information for embedded items furnished under other Sections.
 4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
 5. Ensure that conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 regarding size and location limitations.
 6. Install formed openings for items to be embedded in or passing through concrete Work.
 7. Locate and set in place items required to be cast directly into concrete.
 8. Install accessories straight, level, and plumb, and ensure that items are not disturbed during concrete placement.
 9. Frame openings in concrete where indicated on Drawings.
 10. Establish exact locations, sizes, and other conditions required for openings and attachment of Work specified under other Sections.
 11. Coordinate Work to avoid cutting and patching of concrete after placement.
 12. Temporary Openings:

- a. Provide temporary ports or openings in formwork as required to facilitate cleaning
- b. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris, and waste material.
- c. Locate openings at bottom of forms to allow flushing water to drain.
- d. Remove chips, sawdust, and other debris.
- e. Thoroughly blow out forms with compressed air just before concrete is placed and inspection.
- f. Clean forms and surfaces against which concrete is to be placed.
- g. Close temporary openings with tight-fitting panels, flush with inside face of forms, and neatly fitted such that joints will not be apparent in exposed concrete surfaces.

E. Form Ties:

1. Provide sufficient strength and quantity to prevent spreading of forms.
2. Place ties at least 1 inch away from edge of concrete.
3. Leave inner rods in concrete when forms are stripped.
4. Space form ties equidistant, symmetrical, and aligned vertically and horizontally unless indicated otherwise on Drawings.

F. Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

G. Construction Joints:

1. Install surfaced pouring strip where construction joints intersect on exposed surfaces to provide straight line at joints.
2. Just prior to subsequent concrete placement, remove strip, and tighten forms to conceal shrinkage.
3. Appearance:
 - a. Show no overlapping of construction joints.
 - b. Construct joints to present same appearance as butted plywood joints.
4. Arrange joints in continuous line straight, true, and sharp.

H. Embedded Items:

1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, waterstops, and other features.
2. Do not embed wood or uncoated aluminum in concrete.
3. Obtain installation and setting information for embedded items furnished under other Sections.
4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
5. Ensure that conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 regarding size and location limitations.

I. Screeds:

1. Set screeds and establish levels for tops of and finish on concrete slabs.
2. Slope slabs to drain where required or as indicated on Drawings.
3. Before depositing concrete, remove debris from space to be occupied by concrete, thoroughly wet forms, and remove freestanding water.

J. Cleanouts and Access Panels:

1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris, and waste material.
2. Clean forms and surfaces against which concrete is to be placed.
3. Remove chips, sawdust, and other debris.
4. Thoroughly blow out forms with compressed air just before concrete is placed.

3.3 TOLERANCES

- A. Construct formwork to maintain tolerances according to ACI 301.

3.4 FIELD QUALITY CONTROL

- A. Section 014000 “Quality Requirements: Requirements for inspecting and testing”.

B. Inspection:

1. Inspect erected formwork, shoring, and bracing to ensure that Work complies with formwork design and that supports, fastenings, wedges, ties, and items are secure.
2. Notify Engineer after placement of reinforcing steel in forms at least six working hours prior to proposed concrete placement.
3. Schedule concrete placement to permit formwork inspection before placing concrete.
4. Failure of forms to comply with specified requirements or to produce concrete complying with requirements specified shall be grounds for rejection of that portion of concrete work. Repair or replace rejected work as directed by the Engineer at no additional compensation. Make required repair or replacement subject to requirements of these Specifications and approval of the Engineer.

3.5 SCHEDULE

- A. Concrete Not Exposed to View: Site-fabricated plywood coated with form oil.
- B. Concrete Exposed to View: New and unused exterior grade plywood panels.

END OF SECTION 031000

SECTION 031500 - CONCRETE JOINTS AND 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 construction of durable, watertight joints in concrete structures.
- B. Related Requirements:
 - 1. Section 031000.00 "Concrete Forming and Accessories" for formwork.
 - 2. Section 032000.00 "Concrete Reinforcing" for reinforcing.
 - 3. Section 033000 "Cast-In-Place Concrete" for cement, and related concrete products.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Use materials in a given joint that are compatible with one another. Coordinate selection of suppliers and products to provide compatibility. Do not use asphaltic bond breakers or asphaltic joint fillers in joints receiving sealant.

2.2 MATERIALS - SEALANTS

- A. Sealant:
 - 1. Comply with ASTM C 920 for following conditions:
 - a. Sealant for Joints in Horizontal Surfaces: Type S or M, Grade P or NS, Class 25.
 - b. Sealant for Joints in Sloping and Vertical Surfaces: Type S or M, Grade NS, Class 25.
 - c. Sealant in Pedestrian and Vehicular Traffic Areas: Use T₁.
 - d. Sealant in Non-Traffic Areas: Type S or M, Grade P, Use NT.

PART 3 - EXECUTION

3.1 INSTALLATION - SEALANTS

- A. Install sealants in clean dry recesses free of frost, oil, grease, form release agent, loose material, laitance, dirt, dust, and other deleterious materials that will impair bond.

- B. Apply sealant conforming to manufacturer's recommendations including concrete cure, temperature, moisture, mixing, primer, primer cure time, joint and recess preparation, tooling, and curing.
- C. Apply masking tape to each side of joint prior to sealant installation. Remove masking tape afterwards, along with any spillage to leave a sealant installation with neat straight edges.

3.2 CLEANING AND PROTECTION

- A. Clean adjacent surfaces removing excess spills.
- B. Protect installed products until subsequent work is installed. For exposed materials, protect from damage until Substantial Completion.

END OF SECTION 031500

SECTION 032000 “CONCRETE REINFORCING”

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. Reinforcing bars.
- 2. Welded wire fabric.
- 3. Reinforcement accessories.

- B. Related Requirements:

- 1. Section 031000 “Concrete Forming and Accessories”: Form materials, and accessories required to form cast-in-place concrete.
- 2. Section 033000 “Cast-in-Place Concrete”: Cast-in-place concrete.

1.3 COORDINATION

- A. Coordinate Work of this Section with placement of formwork, formed openings, masonry dowels, and other Work.

1.4 ACTION SUBMITTALS

- A. Shop Drawings:

- 1. Indicate bar sizes, spacings, locations, splice locations, and quantities of reinforcing steel and welded wire fabric.
- 2. Indicate bending and cutting schedules.
- 3. Indicate supporting and spacing devices.
- 4. Placement Drawings:
 - a. Slabs: Show top and bottom reinforcement on separate plan views, as needed for clarity.
 - b. Show additional reinforcement around openings, at corners and at other locations indicated, diagrams of bent bars, arrangements, and assemblies, all as required for the fabrication and placement of concrete reinforcement.
 - c. Reference bars to same identification marks shown on bar bending details. Identify bars to have special coatings or to be of special steel or special yield strength.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- B. Submit certified copies of mill test report of reinforcement materials analysis.

1.6 QUALITY ASSURANCE

- A. Perform Work according to ACI 301 and ACI 318.
- B. Prepare Shop Drawings according to ACI SP-66.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Ship and store reinforcement with bars of same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing same "mark" designations as those shown on submitted placement drawings. Indicate that reinforcing is weldable on tags for ASTM A706 reinforcing and for ASTM A615 reinforcing meeting specified requirements in PART 2.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture by storing off ground, in clean, and dry location.
 - 2. Provide additional protection according to manufacturer instructions.

1.8 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 REINFORCEMENT

- A. Reinforcing Steel:
 - 1. Comply with ASTM A615
 - 2. Yield Strength: 60 ksi
 - 3. Billet Bars: Deformed.
 - 4. Finish: Uncoated

- B. Welded Plain Wire Fabric:
 - 1. Comply with ASTM A1064.
 - 2. Finish: Uncoated.

2.2 FABRICATION

- A. Fabricate concrete reinforcement according to applicable code.
- B. Form standard hooks for as indicated.
- C. Form reinforcement bends with minimum diameters according to ACI 318.
- D. Bend bars cold. Do not straighten or rebend bars.
- E. Bend bars around a revolving collar having a diameter not less than that recommended by the CRSI or ACI 318.
- F. Saw cut bar ends that are to be butt spliced, placed through limited diameter holes in metal, or threaded. Terminate saw cut ends in flat surfaces within 1-1/2 degrees of a right angle to the axis of the bar.

2.3 ACCESSORY MATERIALS

- A. Tie Wire:
 - 1. Minimum 16 gage, Use black wire to tie uncoated reinforcing.
- B. Reinforcing Steel Accessories:
 - 1. Plastic Protected Wire Bar Supports: CRSI Bar Supports, Class 1 - Maximum Protection.
 - 2. Stainless Steel Protected Wire Bar Supports: CRSI Bar Supports, Class 2 - Moderate Protection with legs made wholly from stainless steel wire.
 - 3. Precast Concrete Bar Supports: CRSI Bar Supports, Precast Concrete Bar Supports. Precast concrete blocks that have equal or greater strength than the surrounding concrete.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with CRSI 10-MSP for surface condition, bending, spacing and tolerances of placement for reinforcement. Provide the amount of reinforcing indicated at the spacing and clearances indicated on the Drawings.
- B. Coat uncoated reinforcement which will be exposed for more than 60 days after placement with a heavy coat of neat cement slurry.

- C. Do not weld reinforcing steel bars either during fabrication or erection unless indicated or as specified herein, or unless prior written approval has been obtained from Engineer. Remove immediately all bars that have been welded, including tack welds, without such approval. Comply with AWS D1.4 when welding of reinforcement is indicated, specified, or approved.
- D. Reinforcing steel interfering with the location of other reinforcing steel, piping, conduits, or embedded items may be moved within the specified tolerances or one bar diameter, whichever is greater. Obtain the approval of Engineer if greater displacement of bars to avoid interference is needed. Do not cut reinforcement to install inserts, conduits, mechanical openings, or other items without the prior approval of Engineer.
- E. Place, support, and secure reinforcement against displacement. Secure dowels in place before placing concrete.
- F. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- G. Do not deviate from required position beyond specified tolerance.
- H. Do not field bend reinforcing unless indicated or specifically authorized in writing by Engineer. Cold-bend bars indicated or authorized to be field bent around the standard diameter spool specified in the CRSI. Do not heat bars. Closely inspect the reinforcing steel for breaks. Replace, repair by cutting out damaged bars and splicing new bars using exothermic welding type reinforcing splicing devices, or otherwise repair damaged reinforcing bars as directed by Engineer without additional compensation. Do not bend reinforcement after it is embedded in concrete unless indicated.
- I. Do not displace or damage vapor retarder.
- J. Chairs, Bolsters, Bar Supports, and Spacers:
 - 1. Size and Shape: To support reinforcement and prevent displacement of reinforcing during concrete placement conditions.
 - 2. Furnish load-bearing pad on bottom to prevent vapor retarder puncture.
 - 3. Use precast concrete blocks where reinforcing steel is to be supported over soil.
 - 4. Provide #5 minimum size support bars. Do not reposition upper bars in a bar mat for use as support bars.
 - 5. Alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcing steel fastened to the bottom and top mats, may be used if approved by Engineer.
- K. Determine clear concrete cover based on exposure to the environment. Provide the following clear concrete cover over reinforcement, unless indicated otherwise:
 - 1. Concrete cast against and permanently exposed to earth: 3 inches .
 - 2. Concrete exposed to soil, water, sewage, sludge and/or weather:
 - a. Slabs (top and bottom cover), walls: 2 inches .

L. Splicing:

1. Tension Members: Avoid splicing of reinforcing steel in concrete elements indicated as "tension members." However, if splices are required for constructability, splices in the reinforcement subject to direct tension shall be butted and joined with complete penetration welds to develop, in tension, at least 125 percent of the specified yield strength of the bar. Offset splices in adjacent bars the distance of a Class B splice or 30 inches, whichever is greater.
2. Welded Wire Fabric: Provide lap splices in accordance with the requirements of ACI 318 but not less than 12 inches. Tie the spliced fabrics together with wire ties spaced not more than 24 inches on center and lace with wire of the same diameter as the welded wire fabric. Offset splices in adjacent widths to prevent continuous splices.

3.2 TOLERANCES

- A. Install reinforcement within following tolerances for slabs, beams, girders, and, foundation elements:
1. Member Depth (or Thickness) Greater Than 12 Inches :
 - a. Reinforcement Location: Plus or Minus 1/2 inch.
 - b. Concrete Cover: Plus or Minus 1/2 inch.
 2. Member Depth (or Thickness) Less Than or Equal to 12 Inches:
 - a. Reinforcement Location: Plus or Minus 3/8 inch.
 - b. Concrete Cover: Plus or Minus 3/8 inch .

3.3 FIELD QUALITY CONTROL

- A. Inspection by Engineer: When reinforcing is complete and ready for inspection, notify Engineer at least six working hours prior to proposed concrete placement.
- B. Do not cover reinforcing steel with concrete until reinforcement, including the size, spacing and position has been inspected by Engineer and Engineer's release to proceed with concreting has been obtained. Keep forms open until Engineer has completed inspection of the reinforcement.

END OF SECTION 032000

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SECTION 033000 - 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 for various items indicated in Contract Documents.
- B. Furnish, as required to establish concrete mixes, all sampling and laboratory testing of products and materials performed by an independent testing laboratory engaged by and at the expense of Contractor.
- C. Related Requirements:
 - 1. Section 031000 "Concrete Forming and Accessories": Formwork and accessories.
 - 2. Section 032000 "Concrete Reinforcing": Requirements for reinforcing steel and supports.
 - 3. Section 031500 "Concrete Joints and Accessories".
 - 4. Section 033900 "Concrete Curing": Curing of concrete surfaces.

1.3 ACTION SUBMITTALS

- 1. Product Data: For each type of product
- B. Concrete Mixes: 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. Provide either subparagraph 1. or 2., below, for each mix proposed.
 - 1. Standard deviation data for each proposed concrete mix based on statistical records. Provide the following for each strength data point used in the calculation of the standard deviation for determination of the minimum required average strength:
 - a. Date of sampling and name of testing laboratory.
 - b. Name of concrete batch plant.
 - c. Water cementitious ratio.
 - d. Slump of batch.
 - e. Air content of batch.
 - f. Compressive strengths of all cylinders tested at that age in that batch.
 - g. If available, temperature and unit weight of batch.
 - h. Provide data from projects not more strictly controlled than outlined in these specifications. Provide summary sheet showing all pertinent data and the computation of the standard deviation.

2. Water cementitious ratio curve for concrete mixes based on laboratory tests. Provide average cylinder strength test results at 7, 14, and 28 days for laboratory concrete mix designs.
- C. Samples: Fine and coarse aggregates, if requested for examination by Engineer.

1.4 INFORMATIONAL SUBMITTALS

A. Test Reports:

1. Aggregates: Conformance to ASTM standards, including sieve analysis, mechanical properties, deleterious substance content, and mortar bar expansion test results.
2. Cement: Conformance to ASTM standards, including chemical analysis and physical tests.

B. Certifications:

1. Certify that admixtures used in the same concrete mix are compatible with each other and the aggregates.
2. Certify that Contractor is not associated with independent testing laboratory proposed for use by Contractor nor does Contractor or its officers have a beneficial interest in the laboratory.
3. Certificate of conformance for concrete production facilities from the NRMCA.

C. Qualifications:

1. Independent Testing Laboratory:
 - a. Name and address
 - b. Names and positions of principal officers and the name, position, and qualifications of the responsible registered professional engineer in charge.
 - c. Listing of technical services to be provided. Indicate external technical services to be provided by other organizations.
 - d. Names and qualifications of the supervising laboratory technicians.
 - e. Statement of conformance provided by evaluation authority defined in ASTM C1077. Provide report prepared by evaluation authority when requested by Engineer.
 - f. Submit as required above for other organizations that will provide external technical services.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of embedded utilities and components concealed from view in finished construction.

1.6 QUALITY ASSURANCE

- A. Comply with ACI 318 and ACI 350 and other stated specifications, codes and standards. Apply the most stringent requirements of other stated specifications, codes, standards, and this Section when conflicts exist.
- B. Independent Testing Laboratory: Meet requirements of ASTM E329 and ASTM C1077. Do not use laboratories affiliated and having a beneficial interest with Contractor or its officers.
- C. Provide concrete uniform in color and appearance.
- D. Preconstruction Meeting: At least 10 working days before first concrete placement, hold a meeting to review concrete placement requirements, waterstop placement, jointing, concrete curing, hot and cold weather concreting, and finishing. Notify all parties involved, including Engineer, of the meeting at least 10 working days prior to its scheduled date. Prepare an agenda for the meeting. Take meeting minutes and distribute to meeting attendees.
- E. If during work progress, it is impossible to secure concrete of the specified workability and strength with the materials being furnished, Engineer may order such changes in proportions or materials, or both, as may be necessary to secure the specified properties. Make ordered changes without additional compensation.
- F. If during work progress, materials from the sources originally accepted change in characteristics, make new acceptance tests of materials and establish new concrete mixes with assistance of an independent testing laboratory, without additional compensation.
- G. Provide field testing and inspection services and related laboratory tests. Perform testing methods conforming to latest applicable ASTM methods. Test following items to verify conformity with this Section:
 - 1. Concrete Placements: Compressive strength (cylinders), temperature, slump, and air content.
 - 2. Other materials that may require field testing.
- H. Concrete Placement: Compressive strength (cylinders), temperature, slump, and air content.
- I. Provide laboratory tests of samples, constituents, and as-placed concrete. Materials incorporated in the work shall conform to accepted samples.
- J. Perform Work according to ACI 301, 318 and 350.
- K. Comply with ACI 305R when placing concrete during hot weather.
- L. Comply with ACI 306.1 when placing concrete during cold weather.
- M. Acquire cement and aggregate from one source for Work.
- N. Maintain one copy of each standard affecting Work of this Section on Site.

1.7 AMBIENT CONDITIONS

- A. Maintain concrete temperature after installation at minimum 50 degrees F (10 degrees C) for minimum seven days.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials shall comply with this Section and any applicable State or local requirements.
- B. Cement: Domestic portland cement conforming to ASTM C150. Do not use air entraining cements. Cement brand must be approved by Engineer and one brand shall be used throughout the work.
 - 1. Comply with ASTM C150 (C150M), Type I - Normal Type II - Moderate Sulfate Resistant.
 - 2. Type: Portland.
- C. Aggregates:
 - 1. Fine Aggregate: Washed inert natural sand conforming to ASTM C33.
 - 2. Coarse Aggregate: Well-graded crushed stone or washed gravel conforming to ASTM C33. Grading requirements are listed in ASTM C33, Table 3 for the specified coarse aggregate size number listed in Table 1. Limits of deleterious substances and physical property requirements are listed in ASTM C33, Table 4 for severe weathering regions. Do not use coarse aggregates known to be deleteriously reactive with alkalis in cement.
 - 3. Fine and coarse aggregates used shall not cause expansion of mortar bars greater than 0.1 percent in 16 days when tested in accordance with ASTM C1260 and using project proposed cement.
- D. Water:
 - 1. Comply with ACI 318 (318M) ACI 350 (350M).
 - 2. Potable,.
- E. Admixtures: Use admixtures free of chlorides and alkalis, except for those attributable to drinking water. Provide admixtures from same manufacturer when it is required to use more than one admixture in the same concrete mix. Use admixtures compatible with concrete mix including other admixtures. Do not use admixtures causing retarded or accelerated setting of concrete without written approval from Engineer. Use retarding or accelerating water reducing admixtures when so approved.
 - 1. Air Entrainment: Comply with ASTM C260 (C260M).
 - 2. Chemical:
 - a. Comply with ASTM C494.
 - b. Type A - Water Reducing.
 - c. Type B - Retarding.

- d. Type C - Accelerating.
- e. Type D - Water Reducing and Retarding.
- f. Type E - Water Reducing and Accelerating.
- g. Type F - Water Reducing, High Range.
- h. Type G - Water Reducing, High Range, and Retarding.

F. Supplementary Cementitious Materials:

- 1. Fly Ash: Class F fly ash complying with ASTM C618, including the requirements of Table 1 but with the Loss on Ignition (LOI) limited to 3 percent maximum and the optional physical requirements of Table 3. Test in compliance with ASTM C311 with a minimum of one sample weighing four pounds taken from each 200 tons of fly ash supplied for the project.
- 2. Ground Granulated Blast Furnace Slag: Grade 100 or Grade 120 ground granulated blast furnace slag complying with ASTM C989. Provide ground granulated blast furnace slag from a single source and uniform in color. Mill test reports submitted must be within 6 months of submittal date.
- 3. Silica Fume: Comply with ASTM C1240.

2.2 CONCRETE MIX

- A. Engage an independent testing laboratory to establish concrete mixes and perform sampling and laboratory testing of products and materials.
- B. Select proportions of ingredients to meet the design strength and materials limits specified in Table 1 and to produce placeable, durable concrete conforming to these specifications. Proportion ingredients to produce a homogenous mixture which will readily work into corners and angles of forms and around reinforcement without permitting materials to segregate or allowing free water to collect on the surface.
- C. Base concrete mixes on standard deviation data of prior mixes with essentially the same proportions of the same constituents or, if not available, develop concrete mixes by laboratory tests using the materials proposed for the work.
 - 1. For concrete mixes based on standard deviation data of prior mixes, submit standard deviation data of prior mixes with essentially the same proportions of the same constituents in accordance with ACI 318 and based on the modification factors for standard deviation tests contained in ACI 318.
 - 2. For concrete mixes developed by laboratory testing, base cementitious content of the concrete on curves showing the relation between water cementitious ratio and 7, 14 and 28-day compressive strengths of concrete made using the proposed materials. Determine curves by four or more points, each representing an average value of at least three test specimens and one water-cementitious ratio at each age. Provide curves with a range of values sufficient to yield the desired data, including the compressive strengths specified, without extrapolation. Cementitious content of the concrete mixes to be used, as determined from the curve, shall correspond to the required average compressive strength in Table 5.3.2.2 of ACI 318. Resulting mix shall not conflict with the limiting values for maximum water cementitious ratio and net minimum cementitious content specified in Table 1.

- D. Test fly ash or ground granulated blast furnace slag and concrete mixture to provide test data confirming that materials in combination with the cement meet strength requirements and are compatible with other concrete additives.
- E. Test aggregates for potential alkali reactivity in accordance with ASTM C1260. If initial testing indicates aggregates are not potentially reactive repeat test at 3 month intervals.
- F. Compression Tests: Provide testing of the proposed concrete mixes to demonstrate compliance with compression strength requirements in conformity with the provisions of ACI 318.
- G. Entrained Air: Measure by ASTM C231 as shown in Table 1.
 - 1. If proposed air entrainment admixture requires testing methods other than ASTM C231 to accurately determine air content, make special note of this requirement in admixture submittal.
- H. Concrete Slump: Measure by ASTM C143 as shown in Table 1.
- I. Proportion admixtures according to the manufacturer's recommendations. Two or more admixtures specified may be used in the same mix provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of the other admixture(s).

TABLE 1

Class	Design Strength 1	Cement 2	Fine Aggregate 3	Coarse Aggregate 3	Cementitious Content 4
A	2500	Type II	Sand	57 (9)	440
B	3000	Type II	Sand	57	480
C	3500	Type II	Sand	57	540
D1	4000	Type II	Sand	467	540
D2	4000	Type II	Sand	57	560
D3	4000	Type II	Sand	67	590
E1	4500	Type II	Sand	467	560
E2	4500	Type II	Sand	57	580
E3	4500	Type II	Sand	67	610
F	4000	Type II	Sand	8	600

Class	W/C Ratio 5	SCM 6	AE Range 7	WR 8	HRWR 10	Slump Range Inches
A	0.62 max.	Yes	3.5 to 5	Yes	No	1-4
B	0.54 max.	Yes	3.5 to 5	Yes	No	1-3
C	0.45 max.	Yes	3.5 to 5	Yes	No	3-5
D1	0.44 max.	Yes	3.5 to 5	Yes	No	3-5
D2	0.44 max.	Yes	3.5 to 5	Yes	No	3-5
D3	0.44 max.	Yes	3.5 to 5	Yes	No	3-5
E1	0.42 max.	Yes	3.5 to 5	Yes	No	3-5
E2	0.42 max.	Yes	3.5 to 5	Yes	No	3-5

E3	0.42 max.	Yes	3.5 to 5	Yes	No	3-5
F	0.44 max.	Yes	3.5 to 5	Yes	No	3-5

TABLE NOTES:

1. Minimum compressive strength in psi at 28 days.
2. ASTM designation in ASTM C150.
3. Size Number in ASTM C33.
4. Minimum cementitious content in pounds per cubic yard where fly ash or ground granulated blast furnace slag is used cementitious content is defined as cement content plus fly ash or ground granulated blast furnace slag content.
5. W/C is Maximum Water Cementitious ratio by weight.
6. AE is percent air entrainment.
7. WR is water reducing admixture.
8. Except as specified in Section 260543 for concrete electrical raceway encasement.

J. Admixtures:

1. Include admixture types approved by Engineer and their quantities in concrete mix designs.
2. Cold Weather:
 - a. ASTM C494 Type E admixture may be used in cold weather, if approved by Engineer.
 - b. Use of admixtures will not relax cold-weather placement requirements.
3. Hot Weather:
 - a. ASTM C494 Type D admixture may be used in hot weather, if approved by Engineer.
 - b. Use of admixtures will not relax hot-weather placement requirements.
4. Do not use calcium chloride or admixtures containing calcium chloride.
5. Add air entrainment admixture to all concrete.
6. Add water reducing admixture to all concrete.

K. Ready-Mixed Concrete: Mix and deliver concrete according to ASTM C94.

2.3 ACCESSORIES

1. Manufacturers:

- a. a. Carlisle Coatings & Waterproofing Inc.
- b. b. Fortifiber Building Systems Group.
- c. c. GCP Applied Technologies Inc.
- d. d. ISI Building Products.
- e. e. Raven Industries, Inc.
- f. f. Reef Industries, Inc.
- g. g. Stego Industries, LLC.
- h. h. W.R. Meadows, Inc.

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 a plant complying with ACI 318 and ASTM C94. Batch all constituents, including admixtures, at the plant.
- 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 the 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, the cement shall be weighed first.
- D. Measure the 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 an automatic dispenser approved by the 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 the 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 the 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 the site in watertight agitator or mixer trucks loaded not in excess of their rated capacities as stated on the name plate.
- C. Keep water tank valve on each transit truck locked at all times. 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 the addition of all water. Meter all added water and show the 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 horizontal. Chutes more than 20 feet (6 meters) 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 the 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 a delivery ticket for ready mixed concrete to Engineer as each truck arrives. Provide a printed record of the weight of cement and each aggregate as batched individually on each ticket. Use the 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 the 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.
 - 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 Degree C) 80 Degree F to 90 Degree F (32 Degree C)	45 minutes
(21 Degree C) 70 Degree F to 79 Degree F (26 Degree C)	60 minutes
(5 Degree C) 40 Degree F to 69 Degree F (20 Degree C)	90 minutes

3.3 EXAMINATION

- A. Section 017300 “Execution”: Requirements for installation examination.

- B. Verify requirements for concrete cover over reinforcement.
- C. Verify that anchors, seats, plates, reinforcement, piping, electrical conduits and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.
- D. At all times batch, mix, transport, place, and cure concrete to the inspection of Engineer. Advise Engineer of readiness to proceed at least 24 hours prior to each concrete placement. Engineer will inspect the preparations for concreting, including preparation of previously placed concrete, reinforcing and alignment, cleanliness, and tightness of formwork. Do not place concrete without the inspection and acceptance of Engineer.

3.4 EMBEDDED ITEMS

- A. Secure to forms as required or set for embedment as required, miscellaneous metal items, sleeves, reglets, anchor bolts, anchors, inserts and other items furnished under other Sections and required to be embedded into concrete. Set and secure such items in the locations and alignments needed so they are not displaced by concrete placement.
- B. Clean embedded items free of rust, mud, dirt, grease, oil, ice, or other contaminants which would reduce or prevent bonding with concrete.
- C. Coat or isolate all aluminum embedments to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel.
- D. Do not embed piping in concrete unless indicated on Drawings.
- E. Do not embed electrical conduits in concrete unless indicated on Drawings.
- F. Fabricate piping and conduit such that cutting, bending, or relocation of reinforcing steel is not required. Satisfy the following for pipes and conduits embedded within a slab or wall (other than those merely passing through), unless otherwise indicated on Drawings or approved:
 - 1. Maximum outside dimension of pipe or conduit: Be not greater than one third the overall thickness of slab or wall.
 - 2. Spacing of pipes or conduits: Be greater than or equal to three diameters or widths on center.
- G. Close open ends of piping, conduits, and sleeves embedded in concrete with caps or plugs prior to placing concrete.
- H. Ensure specified tests and inspections on embedded piping are completed and satisfactory before starting concrete placement. Ensure mechanical or electrical tests and inspections are completed and satisfactory prior to starting concrete placement. Do not place concrete until unsatisfactory items and conditions have been corrected.
- I. Position embedded anchor bolts using templates.
- J. Correct embedded items not installed in the location or alignment needed or displaced by concrete placement without additional compensation.

3.5 PREPARATION

- A. Section 017300 “Execution”: Requirements for installation preparation.
- B. Previously Placed Concrete:
 - 1. Prepare joints as specified in Section 031500 “Concrete Joints and Accessories”.
- C. Remove debris and ice from formwork, reinforcement, and concrete substrates.
- D. Remove water from areas receiving concrete before concrete is placed.

3.6 CONCRETE APPEARANCE

- A. Remix concrete showing either poor cohesion or poor coating of the coarse aggregate with paste. Reject remixed concrete showing either poor cohesion or poor coating of the coarse aggregate with paste. Make, at no additional cost to Owner, changes in the concrete mix design for future deliveries only by adjusting one or more of the following if the slump is within the allowable limit, but excessive bleeding, poor workability, or poor finish ability are observed:
 - 1. Gradation of aggregate.
 - 2. Proportion of fine and coarse aggregate.
 - 3. Percentage of entrained air, within the allowable limits.
- B. Provide concrete having a homogeneous structure which, when hardened, will have the specified strength, durability and appearance. Provide mixtures and workmanship such that concrete surfaces, when exposed, will require no finishing except as specified in Section 033500.

3.7 INSTALLATION

- A. Placing Concrete:
 - 1. Place concrete according to ACI 301.
 - 2. Notify testing laboratory and Engineer minimum 24 hours prior to commencement of operations.
 - 3. Ensure that reinforcement, inserts, and embedded parts are not disturbed during concrete placement.
 - 4. Verify that formwork completely encloses concrete to be placed and is securely braced prior to concrete placement. Remove ice, standing water, dirt, debris, and other foreign materials from forms and exposed joint surfaces. Confirm that reinforcement and other embedded items are securely in place. Have a worker at the location of the placement who can check that reinforcement and embedded items remain in designated locations and alignments while concrete is being placed. Sprinkle semi-porous subgrades or forms to eliminate suction of water from the mix. Do not place concrete on frozen subgrade, snow, or ice.

5. Deposit concrete as near its final position as possible to prevent segregation due to rehandling or flowing. Place concrete continuously at a rate that allows the concrete previously placed to be integrated with fresh plastic concrete. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials or on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If the section cannot be placed continuously, place construction joints as specified or as approved.
 6. Pumping of concrete will be permitted. Use a mix design and aggregate sizes chosen for pumping and submit for approval. Do not use pipelines made of aluminum or aluminum alloy. When concrete is pumped, determine slump at point of truck discharge and determine air content at point of placement.
 7. Remove temporary spreaders from forms when the spreader is no longer needed. Temporary spreaders may remain embedded in concrete only when made of galvanized steel or concrete and if prior approval has been obtained.
 8. Do not place concrete for supported elements until concrete previously placed in the supporting element has attained design strength.
 9. Where surface mortar is to form the base of a finish, especially surfaces designated to be painted, work coarse aggregate back from forms to bring the full surface of the mortar against the form. Prevent the formation of surface voids.
 10. Slabs:
 - a. After bulkheads, screeds and jointing materials have been positioned, place concrete continuously between joints beginning at a bulkhead, edgeform, or corner. Place each batch into the edge of the previously placed concrete to avoid stone pockets and segregation.
 - b. Avoid delays in placement. If there is a delay in placement, spade and consolidate concrete placed after the delay at the edge of previously placed concrete to avoid cold joints. Bring concrete to correct level and strike off with a straightedge. Use bullfloats or darbies to smooth the surface, leaving it free of humps or hollows.
 - c. Where slabs are to be placed integrally with the walls below them, place the walls and compact as specified. Allow one hour to pass between placement of the wall and the overlying slab to permit consolidation of the wall concrete. Keep top surface of the wall moist to prevent cold joints.
 11. Formed Concrete:
 - a. Place concrete in forms using tremie tubes taking care to prevent segregation. Maintain bottom of tremie tubes near the surface of concrete already placed. Do not permit concrete to drop freely more than 4 feet. Place concrete for walls in 12
 12. Maintain records of concrete placement, including date, location, quantity, air temperature, and test samples taken.
- B. Compacting:
1. Consolidate concrete by vibration and puddling, spading, rodding, or forking so that concrete is completely worked around reinforcement, embedded items and openings and into corners of forms. Continuously perform puddling, spading, rodding, and forking along with vibration of the placement to eliminate air or stone pockets which may cause honeycombing, pitting, or planes of weakness.

2. Compact concrete with mechanical vibrators. Do not order concrete until vibrators (including standby units in working order) are on the job.
3. Use mechanical vibrators having a minimum frequency of 8000 vibrations per minute. Insert vibrators and withdraw at points from 18 inches to 30 inches apart. Vibrate sufficiently at each insertion to consolidate concrete, generally from 5 to 15 seconds. Do not over vibrate so as to segregate. Keep standby vibrators on the site during concrete placing operations.
4. Concrete Slabs: Vibrate concrete slabs less than 8 inch thick by vibrating screeds. Vibrate concrete slabs 8 inches and thicker by internal vibrators and (optionally) with vibrating screeds. Place vibrators into concrete vertically. Do not lay vibrators horizontally or lay over.
5. Walls and Columns: Use internal vibrators rather than form vibrators, unless otherwise approved by Engineer. General: for each vibrator needed to level the batch at the point of discharge, use one or more additional vibrators to densify, homogenize, and perfect the surface. Insert vibrators vertically at regular intervals, through fresh concrete and slightly into the previous lift, if any.
6. Amount of Vibration: Use vibrators to consolidate properly placed concrete. Do not use vibrators to move or transport concrete in the forms. Continue vibration until:
 - a. Frequency of vibrator returns to normal.
 - b. Surface appears liquefied, flattened and glistening.
 - c. Trapped air ceases to rise.
 - d. Coarse aggregate has blended into surface but has not disappeared.

3.8 PROTECTION

- A. Protect all concrete work against injury from the elements and defacements of any nature during construction operations.
- B. Protect finished surfaces and slabs whenever ambient conditions of humidity, temperature, sunlight and wind may result in the rapid evaporation of water from the concrete, to prevent checking and crazing, until the beginning of curing.
- C. Cold Weather Concreting:
 1. For this Specification, 'cold weather' is defined as a period when for more than three successive days, the average daily outdoor temperature drops below 40 degrees F. Calculate average daily temperature as the average of highest and lowest temperature during the period from midnight to midnight.
 2. Batch, deliver, place, cure, and protect concrete during cold weather in compliance with the recommendations of ACI 306R and the additional requirements of this Section.
 3. Review cold weather concreting plan at preconstruction meeting. Include methods and procedures for use during cold weather including the production, transportation, placement, protection, curing, and temperature monitoring of concrete and procedures to be implemented upon abrupt changes in weather conditions or equipment failures.
 4. Maintain minimum temperature of concrete immediately after placement and during the protection period as indicated in Table 3. The temperature of the concrete in place and during the protection period shall not exceed these values by more than 20 degrees F. Prevent overheating and non-uniform heating of the concrete.

TABLE 3

Minimum Concrete
Temperatures For
Section Dimensions

Minimum Concrete Temperature:	<u>< 12 inches</u> 55 degrees F	<u>12 - 36 inches</u> 50 degrees F
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5. Protect concrete during periods of cold weather to provide continuous warm, moist curing (with supplementary heat when required by weather conditions) for a total of at least 350 degree-days of curing.
 - a. Degree-days are defined as the total number of 24-hour periods multiplied by the weighted average daily air temperature at the surface of the concrete, where 7 days at an average 50 degrees F equals 350 degree-days.
 - b. To calculate the weighted average daily air temperature, sum hourly measurements of air temperature in the shade at concrete surface taking any measurement less than 50 degrees F as 0 degrees F. Divide the sum thus calculated by 24 to obtain the weighted average temperature for that day.
6. Do not use salt, manure or other chemicals for protection.
7. At the end of the protection period, allow the concrete to cool gradually to the ambient temperature. If water curing has been used, do not expose concrete to temperatures below those shown in Table 3 until at least 24 hours after water curing has been terminated and air-dry concrete for at least 3 days prior to first exposure to freezing temperatures.
8. During periods not defined as cold weather, but when freezing temperatures are expected or occur, protect concrete surfaces from freezing for the first 24 hours after placing.

D. Hot Weather Concreting:

1. For this Specification, 'hot weather' is defined as any combination of high air temperatures, low relative humidity, and wind velocity which produces a rate of evaporation as estimated in ACI 305R, approaching or exceeding 0.2 pounds per square foot per hour.
2. Batch, deliver, place, cure, and protect concrete during hot weather in compliance with the recommendations of ACI 305R and the additional requirements of this Section.
 - a. Temperature of concrete being placed shall not exceed 90 degrees F. Maintain a uniform concrete mix temperature below this level. The temperature of the concrete shall not cause loss of slump, flash set or cold joints.
 - b. Promptly deliver concrete to the site and promptly place the concrete upon its arrival at the site, not exceeding the maximum time interval specified in Paragraph 3.2 I.4. Provide vibration immediately after placement.
 - c. Engineer may direct Contractor to immediately cover concrete with sheet curing material.
3. Review hot weather concreting plan at preconstruction meeting. Include methods and procedures for use during hot weather, including production, placement, and curing.

3.9 REMOVAL OF FORMS

- A. Do not remove forms before concrete has attained a strength of at least 70 percent of its specified design strength for beams and slabs and at least 30 percent of its specified design strength for walls and vertical surfaces, nor before reaching the following number of day-degrees of curing, whichever is longer.

TABLE 4

Forms for	Degree Days
Beams and slabs	500
Walls and vertical surfaces	100

(See definition of degree-days in Paragraph 3.8C).

- B. Do not remove shores until concrete has attained at least 70 percent of its specified design strength and also sufficient strength to support safely its own weight and construction live loads.
- C. In cold weather when temperature of concrete exceeds ambient air temperature by 20 degrees F at the end of the protection period, loosen forms and leave in place for at least 24 hours to allow concrete to cool gradually to ambient air temperature.

3.10 FIELD QUALITY CONTROL

- A. Section 014000 “Quality Requirements”: Requirements for inspecting and testing.
- B. Inspection and Testing: Performed by Owner's testing laboratory according to ACI 318 (318M).
- C. Provide unrestricted access to Work and cooperate with appointed testing and inspection firm.
- D. Submit proposed mix design of each class of concrete to inspection and testing firm for review and approval prior to commencement of Work.
- E. Concrete Inspections:
 - 1. Continuous Placement Inspection: Inspect for proper installation procedures.
 - 2. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.
- F. Patching:
 - 1. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.
 - 2. It is the intent of these Specifications to require quality work including forming, mixing, and placement of concrete and curing so completed concrete surfaces will require no patching or repairs.
 - 3. As soon as forms have been stripped and concrete surfaces exposed: remove fins and other projections; fill recesses left by the removal of form ties; and repair surface defects which do not impair structural strength. Clean exposed concrete surfaces and adjoining work stained by leakage of concrete.

4. Immediately after removal of forms, remove tie cones and metal portions of ties as specified in Section 031000 "Concrete Forming and Accessories". Fill holes promptly upon stripping as follows: Moisten the hole with water, followed by a 1/16 inch brush coat of neat cement slurry mixed to consistency of a heavy paste. Immediately plug hole with a 1 to 1.5 mixture of cement and concrete sand mixed slightly damp to the touch (just short of "balling"). Hammer grout into the hole until dense, and an excess of paste appears on the surface in the form of a spider web. Trowel smooth with heavy pressure. Avoid burnishing.
5. When filling tie cone holes and patching or repairing exposed surfaces use the same source of cement and sand as used in the parent concrete. Adjust color to match by addition of white cement. Rub lightly with a fine carborundum stone at an age of one to five days as necessary to bring surface down with parent concrete. Do not damage or stain virgin skin of surrounding parent concrete. Wash thoroughly to remove rubbed matter.
6. For very heavy (generally formed) patches, Engineer may order the addition of pea gravel to the mixture and the proportions modified as follows:

<u>Material</u>	<u>Volumes</u>	<u>Weights</u>
Cement	1.0	1.0
Sand	1.0	1.0
Pea Gravel	1.5	1.5

7. Patch imperfections according to ACI 301.
8. Defective concrete and honeycombed areas: Chip down square and at least 1-inch deep to sound concrete with hand chisels or pneumatic chipping hammers. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly embedded in the parent concrete. If honeycomb exists around reinforcement, chip to provide a clear space at least 3/8 inch wide around the steel. For areas less than 1-1/2 inches deep, the patch may be made in the same manner as described above for filling form tie holes, care being exercised to use adequately dry (non-trowelable) mixtures and to avoid sagging. Thicker repairs will require build-up in successive 1-1/2 inch layers on successive days, each layer being applied with slurry as described above.

G. Defective Concrete:

1. Description: Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.
2. Repair or replacement of defective concrete will be determined by Engineer.
3. Do not patch, fill, touch up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

3.11 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 1.8E. 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.

3.12 SCHEDULE

- A. Following Table 5 are general applications for various concrete classes and design strengths:

TABLE 5

<u>Class</u>	<u>Design Strength</u> (psi)	<u>Description</u>
D1	4,000	Structural concrete foundation mats and slabs, walls, and footings 16 inches and greater in thickness.
D2	4,000	Except as noted above for Class D1 concrete: Structural concrete greater than 10 inches in thickness including walls, slabs on grade and all other structural concrete greater than 10 inches in thickness.
D3	4,000	Structural concrete 10 inches or less in thickness including walls, slabs on grade, and all other structural concrete 10 inches or less in thickness.

END OF SECTION 033000

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SECTION 033900 - CONCRETE CURING

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: Initial and final curing of horizontal and vertical concrete surfaces.
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete": Coordinate Work of this Section with concrete placement, including Hot and Cold Weather and other environmental factors affecting concreting procedures.

1.3 ACTION SUBMITTALS

- A. Section 013300 "Submittal Procedures": Requirements for submittals.
- B. Product Data: Submit manufacturer's information on curing compounds, mats, paper, sheets, and film, including compatibilities and limitations.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- B. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- C. Qualifications Statement:
 - 1. Submit qualifications for manufacturer.

1.5 QUALITY ASSURANCE

- A. Perform Work according to ACI 301.
- B. Maintain one 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 three years' documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 "Product Requirements": Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location.
 - 2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Membrane-Curing Compound, Type A:
 - 1. Comply with ASTM C 309, Type 1, Class A, containing no wax, paraffin or oil and be non-yellowing.
 - 2. Comply with Federal, State and local VOC limits.
- B. Absorptive Mats
 - 1. Description:
 - a. Material: Burlap-polyethylene (PE).
 - b. Minimum Weight: 9 oz./sq. yd.
 - c. Bonded to prevent separation during handling and placing.
- C. PE Film:
 - 1. Comply with ASTM C 171 and D 2103.
 - 2. Thickness: 6 mils.
 - 3. Color: Clear.
- D. Water: Potable; not detrimental to concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 017300 “Execution”: Requirements for application examination.
- B. Verify that substrate surfaces are ready to be cured.

3.2 APPLICATION

- A. Curing Methods for Concrete Surfaces: Cure concrete to retain moisture and maintain a temperature of at least 50 degrees F (10 degrees C) at concrete surface for a minimum of seven days after placement. Use the following curing methods as specified:
 - 1. Water Curing: Keep entire concrete surface wet by ponding, continuous sprinkling, or covered with saturated burlap. Begin water curing as soon as concrete attains an initial set and maintain water curing 24 hours a day. Do not permit concrete surface to dry out at any time during curing period. Provide temperature of curing water within 20 degrees F (-7 degrees C) of concrete temperature.
 - 2. Sheet Material Curing: Cover entire surface with sheet material. Anchor sheeting to prevent wind and air from lifting the sheeting or entrapping air under the sheet. Place and secure sheet as soon as initial concrete set occurs..
 - 3. Membrane Curing: Apply over entire concrete surface except as follows.
 - a. Do not apply curing compound on any concrete surface where additional concrete or grout is to be placed, where concrete sealers or surface coatings are to be used, or where concrete finish requires an integral floor product.
 - b. Apply curing compound as soon as free water on the surface has disappeared and no water sheen is visible.
 - c. Do not apply after the concrete is dry or when curing compound can be absorbed into the concrete. Apply in compliance with manufacturer's recommendations.]
- B. Specified Applications of Curing Methods:
 - 1. Slabs for Liquid Retaining Structures: Water cure only.
 - 2. Slabs on Grade and Footings (not used to retain liquids): Water cure or sheet material cure or membrane cure.
 - 3. : Water cure.
 - 4. Formed Surfaces:
 - a. No curing, if nonabsorbent forms are left in place seven days.
 - b. Water cure if absorbent forms are used.
 - c. Water cure if forms are removed prior to seven days.
 - d. Water cure exposed horizontal surfaces of formed walls or columns for seven days or until next placement of concrete is made.
 - 5. Surfaces of Concrete Joints: Water cure or sheet material cure.

- C. Protect finished surfaces and slabs whenever ambient conditions of humidity, temperature, sunlight and wind may result in the rapid evaporation of water from the concrete, to prevent checking and crazing, until the beginning of curing.

3.3 PROTECTION

- A. Section 017300 “Execution”: Requirements for protecting finished Work.
- B. Do not permit traffic over unprotected surfaces.
- C. Reference Section 033000 “Cast-In-Place Concrete” for additional protection requirements.

END OF SECTION 033900

SECTION 040110 - MASONRY CLEANING

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 cleaning the following:
 - 1. Unit masonry surfaces.
 - 2. Stone surfaces.

1.3 ALLOWANCES

- A. Allowances for cleaning masonry are specified in Section 012100 "Allowances."

1.4 DEFINITIONS

- A. Very Low-Pressure Spray: Under 100 psi.
- B. Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm.
- C. Medium-Pressure Spray: 400 to 800 psi; 4 to 6 gpm.
- D. High-Pressure Spray: 800 to 1200 psi; 4 to 6 gpm.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to cleaning masonry including, but not limited to, the following:
 - a. Verify masonry-cleaning equipment and facilities needed to make progress and avoid delays.
 - b. Materials, material application, and sequencing.
 - c. Cleaning program.
 - d. Coordination with building occupants.

1.6 SEQUENCING AND SCHEDULING

- A. Work Sequence: Perform masonry-cleaning work in the following sequence:
 - 1. Remove plant growth.
 - 2. Inspect for open mortar joints. Where repairs are required, delay further cleaning work until after repairs are completed, cured, and dried to prevent the intrusion of water and other cleaning materials into the wall.
 - 3. Remove paint.
 - 4. Clean masonry surfaces.
 - 5. Where water repellents are to be used on or near masonry, delay application of these chemicals until after cleaning.
- B. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in masonry units according to masonry repair Sections. Patch holes in mortar joints according to masonry repointing Sections.

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include material descriptions and application instructions.
 - 2. Include test data substantiating that products comply with requirements.

1.8 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For paint-remover manufacturer and chemical-cleaner manufacturer.
- B. Preconstruction Test Reports: For cleaning materials and methods.
- C. Cleaning program.

1.9 QUALITY ASSURANCE

- A. Paint-Remover Manufacturer Qualifications: A firm regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection, preconstruction product testing, and on-site assistance.
- B. Chemical-Cleaner Manufacturer Qualifications: A firm regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection, preconstruction product testing, and on-site assistance.
- C. Cleaning Program: Prepare a written cleaning program that describes cleaning process in detail, including materials, methods, and equipment to be used; protection of surrounding materials; and control of runoff during operations. Include provisions for supervising worker performance and preventing damage.

1. If materials and methods other than those indicated are proposed for any phase of cleaning work, add a written description of such materials and methods, including evidence of successful use on comparable projects and demonstrations to show their effectiveness for this Project.

1.10 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage one or more chemical-cleaner and paint-remover manufacturers to perform preconstruction testing on masonry surfaces.
 1. Use test areas as indicated and representative of proposed materials and existing construction.
 2. Propose changes to materials and methods to suit Project.

1.11 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit masonry-cleaning work to be performed according to product manufacturers' written instructions and specified requirements.
- B. Clean masonry surfaces only when air temperature is 40 deg F and above and is predicted to remain so for at least seven days after completion of cleaning.

PART 2 - PRODUCTS

2.1 PAINT REMOVERS

- A. Alkaline Paste Paint Remover: Manufacturer's standard alkaline paste or gel formulation, for removing paint from masonry; containing no methylene chloride.
- B. Covered or Skin-Forming Alkaline Paint Remover: Manufacturer's standard covered or skin-forming, alkaline paste or gel formulation, for removing paint from masonry; containing no methylene chloride.
- C. Solvent-Type Paste Paint Remover: Manufacturer's standard water-rinsable, solvent-type paste or gel formulation, for removing paint from masonry.
- D. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinsable, solvent-type paste, gel, or foamed emulsion formulation, for removing paint from masonry; containing no methanol or methylene chloride.
- E. Covered, Solvent-Type Paste Paint Remover: Manufacturer's standard, low-odor, covered, water-rinsable, solvent-type paste or gel formulation, for removing paint coatings from masonry; containing no methanol or methylene chloride.

2.2 CLEANING MATERIALS

- A. Water: Potable.
- B. Hot Water: Water heated to a temperature of 140 to 160 deg F.
- C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 1/2 cup of laundry detergent, and 20 quarts of hot water for every 5 gal. of solution required.
- D. Mold, Mildew, and Algae Remover, Job Mixed: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 5 quarts of 5 percent sodium hypochlorite (bleach), and 15 quarts of hot water for every 5 gal. of solution required.
- E. Nonacidic Gel Cleaner: Manufacturer's standard gel formulation, with pH between 6 and 9, that contains detergents with chelating agents and is specifically formulated for cleaning masonry surfaces.
- F. Nonacidic Liquid Cleaner: Manufacturer's standard mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including polished stone, brick, aluminum, plastics, and wood.
- G. Mild-Acid Cleaner: Manufacturer's standard mild-acid cleaner containing no muriatic (hydrochloric), hydrofluoric, or sulfuric acid; or ammonium bifluoride or chlorine bleaches.
- H. Acidic Cleaner: Manufacturer's standard acidic masonry cleaner composed of hydrofluoric acid or ammonium bifluoride blended with other acids, detergents, wetting agents, and inhibitors.
- I. One-Part Limestone Acidic Cleaner: Manufacturer's standard one-part acidic formulation for cleaning limestone.
- J. Two-Part Chemical Cleaner: Manufacturer's standard system consisting of potassium- or sodium-hydroxide-based, alkaline prewash cleaner and acidic afterwash cleaner that does not contain hydrofluoric acid.

2.3 ACCESSORY MATERIALS

- A. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, glazed masonry, and polished stone surfaces from damaging effects of acidic and alkaline masonry cleaners.

2.4 CHEMICAL CLEANING SOLUTIONS

- A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended in writing by chemical-cleaner manufacturer.
- B. Acidic Cleaner Solution for Nonglazed Masonry: Dilute acidic cleaner with water to produce hydrofluoric acid content of 3 percent or less, but not greater than that recommended in writing by chemical-cleaner manufacturer.

- C. Acidic Cleaner for Glazed Masonry: Dilute acidic cleaner with water to concentration demonstrated by testing that does not etch or otherwise damage glazed or polished surface, but not greater than that recommended in writing by chemical-cleaner manufacturer.

PART 3 - EXECUTION

3.1 MASONRY-CLEANING SPECIALIST

- A. Masonry-Cleaning Specialist Firms: Subject to compliance with requirements,:

3.2 PROTECTION

- A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent paint removers and chemical cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.
 - 1. Cover adjacent surfaces with materials that are proven to resist paint removers and chemical cleaners used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant. Apply masking agents according to manufacturer's written instructions. Do not apply liquid strippable masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
 - 2. Do not apply chemical solutions during winds of enough force to spread them to unprotected surfaces.
 - 3. Neutralize alkaline and acid wastes before disposal.
 - 4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.
- B. Remove downspouts and associated hardware adjacent to immediate work area and store during masonry cleaning. Reinstall when masonry cleaning is complete.
 - 1. Provide temporary rain drainage during work to direct water away from building.

3.3 CLEANING MASONRY, GENERAL

- A. Cleaning Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 20 feet away by Engineer.
- B. Proceed with cleaning in an orderly manner; work fromtop to bottom of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.
- C. Use only those cleaning methods indicated for each masonry material and location.
 - 1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.

2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage surfaces, including joints.
 - a. Equip units with pressure gages.
 - b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
 - c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
 - d. For high-pressure water-spray application, use fan-shaped spray that disperses water at an angle of at least 40 degrees.
 - e. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F at flow rates indicated.
 - f. For steam application, use steam generator capable of delivering live steam at nozzle.

- D. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces. Keep wall wet below area being cleaned to prevent streaking from runoff.

- E. Perform additional general cleaning, paint and stain removal, and spot cleaning of small areas that are noticeably different when viewed according to the "Cleaning Appearance Standard" Paragraph, so that cleaned surfaces blend smoothly into surrounding areas.

- F. Water Application Methods:
 1. Water-Soak Application: Soak masonry surfaces by applying water continuously and uniformly to limited area for time indicated. Apply water at low pressures and low volumes in multiple fine sprays using perforated hoses or multiple spray nozzles. Erect a protective enclosure constructed of polyethylene sheeting to cover area being sprayed.
 2. Water-Spray Applications: Unless otherwise indicated, hold spray nozzle at least 6 inches from masonry surface and apply water in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.

- G. Steam Cleaning: Apply steam to masonry surfaces at the very low pressures indicated for each type of masonry. Hold nozzle at least 6 inches from masonry surface and apply steam in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.

- H. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces according to chemical-cleaner manufacturer's written instructions; use brush or spray application. Do not spray apply at pressures exceeding 50 psi. Do not allow chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

- I. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.

1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.
- J. After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

3.4 PRELIMINARY CLEANING

- A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing remaining growth to dry as long as possible before removal. Remove loose soil and plant debris from open joints to whatever depth they occur.
- B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, calking, asphalt, and tar.
1. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.
 2. Remove paint and calking with alkaline paint remover.
 - a. Comply with requirements in "Paint Removal" Article.
 - b. Repeat application up to two times if needed.
 3. Remove asphalt and tar with solvent-type paste paint remover.
 - a. Comply with requirements in "Paint Removal" Article.
 - b. Apply paint remover only to asphalt and tar by brush without prewetting.
 - c. Allow paint remover to remain on surface for 10 to 30 minutes.
 - d. Repeat application if needed.

3.5 PAINT REMOVAL

- A. Paint-Remover Application, General: Apply paint removers according to paint-remover manufacturer's written instructions. Do not allow paint removers to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.
- B. Paint Removal with Alkaline Paste Paint Remover:
1. Remove loose and peeling paint using high-pressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
 2. Apply paint remover to dry, painted surface with brushes.
 3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
 4. Rinse with cold water applied by high-pressure spray to remove chemicals and paint residue.
 5. Repeat process if necessary to remove all paint.
 6. Apply acidic cleaner or manufacturer's recommended afterwash to surface, while surface is still wet, using low-pressure spray equipment or soft-fiber brush. Let cleaner or

afterwash remain on surface as a neutralizing agent for period recommended in writing by chemical-cleaner or afterwash manufacturer.

7. Rinse with cold water applied by high-pressure spray to remove chemicals and soil.

C. Paint Removal with Covered or Skin-Forming Alkaline Paint Remover:

1. Remove loose and peeling paint using high-pressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted surface with trowel, spatula, or as recommended in writing by manufacturer.
3. Apply cover according to manufacturer's written instructions.
4. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
5. Scrape off paint and remover.
6. Rinse with cold water applied by high-pressure spray to remove chemicals and paint residue.
7. Apply acidic cleaner or manufacturer's recommended afterwash to surface, while surface is still wet, using low-pressure spray equipment or soft-fiber brush. Let cleaner or afterwash remain on surface as a neutralizing agent for period recommended in writing by chemical-cleaner or afterwash manufacturer.
8. Rinse with cold water applied by high-pressure spray to remove chemicals and soil.
9. For spots of remaining paint, apply alkaline paste paint remover, according to "Paint Removal with Alkaline Paste Paint Remover" Paragraph.

D. Paint Removal with Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using high-pressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply thick coating of paint remover to painted surface with natural-fiber cleaning brush, deep-nap roller, or large paint brush. Apply in one or two coats according to manufacturer's written instructions.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Rinse with cold water applied by high-pressure spray to remove chemicals and paint residue.

E. Paint Removal with Covered, Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using high-pressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted surface with trowel, spatula, or as recommended in writing by manufacturer.
3. Apply cover according to manufacturer's written instructions.
4. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
5. Scrape off paint and remover.
6. Rinse with cold water applied by high-pressure spray to remove chemicals and paint residue.

- 3.6 CLEANING MASONRY Copy this article and re-edit for significantly different types of cleaning and masonry types.
- A. Cold-Water Soak:
 - 1. Apply cold water by intermittent spraying to keep surface moist.
 - 2. Use perforated hoses or other means that apply a fine water mist to entire surface being cleaned.
 - 3. Apply water in cycles of five minutes on and 20 minutes off.
 - 4. Continue spraying until surface encrustation has softened enough to permit its removal by water wash, as indicated by cleaning tests for 72 hours.
 - 5. Remove soil and softened surface encrustation from surface with cold water applied by low-pressure spray.
 - B. Cold-Water Wash: Use cold water applied by low -pressure spray.
 - C. Hot-Water Wash: Use hot water applied by low -pressure spray.
 - D. Steam Cleaning: Apply steam at very low pressures not exceeding 30 psi. Remove dirt softened by steam with wood scrapers, stiff-nylon or -fiber brushes, or cold-water wash, as indicated by cleaning tests.
 - E. Detergent Cleaning:
 - 1. Wet surface with cold water applied by low-pressure spray.
 - 2. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
 - 3. Rinse with cold water applied by low-pressure spray to remove detergent solution and soil.
 - 4. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.
 - F. Mold, Mildew, and Algae Removal:
 - 1. Wet surface with cold water applied by low-pressure spray.
 - 2. Apply mold, mildew, and algae remover by brush or low-pressure spray.
 - 3. Scrub surface with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that surface remains wet.
 - 4. Rinse with cold water applied by low-pressure spray to remove mold, mildew, and algae remover and soil.
 - 5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.
 - G. Nonacidic Liquid Chemical Cleaning:
 - 1. Wet surface with cold water applied by low-pressure spray.
 - 2. Apply cleaner to surface in two applications by brush or low-pressure spray.

3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
4. Rinse with cold water applied by low-pressure spray to remove chemicals and soil.
5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

H. Two-Part Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply alkaline prewash cleaner to surface by brush or roller.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer unless otherwise indicated.
4. Rinse with cold water applied by medium-pressure spray to remove chemicals and soil.
5. Apply acidic afterwash cleaner to surface in two applications, while surface is still wet, using low-pressure spray equipment, deep-nap roller or soft-fiber brush. Let neutralizer remain on surface for period recommended in writing by manufacturer unless otherwise indicated.
6. Rinse with cold water applied by medium-pressure spray to remove chemicals and soil. Rinse until surface reaction value is between pH 5 and pH 9 according to pH-measuring paper, pen, or indicator solution.
7. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once.

3.7 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage paint-remover manufacturer's and chemical-cleaner manufacturer's factory-authorized service representatives for consultation and Project-site inspection, to perform preconstruction product testing, and provide on-site assistance when requested by Engineer. Have paint-remover manufacturer's and chemical-cleaner manufacturer's factory-authorized service representatives visit Project site not less than once to observing progress and quality of the work.

3.8 FINAL CLEANING

- A. Clean adjacent nonmasonry surfaces of spillage and debris. Use detergent and soft brushes or cloths.
- B. Remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.
- C. Remove masking materials, leaving no residues that could trap dirt.

END OF SECTION 040110

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. Steel framing and supports for mechanical and electrical equipment.
- 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
- 3. Shelf angles.
- 4. 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. Loose steel lintels.
- 2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
- 3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

- C. Related Requirements:

- 1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
- 2. 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. Product Data: For the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Prefabricated building columns.
3. Metal nosings and treads.
4. Paint products.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Steel framing and supports for mechanical and electrical equipment.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
3. Shelf angles.
4. Loose steel lintels.

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.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Delegated Design Engineer: Licensed professional engineer experienced in design of specified Work and licensed in the State of Project location.

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 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. 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 316L for welded components.
- E. Stainless steel Bars and Shapes: ASTM A276, Type 316L for welded components.
- F. Steel Tubing: ASTM A500/A500M, Grade B cold-formed steel tubing.
- G. Steel Pipe: ASTM A53/A53M, Type S Grade B Standard Weight (Schedule 40) unless otherwise indicated.
- H. Gray Iron Castings: ASTM A48, Class 35.
- I. Ductile Iron Castings: ASTM A536, Grade 65-45-12.
- J. Stainless steel Bolts: ASTM F593, Type 316.
- K. Stainless steel Nuts: ASTM F594, Type 316.
- L. Carbon Steel Bolts and Studs: ASTM A307, Grade A (hot dip galvanized nuts and washers where noted)
- M. 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.
- N. Galvanizing: ASTM A123, Zn w/0.05 percent minimum Ni.
- O. Galvanizing, hardware: ASTM A153, Zn w/0.05 percent minimum Ni.
- P. Galvanizing, anchor bolts: ASTM F2329, Zn w/0.05 percent minimum Ni.
- Q. Welding electrodes, steel: AWS A5.1 E70xx.

2.3 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 (ASTM F1941M), 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.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ASTM F568M, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.
- D. Mechanically Galvanized Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM F3125, Grade A325, Type 3 (ASTM F3125M, A325M, Type 3); with hex nuts, ASTM A563, Grade C3 (ASTM A563M, Class 8S3); and, where indicated, flat washers.
- E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); 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.
- F. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488 (ASTM E488M), conducted by a qualified independent testing agency.
- G. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47 (ASTM A47M) malleable iron or ASTM A27 (ASTM A27M) cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

2.4 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.
- E. Stair Treads for Aluminum Stairs: As specified for grating and having cast abrasive non-slip nosing as approved.
- F. Aluminum Nosing at Concrete Stairs: Furnish with wing type anchors and flat head stainless steel machine screws, 12 inches (305 mm) on center. Provide nosing at concrete ladder openings. Single piece nosing for each step extending to within full ladder width. Set nosing flush with stair tread finish at concrete stairs. Furnish treads with heavy duty protective tape cover.
 - 1. Basis-of-Design: Wooster Products, Inc.; Alumogrit Treads, Type 116; similar by Barry Pattern and Foundry Co.; Andco or equal.
- G. Aluminum Finishes:
 - 1. Anodized Finish: Give an anodic oxide treatment in accordance with AA M31C22A41
 - 2. Mill Finish: Have a cleaned and degreased mill finish on other aluminum items.

2.5 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. Lintels, relief angles or other steel supporting masonry or embedded in masonry: Galvanized.
- F. 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 (76 mm) of proposed field welds. Apply paint to dry surfaces and be thoroughly and evenly spread and well worked into joints and other open spaces.
- G. Galvanizing, where required: Use hot-dip zinc process after fabrication, coating not less than 2 oz/sq.ft. (610 g/sq.m) of surface.

2.6 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.

2.7 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- B. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

- C. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187 (ASTM D1187M).

2.8 CASTINGS:

- A. General: Good quality, strong, tough, even-grained, smooth, free from scale, lumps, blisters, sand holes, and other defects. Thoroughly clean castings to remove foreign matter, and deleterious films. Castings will be subjected to a hammer inspection in the field by the Engineer. Damaged castings may be rejected and replaced at no cost to the Owner.
- B. Matching Surfaces: Machine to a true plane surface allowing contact surfaces to seat without rocking. Provide allowances in patterns so specified thickness is not reduced to obtain finished surfaces. Castings will not be acceptable if actual weight is less than 95 percent of theoretical weight computed from dimensions. Provide facilities for weighing castings in the presence of the Engineer.

2.9 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 (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form exposed work with accurate angles and surfaces and straight edges.
- D. 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.
- E. 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.

- F. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- G. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- H. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.10 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
- C. Galvanize miscellaneous framing and supports where indicated.
- D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.11 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.
 - 1. Provide mitered and welded units at corners.
 - 2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.
- B. Galvanize and prime shelf angles located in exterior walls.

2.12 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates.
- C. Prime plates with zinc-rich primer.

2.13 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles or shapes and plates of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths

for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

- B. Size loose lintels to provide bearing length at each side of openings of 8 inches (200 mm) unless otherwise indicated.
- C. Galvanize and prime loose steel lintels located in exterior walls.
- D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.14 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.15 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.

2.16 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 of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
 - 1. Shop prime with universal shop primer unless zinc-rich primer is indicated.
- D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
- E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

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. Touch up abrasions in the shop primer immediately after erection. Paint areas left unprimed for welding after welding.
 2. 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.
 3. Install specialty products in accordance with the manufacturer's recommendations.
 4. Weld headed anchor studs in accordance with manufacturer's recommendations.
 5. 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.
 6. 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.
 7. Field Welding: Comply with the following requirements:
 8. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 9. Obtain fusion without undercut or overlap.
 10. Remove welding flux immediately.
 11. 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.
 12. 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.
 13. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
 14. 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 (6 mm) thick neoprene isolator pads, 85 plus or minus 5 Shore A durometer, sized for full width and length of bracket or support.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint.
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780 (ASTM A780M).

END OF SECTION 055000

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SECTION 067413 - FIBERGLASS REINFORCED PLASTIC COMPONENTS

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 FRP gratings, frames, and supports for gratings guardrails and plates.

1.3 DEFINITIONS

- A. FRP: Refers to fiberglass reinforced plastic or glass fiber reinforced plastics.

1.4 COORDINATION

- A. Coordinate installation of anchorages for gratings, grating frames, guardrails, plates and supports.
- B. 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 as specified in Division 03 or masonry as specified in Division 04. Deliver such items to Project site in time for installation.

1.5 ACTION SUBMITTALS

- A. Test Data: Certified data based on tests of actual production samples which demonstrate that products conform to specified stress and deflection requirements.
- B. Shop Drawings: Include plans, sections, details, and attachments to other work.
- C. Samples for Verification: Two sets of samples from plant production that represent construction, workmanship, appearance, and surface finish. Resubmit until accepted.
 - 1. Submit 12-inch by 12-inch samples of grating and plates, illustrating surface finish, color, texture, and jointing details.
 - 2. Submit 12-inch long samples of guardrail and handrail.
 - 3. Submit full size samples of elbow, tee, wall bracket, escutcheon, end stop, rail joint connections.

- E. Delegated-Design Submittal: For FRP components, including manufacturer's published load tables and analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer confirming registration in State where project site exists.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: The manufacturers of fiberglass reinforced plastic components shall be experienced in the manufacture of the items specified. Present proof as required demonstrating successful installations of the specified items under conditions similar to those of this project.
- B. Coordinate the work of this Section with the work of other Sections. Verify at the site both the dimensions and work of other trades adjoining items of work in this Section before fabrication and installation of items herein specified.
- C. Furnish to the pertinent trades all items included under this Section that are to be built into the work of other sections.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Transport, lift, and handle units with care, avoiding excessive stress and preventing damage; use appropriate equipment.
- B. Store in a clean dry area off the ground and protected from weather, moisture and damage; do not stack unless permitted by manufacturer.
- C. Handle products to prevent damage from abrasion, cracking, chipping, twisting, deformations, and other types of damage.

1.9 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design FRP components.

- B. Resin for FRP components: Vinyl ester, integrally resistant without applied coatings to: ultra-violet radiation; high concentrations of hydrogen sulfide gas, its solutions and associated compounds; and to the wastewater occurring at the project site.
 - 1. Provide compatible and equally resistant resin as acceptable for shop and field sealing of cut edges.
- C. Colors: Integral colors acceptable to the Engineer selected from standard resin colors.
- D. Pultruded fiberglass reinforcement shall be a combination of continuous roving, continuous strand mat, and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.
- E. Minimum physical properties for pultruded structural FRP shapes and plates:
 - 1. Tensile Strength: According to ASTM D 638.
 - a. Coupon: 30,000 psi.
 - b. Full Section in Bending: 19,986 psi at 75 degrees F.
 - 2. Modulus of Elasticity: According to ASTM D 790.
 - a. 32.3×10^6 psi at 75 degrees F.
 - b. 1.8×10^6 psi at 125 degrees F.
 - 3. Barcol Hardness: 50.
 - 4. Water Absorption: 0.75 percent (by weight), according to ASTM D 349.
 - 5. Specific Gravity: 1.66, according to ASTM D 792.
- F. Provide pultruded shapes conforming to the visual quality of ASTM D 4385.
- G. Protect pultruded and molded FRP from ultraviolet (UV) degradation with:
 - 1. Integral UV inhibitors in the resin.
 - 2. A synthetic surfacing veil to produce a resin rich surface.
- H. Structural Performance: Withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
 - 1. Walkways and Elevated Platforms Used as Exits: Uniform load of 100 lb/sq. ft..
 - 2. Limit live load deflection to L/360 or 1/4 inch, whichever is less.
- I. Seismic Performance: Gratings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Component Importance Factor: 1.5.

2.2 GRATING COMPONENTS

- A. Molded FRP Gratings: Bar gratings made by placing glass-fiber strands that have been saturated with thermosetting plastic resin in molds in alternating directions to form interlocking bars without voids and with a high resin content.
 - 1. Configuration: 1-1/2-inch- square mesh, 1-1/2 inches thick or 2-inch- square mesh, 2 inches thick.
 - 2. Resin: Polyester.
 - 3. Color: Manufacturer's standard.
 - 4. Traffic Surface: Applied abrasive finish.
- B. Protect grating from ultraviolet (UV) degradation with:
 - 1. Integral UV inhibitors in the resin
 - 2. A synthetic surfacing veil to produce a resin rich surface
- C. Securely attach FRP grating to supporting members and angles using FRP with titanium fasteners. Attach each grating panel to supporting members at a minimum of four locations, two at each edge. Provide materials and incidentals required for attaching grating to angle frame and supports under this Section.
- D. Coordinate grating panel layouts with work of other Sections to provide openings for approved mechanical equipment, operators, gates, and other items which require penetrations or openings in the grating. Further subdivide grating panels and support to provide maximum panel weight of 110 lbs.

2.3 MISCELLANEOUS COMPONENTS

- A. Provide structural FRP angle frames, structural support shapes, and grit impregnated plate where required and appurtenances as indicated.
- B. Provide angle frames continuous around the opening in order to present an even and flat support for the grating except as otherwise indicated.
- C. Provide all finished surfaces of FRP items and fabrications smooth, resin rich, free of voids and without dry spots, cracks, crazes or unreinforced areas. Provide glass fibers well covered with resin to protect against exposure due to wear or weathering.
- D. Provide all exposed surfaces smooth and true to form, consistent with ASTM D 4385.

2.4 GUARDRAIL SYSTEM

- A. Design FRP guardrail system, including connections, to meet loading and deflection requirements of OSHA and ICC AC 273.
 - 1. Basis-of-Design: Safrail Handrail System by Strongwell Corporation; Dynarail Guardrail and Handrail by Fibergrate; or equal.

- B. Provide system composed of 2-inch square FRP tubes; solid FRP connector plugs snugly fitting inside dimensions of tubes; solid 0.49-inch diameter FRP connector rods; and flattened corrugated 0.125-inch thick, 4-inch high, FRP kickplates with 0.5-inch deep corrugations and titanium drive rivets for fastening to posts.
- C. Provide FRP sleeves for removable connections to concrete and FRP baseplate assemblies with titanium fasteners for wall connections and for slab connections where shown. Provide approved epoxy cement for tube, plug and rod connections and epoxy grout for post connections set in concrete.
- D. Fabricate with continuous posts and top rail, and intermediate rails cut between posts. Miter corners and direction changes. Provide for rail expansion with internal plugs cemented one side and square, resin sealed, tube ends. Provide for kickplate expansion as detailed.

2.5 FASTENERS

- A. General: Unless otherwise indicated, provide Titanium stainless-steel fasteners. Select fasteners for type, grade, and class required.

2.6 FABRICATION

- A. Shop Assembly: Shop fabricate grating sections to greatest extent possible to minimize field splicing and assembly. 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 material 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 FRP components from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.
- D. Fit exposed connections accurately together to form hairline joints.
- E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.
- F. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

2.7 FRP FRAMES AND SUPPORTS

- A. Frames and Supports for FRP Gratings and Plates: Fabricate from FRP shapes of sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
 - 1. Unless otherwise indicated, use shapes made from same resin as gratings.

2. Equip units indicated to be cast into concrete or built into masonry with integral anchors.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate locations and elevations of required supports. Verify that members are properly installed to support components specified in this Section.
- B. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install assemblies in accordance with manufacturer's installations instructions. Install products plumb, level, and square, unless otherwise required by the design.
- B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
- C. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing FRP components. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry. Provide additional supports at penetrations through grating in order to meet design criteria.
- E. Fit exposed connections accurately together to form hairline joints.

3.3 INSTALLING FRP COMPONENTS

- A. Comply with manufacturer's written instructions for installing components. Use manufacturer's standard stainless-steel anchor clips and hold-down devices for grating anchorage.

END OF SECTION 067413

SECTION 099679 – ATMOSPHERIC PROTECTION AND PLANT SERVICE AREAS COATINGS

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 surface preparation and application of high-performance coating systems for water and wastewater treatment on the following substrates:
 - 1. Interior Substrates:
 - a. Concrete vertical and horizontal surfaces.
 - b. Ductile or cast iron.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for shop priming of structural steel with primers specified in this Section.
 - 2. Section 400519 "Ductile Iron Process Pipe" for factory exterior coating.

1.3 DEFINITIONS

- A. MPI Gloss Levels: Following define gloss levels according to ASTM D 523:
 - 1. MPI Gloss Level 1 - Traditional Matte or Flat Finish: Maximum five units at 60 degrees and 10 units at 85 degrees.
 - 2. MPI Gloss Level 2 - Velvet-Like Finish: Maximum 10 units at 60 degrees and 10 to 35 units at 85 degrees.
 - 3. MPI Gloss Level 3 - Traditional Eggshell-Like Finish: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees.
 - 4. MPI Gloss Level 4 - Satin-Like Finish: 20 to 35 units at 60 degrees and minimum 35 units at 85 degrees.
 - 5. MPI Gloss Level 5 - Traditional Semi-Gloss Finish: 35 to 70 units at 60 degrees.
 - 6. MPI Gloss Level 6 - Traditional Gloss: 70 to 85 units at 60 degrees.
 - 7. MPI Gloss Level 7 - High Gloss: Minimum 85 units at 60 degrees.
- B. Mild Exposure: Normal outdoor weathering and standard industrial exposures are considered mild environments. A normal industrial setting is one with low to moderate levels of humidity and condensation and little development of mold and mildew. A mild environment has only limited exposure to chemical fumes or mist, and occasional occurrences of chemical spills or splash. Regular cleaning with standard commercial chemical cleaning agents, with only occasional use of stronger chemical cleaning agents, is also characteristics of a mild

environment. Metal corrosion will occur in a mild environment, but it is minimal. These are generally dry areas with little to no Hydrogen Sulfide (H₂S), Chlorine, or other corrosive chemicals, or the area is damp.

- C. Moderate Exposure: An atmosphere that can be characterized as corrosive, within reasonable limits, is considered a moderate environment. In an industrial setting, a moderate environment indicates intermittent exposure to high humidity and condensation with occasional development of mold and mildew. Exposure to heavy concentrations of chemical fumes or mist and accidental chemical spills or splash occurs occasionally in a moderate environment. Regular use of strong chemicals rather than standard commercial cleaning agent also changes a mild environment into a moderate one. Metal corrosion is common in a moderate environment.
- D. Severe Exposure: An aggressively corrosive industrial or predominantly chemical environment with regular exposure to strong chemical fumes, mists, and dust is considered a severe environment. In an industrial setting, a severe environment is one with sustained exposure to high humidity and condensation that results in heavy development of mold and mildew. Frequent spilling and splashing of strong chemicals (acids, alkalis, oxidizers, and solvents) are also characteristic of a severe environment. Metal corrosion can be expected in a severe environment. Immersion conditions, marine environment with sustained exposure to saltwater spray, and arctic environment with long periods of extremely low temperature are considered severe environments. These are areas where if no high-performance coatings are applied on steel or concrete, very early failure and structural damage will be evident.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Indicate VOC content.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.
 - 1. Submit Samples on actual substrate material to be coated, 8 inches square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: Use same designations indicated on Drawings and in Atmospheric Protection Coating Schedule and Plant Service Areas Coating Schedule. Include color designations and product runs (batch numbers).

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.
3. Deliver materials on site in factory sealed containers from the manufacturer. Do not use materials from previous jobs.

1.6 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are within the coatings manufacturer's recommendations.
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point and rising; or to damp or wet surfaces.
- C. Lead Paint: It is not expected that lead paint will be encountered in the Work.
 1. If suspected lead paint is encountered, do not disturb; immediately notify Engineer and Owner.

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. Carboline Company (CAR).
 2. PPG Paints (PPG).
 3. The Sherwin-Williams Company (SWC).
 4. Tnemec Company, Inc. (TNE).

2.2 HIGH-PERFORMANCE COATINGS

- A. Material Compatibility:
 1. Each coating system within indicated substrates uses compatible material with one another, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. Topcoat manufacturer recommends products in writing for use in each coating system coat and on indicated substrate.
 3. Use products from same manufacturer for each coat in coating system.
- B. Colors: As selected by Engineer from manufacturer's full range.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, both coatings are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
 1. Application of coating indicates acceptance of surfaces and conditions.
 2. Recoating of Previously Coated Surfaces: Verify conditions and compatibility between new and existing high-performance coating products.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions applicable to substrates and coating systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be coated.
 1. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
 2. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed.
 3. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
 - 1. Concrete Floors: Remove oil, dust, grease, dirt, and other foreign materials. Comply with SSPC-SP-13/NACE 6 or ICRI 310.2R.
 - 2. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi at 6 to 12 inches.
 - 3. Abrasive blast clean surfaces to comply with SSPC-SP-13/NACE 6.
- E. Masonry Substrates: Remove efflorescence and chalk.
 - 1. Do not coat surfaces if moisture content, alkalinity of surfaces, or alkalinity of mortar joints exceeds that permitted in manufacturer's written instructions.
 - 2. Clean surfaces with pressurized water. Use pressure range of 100 to 600 psi at 6 to 12 inches.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by manufacturer.
- G. Galvanized-Steel Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

3.3 APPLICATION

- A. Apply high-performance coatings in accordance with manufacturer's written instructions.
 - 1. Use applicators and techniques suited for coating and substrate indicated.
 - 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.
- D. Film Thickness: Apply paint in wet film thickness (WFT) recommended by high-performance manufacturer to achieve specified dry film thickness (DFT) for each coat of paint. Since DFT varies among manufacturers, this reference is not included in Article "Atmospheric Protection Coating Schedule and Plant Service Areas Coating Schedule."

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
 - 1. Contractor shall touch up and restore coated surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written instructions, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written instructions.

3.5 CLEANING AND PROTECTION

- A. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- B. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Engineer, and leave in an undamaged condition.
- C. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 PLANT SERVICE AREAS COATING SCHEDULE

- A. Miscellaneous Interior Process Support Areas, Non-submerged and Submerged Surfaces, Moderate to Severe Exposure:
 - 1. Concrete Substrates:
 - a. Modified Polyester- Polyurethane over Epoxy System:
 - 1) Prime Coat:
 - a) CAR: Carboguard 60.
 - b) PPG: Amerlock 2/400.
 - c) SWC: Macropoxy 646.
 - d) TNE: Series 66.
 - 2) Intermediate Coat:
 - a) CAR: Carboguard 60.
 - b) PPG: Amerlock 2/400.
 - c) SWC: Macropoxy 646.
 - d) TNE: Series 66.
 - 3) Topcoat: (MPI Gloss Level 6).
 - a) CAR: Sanitile 855.
 - b) PPG: Amershield VOC.

- c) SWC: Polyton HP.
 - d) TNE: Series 290.
 - 2. Steel Substrates:
 - a. Polyamide Epoxy System:
 - 1) Prime Coat:
 - a) CAR: Carboguard 60.
 - b) PPG: Amerlock 2.
 - c) SWC: Macropoxy 646 FC Epoxy.
 - d) TNE: Series 66.
 - 2) Topcoat: (MPI Gloss Level 5).
 - a) CAR: Carboguard 635 VOC.
 - b) PPG: Amerlock 2.
 - c) SWC: Macropoxy 646 FC Epoxy.
 - d) TNE: Series 66.
 - 3. Ductile Iron or Cast-Iron Substrates: Interior Atmospheric Pipe Exposure.
 - a. Polysiloxane System:
 - 1) Prime Coat:
 - a) CAR: Carboguard 60/Carboguard 635.
 - b) PPG: Amerlock 2/400.
 - c) SWC: Macropoxy 646 FC Epoxy.
 - d) TNE: Series 66.
 - 2) Topcoat: (MPI Gloss Level 6).
 - a) CAR: Carboxane 2000.
 - b) PPG: PSX700.
 - c) SWC: Sher-Loxane 800.
 - d) TNE: Series 740.
- B. Interior Flooring, Non-submerged Surfaces: flooring subject to corrosive fumes, washdown, and splashing from chemical leaks and spills. Mild to Moderate to Severe Exposure.
 - 1. Concrete Substrates:
 - a. Epoxy Non-Slip Deck Coating System:
 - 1) Prime Coat:
 - a) CAR: Carboseal 720.
 - b) PPG: Megaseal HSPC Primer.
 - c) SWC: GP3579 w/ Broadcast.
 - d) TNE: Series 201.

- 2) Intermediate Coat:
 - a) CAR: Carboseal 705 with a broadcast.
 - b) PPG: Megaseal HSPC Primer.
 - c) SWC: GP3746 w/ Broadcast.
 - d) TNE: Series 222.

- 3) Topcoat: (MPI Gloss Level 5).
 - a) CAR: Carboseal 705.
 - b) PPG: Megaseal SFT 625 Non-Skis.
 - c) SWC: GP 4850.
 - d) TNE: Series 222.

END OF SECTION 099679

SECTION 133424 – PREFABRICATED FIBERGLASS REINFORCED POLYMER STRUCTURE

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. Engineered, prefabricated fiberglass reinforced polymer (FRP) structure complete and ready for operation as indicated on Drawings.
- 2. Provide The FRP structure with the following:
 - a. Exhaust fan with FRP hood
 - b. Heater with thermostat
 - c. FRP louver with bird screen
 - d. Enclosed and gasketed, fiberglass LED Light
 - e. GFCI outlets (minimum of 3)
 - f. Panelboard
 - g. Light switches
 - h. Doors
 - i. Lifting eyes
 - j. Stainless steel hardware

- B. Related Requirements:

- 1. Section 013300 “Submittal Procedures”
- 2. Section 017823 “Operation and Maintenance Data”
- 3. Section 033000 “Cast-in-Place Concrete”
- 4. Section 400507 “Hangers and Supports for Process Piping”
- 5. Section 400531 “Thermoplastic Process Pipe”

1.3 ACTION SUBMITTALS

- A. Copies of all materials required to establish compliance with the Specifications shall be submitted in accordance with the provisions of Section 013300. Submittals shall include at least the following:

- 1. Resin used.
- 2. Certified independent test results of the representative wall laminate.
- 3. Certified shop drawings showing the following:
 - a. Critical dimensions, jointing and connections, fasteners and anchors. All other important details of construction, dimensions, and anchor bolt locations.

- b. Materials of construction.
 - c. Anchor bolt details indicating locations, quantity, sizes, types, materials, spacing, embedment depth, and minimum edge distance.
 - d. Sizes, spacing and location of structural members, connections, attachments, openings, and fasteners.
 - e. Color.
4. Post-Installed Expansion Anchors:
- a. Design Data: Submit manufacturer's specifications and data including recommended design values and physical characteristics for expansion anchors.
 - b. 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 and masonry.
 - c. Installation Procedures: Submit procedures stating product proposed for use, and complete installation method.
5. Post-Installed Adhesive Anchoring System:
- a. 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.
 - b. 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 and masonry.
6. Installation Procedures: Submit procedures stating method of drilling, product proposed for use, and complete installation method.
7. Descriptive literature, bulletins, and/or catalogs of the equipment.
8. The total weight of the equipment.
9. Structural design calculations signed and sealed by a Professional Engineer registered in the State of New York.
10. A complete total bill of materials.
11. A list of the manufacturer's recommended spare parts with the manufacturer's current price for each item. Include gaskets, hardware, etc. on the list.
12. All information required by Section 013300.
13. Submittal data sheets for exhaust fan, heater, thermostat, and louver.
14. Complete data on motors and power factor correction capacitors (if required) in accordance with Section 230513: Common Motor Requirements For HVAC Equipment.
15. Complete wiring diagrams and schematics of all power systems showing wiring requirements between all system components, motors, sensors, panels, etc., including connections to work of other Sections.
16. Certification by the supplier that the equipment and materials to be provided are suitable for the service intended.
17. In the event that it is impossible to conform with certain details of the Specifications due to different manufacturing techniques, describe completely all non-conforming aspects.

1.4 CLOSEOUT SUBMITTALS

A. Operating and Maintenance Data:

1. Provide instructions specifically for this installation including all required cuts, drawings, equipment lists, descriptions, etc. required to instruct operating and maintenance personnel unfamiliar with such equipment.

- B. Project Record Documents: Record actual locations of concealed components and utilities.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Provide special tools required for normal operation and maintenance.
- B. Provide spare parts required during the first year after installation.
- C. Furnish extra materials and tools that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.6 QUALITY ASSURANCE

- A. Perform Work according to New York Building Code standards, whichever is greater.
- B. Surface-Burning Characteristics for Insulation Installed in Concealed Locations:
 1. Foam Insulation:
 - a. Maximum Flame-Spread/Smoke-Developed Index: 25/450.
 - b. Testing: Comply with ASTM E84.
- C. Surface-Burning Characteristic for Insulation Installed in Exposed Locations:
 1. Maximum Flame-Spread/Smoke-Developed Index: 25/450.
 2. Testing: Comply with ASTM E84.
- D. Comply with New York State Building Code for submission of design calculations, reviewed Shop and erection drawings as required for acquiring permits.
- E. Provide components of each type from one manufacturer, and compatible with adjacent materials.
- F. Vapor Retarder Permeance:
 1. Maximum 1 perm.
 2. Testing:
 - a. Comply with ASTM E96/E96M.
 - b. Method: Water.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' documented experience.

- B. Production capacity to provide work required for this Project without delay.
- C. Certified Test Results: Provide destructive test of entire fiberglass panel by an accredited Testing Laboratory and Third-Party Quality Control Agency and upon request furnish to the engineer the certified and stamped test results of the laboratory testing. The accredited Testing Laboratory must be accredited to ISO 17020 and 17025. The manufacturer shall maintain a quality assurance program that is also certified by an accredited Testing Laboratory and Third Party Quality Control Agency and furnish to the engineer the certified and stamped quality assurance program by an accredited Testing Laboratory and Third party Quality Control Agency.
- D. Erector: Company specializing in performing Work of this Section with minimum three years' experience and approved by manufacturer.
- E. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in the state of New York.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. The fiberglass structure and the accessory items shall be carefully transported, stored, handled and set in place in a manner that will prevent distortion, misalignment or other damage to the units.
- C. During storage prior to installation and following installation, but prior to placing in service, follow the manufacturer's recommendations concerning handling.
- D. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- E. Store materials according to manufacturer's written instructions.
- F. 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.

1.9 FIELD CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

- A. Section 017700 “Closeout Procedures”: Requirements for warranties.
- B. Furnish twenty-five year manufacturer's warranty for pre-engineered structure materials and workmanship.
- C. Furnish two-year manufacturer's warranty for exterior prefinished surfaces' color coat against chipping, cracking or crazing, blistering, peeling, chalking, and fading, including coverage for weathertightness of structure enclosure elements after installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In order to set a level of quality, fabricated fiberglass structures shall be provided by one of the following manufacturer's:
 - 1. Shelter Works
 - 2. Engineer approved Equal.
- B. System Description
 - 1. Structure Name: Leachate Pumping Station
 - a. Provide a weather-proof FRP structure of the following type:
 - 1) Size: 12'-0" exterior width x 15'-9" exterior length x 8'-0" wall height.
 - 2) Roof Slope: The roof pitch shall be 12° minimum.
 - 3) Roof Type: Hip roof design sloping up from all four sides.
 - 4) Roof Deck: ASTM E 108 (Class C) with less than 13 feet of flame spread.
 - b. Supply molded composite construction FRP structure suitable for installation as shown in the Drawings. Each wall shall be one single monolithic piece with a smooth satin finish on the interior and a faux brick textured appearance on the exterior. The walls and roof shall be integral with smooth radii for all corners. No roof overhang allowed. External section connection flanges are not allowed.
 - c. Walls, roof and doors shall be seamless, one-piece panels laminated with at least 1/8" thick sprayed fiberglass outside surface, core material, and at least 1/8" thick sprayed fiberglass inside surface. Walls and roof shall have continuous laminations (floor to ceiling and top-of-wall to ridge) every 12" to permanently bond inner FRP surface with outer FRP surface to provide structural integrity and prevent delamination of the fiberglass from the core material.
 - d. Walls and roof shall have minimum R-21 insulation with core consisting of minimum 3" thick foam.
 - e. Minimum 19/32" thick wood encapsulated within interior surface of wall portions for mounting equipment.

- f. Structure shall be installed on a formed and poured concrete pad. All pad penetrations shall be coordinated with building layout.
 - g. Structure shall be one piece construction, or all wall panels shall overlap to form a weather-proof connection with a seamless exterior appearance. Overlapped wall panels shall use low-maintenance silicone caulk matching the exterior color of the structure.
 - h. Internal connections shall use stainless steel hardware and shall be spaced no more than 4-inches on center.
- C. Designed and proportion all equipment to have liberal strength, stability and stiffness and to be specifically adapted for the intended service.
- D. Rigidly and accurately anchor the equipment into position with necessary foundation bolts, plates, nuts and washers. Provide Type 316 stainless steel Anchor bolts.
- E. Laminate:
1. Isophthalic polyester resin with high performance, chopped, commercial grade glass strand fiber reinforcement with a suitable coupling agent.
 2. Minimum glass content: 30%.
 3. Exterior surface: 18-20 mil (minimum) marine grade gel coat with U.V. inhibitors and a satin finish lightly textured and free from fiber pattern, roughness, or other irregularities. Exterior color selected by Owner from manufacturers available selections.
 4. Exterior laminate: 1/8 inch thick (minimum); chemically bonded to the surface gel coat and encapsulating the foam core.
 5. Foam core (see below)
 6. Interior laminate: 1/8 inch thick (minimum); chemically bonded to the interior gel coat and encapsulating the foam core.
 7. Interior surface: 18-20 mil (minimum) gel coat and a textured finish, free from exposed glass or other irregularities. Interior color selected by Owner from manufacturers available selections.
 8. Laminate properties:
 - a. Tensile strength (ASTM D 638): 16,000 PSI.
 - b. Flexural strength (ASTM D 790): 33,700 PSI.
 - c. Flexural modulus (ASTM D 790): 1,160,000 PSI.
 - d. Tensile Modulus (ASTM D 638): 1,300,000 PSI.
 - e. Barcol hardness (ASTM D 2583): 45.
 - f. Izod Impact – Notched: 16.30 ft-lbs/in
 - g. Izod Impact – unnotched: 21.79 ft-lbs/in
- F. Core
1. Rigid closed cell, self-extinguishing (Class 1), polyisocyanurate foam with a density of 1.5-1.9 pounds per cubic foot. Lower density foams shall not be acceptable.
 - a. 3-inch-thick with an initial insulating value of R-21
- G. Coupons prepared in accordance with ASTM D 618.

- H. The manufacturer shall maintain a continuous quality control program and upon request shall furnish to the Engineer certified test results of the physical properties.

2.2 COMPONENTS

A. Doors:

1. Quantity: (1) 6'-0" wide x 6'-8" high double door.
2. Construction:
 - a. Each door shall be one-piece molded fiberglass construction 80 inches high, 1 ¾ inches thick and 36 inches wide.
 - b. Mount door with three T-304 stainless steel ball bearing type hinges, 5 inches long, equipped with tamper-resistant, non-removable pins. Hinges shall be oriented with no fasteners exposed when door is closed. Door must be readily replaceable – the use of continuous piano hinges or fastening methods other than bolting are not acceptable.
 - c. Rubber bulb gasket with flexible lock to retain permanent grip.
 - d. One-piece, 2 ½ inches deep fiberglass drip cap over doors; drip cap to extend 2 inches each side past door.
 - e. Low profile threshold, aluminum, 1/2 inch high.
 - f. Schlage stainless steel single-point key locked classroom style, lever handle with interior panic bar egress, drop handle with accommodation for user-supplied padlock. To facilitate entry and exit from the structure, raised or integral door sills are not acceptable.
 - g. Heavy duty stainless steel, dual compression spring cushioned overhead door stop, designed for BHMA L52231 and ANSI A156.16.
 - h. Provide single-flap neoprene insert style door sweep.
 - i. Doors shall have a hydraulic closer.

- B. Lifting Eyes: Provide a minimum of two removable, 3/4 inch – 10 partially threaded, eye bolts with 6-inch shank lengths.

1. Steel (5,200 lbs. work load limit).

- C. Mounting Flange: 2 inches wide x 1/4-inch-thick (minimum) with closed cell neoprene sponge rubber gasket 2 inches wide x 3/8 inch thick to provide a weather tight seal around the interior of the structure perimeter. Flanges shall be pre-drilled with 7/16-inch diameter holes 24-inches on center. A sealant shall be provided to provide a weather-proof connection at the base of the structure. Sealant shall be ConSeal Bitumen/Butyl sealant or approved equal.

2.3 EQUIPMENT

A. Electrical

1. Panelboard:
 - a. 208Y/120 Volt, 3 Phase, 4 Wire panelboard meeting the requirements of Section 262416 "Panelboards".

- b. Surface mount type, NEMA 1 120/240V single-phase load center with 100 amp main breaker and at least 10 breaker slots and completely assembled by the panelboard manufacturer.
 - c. 10kAIC, 100Amp rated bus, with a 100Amp, main breaker and surge protective device.
 - 1) Provide 20A, 1 pole, spare breakers to fill out the panelboard for all unused circuits.
2. Provide conduit and wiring in strict accordance with Sections 260533 “Identification for Electrical Systems” and 260519 “Low-Voltage Electrical Power Conductors and Cables”, respectively. Mount conduits in accordance with Section 260529 “Hangers and Supports for Electrical Systems”.
 3. Receptacles: Minimum 3 GFCI duplex receptacles, 2 inside and 1 outside. Receptacles shall be heavy duty, specification grade of the following types and manufacturer or equal. Receptacles shall conform to Fed Spec WC596-F and meet the requirements of Section 262726 “Wiring Devices.”
 - a. Ground fault interrupter, duplex, 20 Amp, 125 Volt, 2 Pole, 3 Wire, GFCI feed thru type with "test" and "reset" buttons. Eaton; Hubbell Wiring Devices-Kellems; Pass & Seymour, Inc., or equal.
 - b. Provide weatherproof non-metallic device plates ‘Not Attended/While-In-Use’ cover, UV & corrosion resistant polycarbonate back & cover, deep cover, gasketed, horizontal or vertical mounting as required, single or double gang as required, lockable hasp, as manufactured by Thomas & Betts (Red Dot); Cooper Wiring Devices (Arrow Hart); Carlon; or equal.
 4. Switches: Weatherproof switch box, located at the exterior front of the structure. Wall switches shall be heavy duty, specification grade, toggle action, and meeting the requirements of Section 262726 “Wiring Devices.”
 5. Provide lighting layout by the structure manufacturer. Prewire necessary exterior and interior fixtures to the panel specified herein. Provide a minimum of 30-foot candles of illumination measured 2.5 foot above the floor. Place lights as close as practical to the center of each structure
 - a. Interior:
 - 1) Vapor-tight, LED light fixture(s) providing an average of 50 foot-candles on the floor area.
 - 2) (1) exit sign above door, red LED letters with battery backup and 150 lumens of egress illumination for 90 minutes in case of power outage.
 - b. Exterior:
 - 1) (1) exterior 2100 lumen LED down light operated by photocell with weatherproof switch override that prevents exterior light from illuminating when in ‘DOWN’ position.

B. Mounting:

1. Provide equipment mounting panels as required for all wall-mounted equipment. Mounting panels shall be ¾-inch thick marine grade plywood panel laminated into the walls. Coordinate dimensions and locations with CONTRACTOR.

C. HVAC

1. Refer to Division 23 for Heating Equipment, Fans, and Testing, Adjusting and Balancing.
2. Exhaust Fan: Shutter-mounted, 120V, exhaust fan with integral gravity shutter, aluminum fan blades, fiberglass 45-degree weather hood, and OSHA compliant polyester-coated wire guard. Exhaust fan to be wired to the weatherproof fan switch with thermal overload and thermostat. Fan shall be rated for a minimum of 800 cubic feet per minute with a 12-inch diameter propeller. Fan operation controlled by thermostat.
3. Louver: Gravity operated fiberglass intake shutter, with steel frame and exterior removable T-316 stainless steel Bird screen, sized at 12 inches by 12 inches (minimum). Provide fiberglass 90-degree weather hood. Manual vents are not permitted.
4. Ventilation through-wall openings shall be protected from the elements with a weather-tight fiberglass hood the same color as the shelter itself.
5. Heater: Line powered, 240V, wall heater. No separate electrical outlet required. 4,800 watt, white powder coat finish with automatic re-set thermal overload protection with indicator light and built-in thermostat.
 - a. Heater will be corrosion resistant type as manufactured by King Electrical Manufacturing Co., model PAW1215-SS or equal.
6. Thermostat: NEMA 4X electric line voltage thermostat for heat removal (summer) operation fan, 30 – 110 F temperature range. Initial set point shall be 85 degrees F. Unit shall be located within 5 feet of exhaust fan wall-mounted 240 Volt, single-phase electric and at least 4.5 Kw
7. Test and balance exhaust fan and heater per the requirements of Section 230593.
8. Provide heavy-duty NEMA 4X 316 stainless steel disconnect switches for each HVAC cooling or heater unit; by Square D, Siemens, or ABB/GE. Lockable hardware on circuit breakers for HVAC equipment may be provided in lieu of NEMA 4X disconnects where approved by the Engineer

- D. Furnish all electrical and HVAC items, pre-wired and installed by the structure manufacturer as shown on the drawings and as specified above.

2.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design the FRP structure in accordance with the New York State Building Code.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

C. Anchorage Design:

1. Anchor bolts for anchoring FRP components to concrete structure shall be stainless steel expansion anchors or adhesive anchors that meet the requirements of Section 050519. Design of anchor bolts embedded into supporting concrete structure shall be performed in accordance with ACI 318 Chapter 17, assuming concrete is cracked and has a 28-day compressive strength of 4500 psi.

D. Structural Loading as follows or as dictated by local and state code, whichever is greater:

1. Shelter: Own dead load.
2. Standard: ASCE/SEI 7-22, Risk Category I, ground level.
3. Roof Load: 69 psf ground snow load
4. Wind Load: 101 mph
5. Seismic Load: Per local building code

2.5 SURFACE PREPARATION AND SHOP PRIME PAINTING

- A. Surface preparation and shop painting is included as a part of the work of this Section.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify that the concrete slab is level, true to plane, and of the correct dimensions to receive the mounting flange of the structure. Contractor shall correct all deficiencies before proceeding with installation.
- B. Install products in accordance with Engineer's plans and instructions, local codes, and in a manner consistent with the installation instructions and recommendations of the manufacturer.
- C. Do not remove the door spacers until all anchor bolts have been completely set and door operation has been verified.
- D. Move and position the FRP structure using the lifting eyes. The neoprene gasket provided with the structure should be positioned between the concrete slab and the structure mounting flange. Use a spreader bar to lift structure.
- E. Do not Fabricate or erect the FRP structure until:
1. The anchor bolt layout and details have been submitted to and approved by the Engineer.
 2. The foundation design and details have been finalized by the Engineer for the selected structure system.
- F. Install anchor bolts following Manufacturer's recommendations.
1. Drill and set the anchor bolts starting with one on each side of the doors. Verify the operation of the doors before installing the remaining anchor bolts.

2. Drill the anchor bolt holes to the depth and diameter required by the anchor bolt manufacturer and the qualified professional engineer.
 3. Verify operation of the doors after installation of anchor bolts and threshold.
- G. Seal the flange with sealant or grout to ensure water tightness.
- H. Install (as necessary) and test the structure accessories in accordance with the manufacturers' instructions.

3.2 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the special inspections required by the New York State Building Code.

3.3 ADJUSTING AND CLEANING

- A. Clean surfaces in accordance with manufacturer's instructions.
- B. Remove trash and debris, and leave the site in a clean condition.

END OF SECTION 133424

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SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING 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 deg 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:
 - 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. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 3. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

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 a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 220513

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SECTION 221429 - SUMP PUMPS

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. Submersible sump pumps.
- B. Related Requirements:
 - 1. Section 221329 "Sanitary Sewerage Pumps" for effluent and sewage pumps.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- 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. 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.
 - 4. Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.

- C. Comply with manufacturer's written instructions for handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. 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.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

2.2 SUBMERSIBLE SUMP PUMPS

- A. Main Pump Station Sump Pump to be replaced in kind with matching performance and power requirements.
- B. Submersible, Fixed-Position, Single-Seal Sump Pumps - Pressure Level/Indicator Vault:
 - 1. Description: Factory-assembled and -tested sump-pump unit.
 - 2. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
 - 3. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
 - 4. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 25 A cast iron, semiopen design for clear wastewater handling, and keyed and secured to shaft.
 - 5. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
 - 6. Seal: Mechanical.
 - 7. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.
 - a. Motor Housing Fluid: Oil.

2.3 SUMP-PUMP CAPACITIES AND CHARACTERISTICS

- A. Main Pump Station Sump Pump: Replace in kind.
- B. Pressure Level/Indicator Vault
 - 1. Unit Capacity: 90 gpm.
 - 2. Number of Pumps: One.
 - 3. Each Pump:
 - a. Capacity: 90 gpm.
 - b. Total Dynamic Head: 5 feet.
 - c. Speed: 1725.
 - d. Discharge Size: 2 inches NPS.

e. Electrical Characteristics:

- 1) Motor Horsepower: 4/10 hp.
- 2) Volts: 115 or 230 V ac.
- 3) Phases: Single.
- 4) Hertz: 60.

2.4 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing 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.
- B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.2 INSTALLATION

- A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

3.3 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test, inspect, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections:
1. Perform each visual and mechanical inspection.
 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Pumps and controls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 STARTUP SERVICE

- A. Perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.

3.6 ADJUSTING

- A. Adjust pumps to function smoothly and lubricate as recommended by manufacturer.
- B. Adjust control set points.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 221429

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 deg 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: Separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. 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.
- J. 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:
 - 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 a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

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. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.
8. 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 230516 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.
4. 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 a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

- B. For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of trapeze hangers.
 - 2. Include design calculations for designing trapeze hangers.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.
- C. Qualification Data: For professional engineer and testing agency.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design.
- 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. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
 - 3. Nonmetallic Coatings: Plastic coated, or epoxy powder-coated.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. 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.

C. 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 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

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. B-line, an Eaton business.
 - b. Thomas & Betts Corporation; A Member of the ABB Group.
 - c. Unistrut; Part of Atkore International.
 - d. Or equal.
2. Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
4. Channels: Continuous slotted carbon-steel channel with inturned lips.
5. Channel Width: Selected for applicable load criteria.
6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
8. Metallic Coating: Pregalvanized G90.

2.5 THERMAL-HANGER SHIELD INSERTS

- 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. Buckaroos, Inc.
2. Pipe Shields Inc.
3. Value Engineered Products, Inc.

- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psi or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psi or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 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.
 - 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. Simpson Strong-Tie Co.
 - b. Hilti, Inc.
 - c. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - d. MKT Fastening, LLC.
- 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. 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. Simpson Strong-Tie Co.
 - b. Hilti, Inc.
 - c. ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - d. MKT Fastening, LLC.
- C. Indoor Applications: stainless-steel.
- D. Outdoor Applications: Stainless steel.

2.7 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand:

1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
3. Hardware: Galvanized steel or polycarbonate.
4. Accessories: Protection pads.

C. Low-Profile, Single Base, Single-Pipe Stand:

1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
3. Vertical Members: Two, stainless-steel, continuous-thread 1/2-inch rods.
4. Horizontal Member: Adjustable horizontal, stainless-steel pipe support channels.
5. Pipe Supports: Roller strut clamps, clevis hanger, or swivel hanger.
6. Hardware: Stainless steel.
7. Accessories: Protection pads.
8. Height: 18 inches above roof.

D. High-Profile, Single Base, Single-Pipe Stand:

1. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Single vulcanized rubber or molded polypropylene.
 - a. Vertical Members: Two, stainless-steel, continuous-thread 1/2-inch rods.
3. Horizontal Member: One, adjustable height, stainless-steel pipe support slotted channel or plate.
4. Pipe Supports: Roller, clevis hanger, or swivel hanger.
5. Hardware: Stainless steel.
6. Accessories: Protection pads, 1/2-inch continuous-thread stainless-steel rod.
7. Height: 36 inches above roof.

E. High-Profile, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: Two or more; vulcanized rubber.
3. Vertical Members: Two or more, stainless-steel channels.
4. Horizontal Members: One or more, adjustable height, stainless-steel pipe support.
5. Pipe Supports: Roller, strut clamps, clevis hanger, or swivel hanger.
6. Hardware: Stainless steel.
7. Accessories: Protection pads.
8. Height: 36 inches above roof.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.9 MATERIALS

- A. Aluminum: ASTM B 221.
- B. Carbon Steel: ASTM A 1011/A 1011M.
- C. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; galvanized.
- D. Stainless Steel: ASTM A 240/A 240M.
- E. Grout: ASTM C 1107/C 1107M, 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. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- B. 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. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. 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.
- F. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. Install hangers and supports to allow controlled thermal and seismic movement 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.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- K. 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.
- L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. 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.
- N. 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.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 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.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

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 trapeze pipe hangers and 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.
- B. Touchup: Comply with requirements in Section 099113 "Exterior Painting" Section 099123 "Interior Painting" and Section 099679 "Atmospheric Protection and Plant Service Areas Coatings" requirements for touching up field-painted surfaces for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

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 hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

- G. Use copper-plated pipe hangers and stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. 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 deg 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.
- K. 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.
- L. 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 deg 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 deg F piping installations.
- M. 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.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 - 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 - 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 - 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 - 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 - 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 - 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 - 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

- R. 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. Open-spring isolators.
4. Restrained-spring isolators.
5. Housed-restrained-spring isolators.
6. Pipe-riser resilient supports.
7. Resilient pipe guides.
8. Elastomeric hangers.
9. Spring hangers.
10. Vibration isolation equipment bases.
11. Restrained isolation roof-curb rails.
12. 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 SUBMITTAL

- 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. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads: Type 1.
 - 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. California Dynamics Corporation.
 - b. Kinetics Noise Control, Inc.
 - c. Mason Industries, Inc.
 - d. Or equal.
 - 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: Ribbed or waffle pattern.

2.2 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts: Type 2.

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. California Dynamics Corporation.
 - b. Kinetics Noise Control, Inc.
 - c. Mason Industries, Inc.
 - d. Or equal.
2. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded.
 - 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.

2.3 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators: Type 3.

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. California Dynamics Corporation.
 - b. Kinetics Noise Control, Inc.
 - c. Mason Industries, Inc.
 - d. Or equal.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.4 RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint: Type 4.
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. California Dynamics Corporation.
 - b. Kinetics Noise Control, Inc.
 - c. Mason Industries, Inc.
 - d. Or equal.
 2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
 - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Top plate with threaded mounting holes.
 - c. Internal leveling bolt that acts as blocking during installation.
 3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
 4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.5 HOUSED-RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing: Type 4.
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. California Dynamics Corporation.
 - b. Kinetics Noise Control, Inc.
 - c. Mason Industries, Inc.
 - d. Or equal.
 2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.6 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 psigon isolation material providing equal isolation in all directions.

2.7 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.

2.8 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: Type 2.
 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. California Dynamics Corporation.
 - b. Kinetics Noise Control, Inc.
 - c. Mason Industries, Inc.
 - d. Or equal.
 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.

2.9 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression: Type 3.
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. California Dynamics Corporation.
 - b. Kinetics Noise Control, Inc.
 - c. Mason Industries, Inc.
 - d. Or equal.
 2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 9. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.10 VIBRATION ISOLATION EQUIPMENT BASES

- 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. California Dynamics Corporation.
 2. Kinetics Noise Control, Inc.
 3. Mason Industries, Inc.
 4. Or equal.
- B. Steel Rails: Factory-fabricated, welded, structural-steel rails.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Rails shall have shape to accommodate supported equipment.

3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- D. Concrete Inertia Base: Factory-fabricated or field-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.11 RESTRAINED ISOLATION ROOF-CURB RAILS

- 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. California Dynamics Corporation.
 2. Kinetics Noise Control, Inc.
 3. Mason Industries, Inc.
 4. Or equal.
- B. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment.
- C. Upper Frame: Upper frame shall provide continuous and captive support for equipment.

- D. Lower Support Assembly: The lower support assembly shall be formed sheet metal section containing adjustable and removable steel springs that support upper frame. The lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials and shall be insulated with a minimum of 2 inches of rigid glass-fiber insulation on inside of assembly. Adjustable, restrained-spring isolators shall be mounted on elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
- E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
- F. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

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 033000 "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.

3.3 VIBRATION ISOLATION EQUIPMENT BASES 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 033000 "Cast-in-Place Concrete."

END OF SECTION 230548.13

SECTION 230713 - DUCT INSULATION

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 insulating the following duct services:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed return located in unconditioned space.
 - 4. Indoor, exposed return located in unconditioned space.
 - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
 - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
 - 7. Outdoor, exposed supply and return.
- B. Related Sections:
 - 1. Section 233113 "Metal Ducts" for duct liners.

1.3 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.4 SCHEDULING

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," article for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 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. Johns Manville; a Berkshire Hathaway company.
 - b. Knauf Insulation.
 - c. Owens Corning.
 - d. Or equal.

2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F. Comply with ASTM C656, Type II, Grade 6. Tested and certified to provide a 1 or 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 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. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller.
 - d. Mon-Eco Industries, Inc.
 - e. Or equal.
- C. FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
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. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
 - e. Or equal.

2.4 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic: Water based; suitable for indoor use on below ambient services.
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. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Knauf Insulation.
 - d. Vimasco Corporation.
 - e. Or equal.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Vapor-Retarder Mastic: Solvent based; suitable for indoor use on below ambient services.
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. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Or equal.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness..
3. Service Temperature Range: 0 to 180 deg F
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

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. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Knauf Insulation.
 - e. Mon-Eco Industries, Inc.
 - f. Vimasco Corporation.
 - g. Or equal.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

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. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller.
 - c. Vimasco Corporation.
 - d. Or equal.
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.6 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

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. Childers Brand; H.B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Mon-Eco Industries, Inc.
 - d. Or equal.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.
- B. Metal Jacket:
 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. ITW Insulation Systems; Illinois Tool Works, Inc.
 - b. RPR Products, Inc.
 - c. Or equal.
 2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Outdoor Applications: 2.5-mil- thick polysurlyn.

2.9 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.

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. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Ideal Tape Co., an American Biltrite Company.
 - c. Knauf Insulation.
 - d. Or equal.
2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.10 SECUREMENTS

A. Bands:

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. ITW Insulation Systems; Illinois Tool Works, Inc.
 - b. RPR Products, Inc.
 - c. Or equal.
2. Stainless Steel: ASTM A167 or ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - 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) AGM Industries, Inc.
 - 2) Gemco.
 - 3) Hardcast, Inc.
 - 4) Or equal.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. 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) AGM Industries, Inc.
 - 2) CL WARD & Family Inc.
 - 3) Gemco.
 - 4) Or equal.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. 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) AGM Industries, Inc.
 - 2) Gemco.
 - 3) Midwest Fasteners, Inc.
 - 4) Or equal.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Aluminum or stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. 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) AGM Industries, Inc.
 - 2) Gemco.
 - 3) Hardcast, Inc.
 - 4) Or equal.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.

5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - 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) AGM Industries, Inc.
 - 2) Gemco.
 - 3) Hardcast, Inc.
 - 4) Or equal.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.

2.11 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D1784, Class 16354-C. White or color-coded to match adjacent surface.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping."
- E. Insulation Installation at Floor Penetrations:
 - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 FIELD-APPLIED JACKET INSTALLATION

- A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.7 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.8 FINISHES

- A. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect ductwork, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 DUCT INSULATION SCHEDULE, GENERAL

- A. See schedule on Drawings for general description of systems to be insulated and type and thickness of insulation to be provided.

3.11 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. See schedule on Drawings for type of field-applied jacket to be provided.
- B. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

- C. If more than one material is listed, selection from materials listed is Contractor's option.

END OF SECTION 230713

SECTION 230923.12 - CONTROL DAMPERS

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 following types of control dampers and actuators for DDC systems:
 - 1. Rectangular control dampers.
 - 2. General control-damper actuator requirements.
 - 3. Electric and electronic actuators.
- B. Related Requirements:
 - 1. Section 078413 "Penetration Firestopping" for penetrations made in fire-rated assemblies.
 - 2. Section 230923 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.

1.3 DEFINITIONS

- A. DDC: Direct-digital control.
- B. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including the following:
 - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
 - 3. Product description with complete technical data, performance curves, and product specification sheets.
 - 4. Installation instructions, including factors affecting performance.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of product 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 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Product installation location shown in relationship to room, duct, and equipment.
2. Size and location of wall access panels for control dampers and actuators installed behind walls.
3. Size and location of ceiling access panels for control dampers and actuators installed above inaccessible ceilings.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For control dampers to include in 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 a qualified testing agency, and marked for intended location and application.
- B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.
- C. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.
- D. Backup Power Source: Systems and equipment served by a backup power source shall have associated control damper actuators served from a backup power source.
- E. Environmental Conditions:
 1. Actuators shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.
 - a. If actuators alone cannot meet requirement, install actuators in a protective enclosure that is isolated and protected from conditions impacting performance.

Enclosure shall be internally insulated, electrically heated and cooled, filtered, and ventilated as required by actuator and application.

2. Actuators and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Actuators not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Actuator's installed location shall dictate following NEMA 250 enclosure requirements:
 - a. Outdoors: Type 4 or Type 4X.
 - b. Indoors, Heated with Filtered Ventilation: Type 1 or Type 2.
 - c. Indoors, Heated with Non-Filtered Ventilation: Type 2 or Type 12.
 - d. Indoors, Heated and Air Conditioned: Type 1.
 - e. Mechanical Equipment Rooms:
 - 1) Chiller and Boiler Rooms: Type 12 Type 4 Type 4X.
 - 2) Air-Moving Equipment Rooms: Type 1, Type 2 or Type 12.
 - 3) Rooms with exposed water: Type 4 or Type 4X.
 - 4) Rooms with water or wastewater pumps: Type 4 or Type 4X.
 - f. Localized Areas Exposed to Washdown: Type 4 or Type 4X.
 - g. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 2, Type 3 or Type 12.
 - h. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4 or Type 4X.

F. Hazardous Locations: Explosion-proof rating for condition Selection Criteria:

1. Dampers shall have stable operation throughout full range of operation, from design to minimum airflow over varying pressures and temperatures encountered.
2. Two-position dampers shall be full size of duct or equipment connection unless otherwise indicated.

2.2 RECTANGULAR CONTROL DAMPERS

A. General Requirements:

1. Unless otherwise indicated, use parallel blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed blade configuration.
2. Factory assemble multiple damper sections to provide a single damper assembly of size required by the application.
3. Damper actuator shall be factory installed by damper manufacturer as integral part of damper assembly. Coordinate actuator location and mounting requirements with damper manufacturer.

B. Insulated Rectangular Dampers:

1. Performance:

- a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.
 - b. Pressure Drop: 0.1-inch wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
 - c. Velocity: Up to 4000 fpm.
 - d. Temperature: Minus 100 to plus 185 degrees F.
 - e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
 - f. Damper shall have AMCA seal for both air leakage and air performance.
2. Construction:
- a. Frame:
 - 1) Material: ASTM B 211, Alloy 6063 T5 extruded-aluminum profiles, 0.08 inch thick.
 - 2) C-shaped channel with integral flange(s). Mating face shall be a minimum of 1 inch.
 - 3) Width not less than 4 inches.
 - 4) Entire frame shall be thermally broken by means of polyurethane resin pockets, complete with thermal cuts.
 - 5) Damper frame shall be insulated with polystyrofoam on four sides.
 - b. Blades:
 - 1) Hollow shaped, extruded aluminum.
 - 2) Blades shall be internally insulated with expanded polyurethane foam and shall be thermally broken. Complete blade shall have an insulating factor of R-2.29 and a temperature index of 55.
 - 3) Parallel or opposed blade configuration as required by application.
 - 4) Material: ASTM B 211, Alloy 6063 T5 aluminum, 0.08 inch thick.
 - 5) Width not to exceed 6 inches.
 - 6) Length as required by close-off pressure, not to exceed 48 inches.
 - c. Seals: Blade and frame seals shall be of flexible silicone and secured in an integral slot within the aluminum extrusions.
 - d. Axles: 0.44-inch- diameter plated or stainless steel, mechanically attached to blades.
 - e. Bearings:
 - 1) Bearings shall be composed of a Celcon inner bearing fixed to axle, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.
 - 2) Where blade axles are installed in vertical position, provide thrust bearings.
 - f. Linkage:
 - 1) Concealed in frame.
 - 2) Constructed of aluminum and plated or stainless steel.
 - 3) Hardware: Stainless steel.

g. Transition:

- 1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
- 2) Factory mount damper in a sleeve with a close transition to mate to field connection.
- 3) Damper size and sleeve shall be connection size plus 2 inches.
- 4) Sleeve length shall be not less than 12 inches for dampers without jackshafts and shall be not less than 16 inches for dampers with jackshafts.
- 5) Sleeve material shall match adjacent duct.

h. Additional Corrosion Protection for Corrosive Environments:

- 1) Provide anodized finish for aluminum surfaces in contact with airstream. Anodized finish shall be a minimum of 0.0007 inch thick.
- 2) Axles, damper linkage, and hardware shall be constructed of Type 316L stainless steel.

2.3 GENERAL CONTROL-DAMPER ACTUATORS REQUIREMENTS

- A. Actuators shall operate related damper(s) with sufficient reserve power to provide smooth modulating action or two-position action and proper speed of response at velocity and pressure conditions to which the damper is subjected.
- B. Actuators shall produce sufficient power and torque to close off against the maximum system pressures encountered. Actuators shall be sized to close off against the fan shutoff pressure as a minimum requirement.
- C. The total damper area operated by an actuator shall not exceed 80 percent of manufacturer's maximum area rating.
- D. Provide one actuator for each damper assembly where possible. Multiple actuators required to drive a single damper assembly shall operate in unison.
- E. Avoid the use of excessively oversized actuators which could overdrive and cause linkage failure when the damper blade has reached either its full open or closed position.
- F. Use jackshafts and shaft couplings in lieu of blade-to-blade linkages when driving axially aligned damper sections.
- G. Provide mounting hardware and linkages for connecting actuator to damper.
- H. Select actuators to fail in desired position in the event of a power failure.
- I. Actuator Fail Positions: See Drawings.

2.4 ELECTRIC AND ELECTRONIC ACTUATORS

- A. Type: Motor operated, with or without gears, electric and electronic.

B. Voltage:

1. See Drawings.
2. Actuator shall deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.
3. Actuator shall function properly within a range of 85 to 120 percent of nameplate voltage.

C. Construction:

1. Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
2. 100 up to 400 W: Gears ground steel, oil immersed, shaft-hardened steel running in bronze, copper alloy, or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel, or cast-aluminum housing.
3. Greater Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

D. Field Adjustment:

1. Spring return actuators shall be easily switchable from fail open to fail closed in the field without replacement.
2. Provide gear-type actuators with an external manual adjustment mechanism to allow manual positioning of the damper when the actuator is not powered.

E. Two-Position Actuators: Single direction, spring return or reversing type.

F. Position Feedback:

1. Equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.
2. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

G. Fail-Safe:

1. Where indicated, provide actuator to fail to an end position.
2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.

H. Integral Overload Protection:

1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

I. Damper Attachment:

1. Unless otherwise required for damper interface, provide actuator designed to be directly coupled to damper shaft without need for connecting linkages.
 2. Attach actuator to damper drive shaft in a way that ensures maximum transfer of power and torque without slippage.
 3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.
- J. Temperature and Humidity:
1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 degrees F.
 2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.
- K. Enclosure: See “Environmental Conditions” Article for NEMA rating requirements.
- L. Stroke Time:
1. Operate damper from fully closed to fully open within 90 seconds.
 2. Operate damper from fully open to fully closed within 90 seconds.
 3. Move damper to failed position within 30 seconds.
 4. Select operating speed to be compatible with equipment and system operation.
 5. Actuators operating in smoke control systems comply with governing code and NFPA requirements.
- M. Sound:
1. Spring Return: 62 dBA.
 2. Non-Spring Return: 45 dBA.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for dampers and instruments installed in duct systems to verify actual locations of connections before installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONTROL-DAMPER APPLICATIONS

- A. Control Dampers: See schedule on Drawings.

3.3 INSTALLATION, GENERAL

- A. Provide products required to satisfy most stringent requirements indicated.
- B. Properly support dampers and actuators, tubing, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a 5lb force.
- C. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- D. Seal penetrations made in fire-rated and acoustically rated assemblies.
- E. Fastening Hardware:
 - 1. Stillson wrenches, pliers, or other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
 - 2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
 - 3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.
- F. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.
- G. Corrosive Environments:
 - 1. Use products that are suitable for environment to which they will be subjected.
 - 2. If possible, avoid or limit use of materials in corrosive environments, including, but not limited to, the following:
 - a. Laboratory exhaust airstreams.
 - b. Process exhaust airstreams.
 - 3. Use Type 316 stainless-steel tubing and fittings when in contact with a corrosive environment.
 - 4. Where actuators are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.4 ELECTRIC POWER

- A. Provide electrical power to products requiring electrical connections.
- B. Provide circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."
- C. Provide power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

- D. Provide raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.5 CONTROL DAMPERS

- A. Install smooth transitions, not exceeding 30 degrees, to dampers smaller than adjacent duct. Install transitions as close to damper as possible but at distance to avoid interference and impact to performance. Consult manufacturer for recommended clearance.
- B. Clearance:
 - 1. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.
 - 2. Install dampers with at least 24 inches of clear space on sides of dampers requiring service access.
- C. Service Access:
 - 1. Dampers and actuators shall be accessible for visual inspection and service.
 - 2. Install access door(s) in duct or equipment located upstream of damper to allow service personnel to hand clean any portion of damper, linkage, and actuator. Comply with requirements in Section 233300 "Air Duct Accessories."
- D. Install dampers straight and true, level in all planes, and square in all dimensions. Install supplementary structural steel reinforcement for large multiple-section dampers if factory support alone cannot handle loading.
- E. Attach actuator(s) to damper drive shaft.
- F. For duct-mounted and equipment-mounted dampers installed outside of equipment, install a visible and accessible indication of damper position from outside.

3.6 CONNECTIONS

- A. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install engraved phenolic nameplate with damper identification on damper.

3.8 CHECKOUT PROCEDURES

A. Control-Damper Checkout:

1. Check installed products before continuity tests, leak tests, and calibration.
2. Check dampers for proper location and accessibility.
3. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material, and support.
4. Verify that control dampers are installed correctly for flow direction.
5. Verify that proper blade alignment, either parallel or opposed, has been provided.
6. Verify that damper frame attachment is properly secured and sealed.
7. Verify that damper actuator and linkage attachment are secure.
8. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
9. Verify that damper blade travel is unobstructed.

3.9 ADJUSTMENT, CALIBRATION, AND TESTING:

- A. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.
- B. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressure.
- C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.
- D. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION 230923.12

SECTION 230923.14 - FLOW INSTRUMENTS

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. Airflow switches.

1.3 DEFINITIONS

- A. Ethernet: Local area network based on IEEE 802.3 standards.
- B. FEP: Fluorinated ethylene propylene.
- C. HART: Highway addressable remote transducer protocol is the global standard for sending and receiving digital information across analog wires between smart devices and control or monitoring systems through bi-directional communication that provides data access between intelligent field instruments and host systems. A host can be any software application from technician's hand-held device or laptop to a plant's process control, asset management, safety, or other system using any control platform.
- D. PEEK: Polyetheretherketone.
- E. PTFE: Polytetrafluoroethylene.
- F. PPS: Polyphenylene sulfide.
- G. RS-485: A TIA standard for multipoint communications using two twisted pairs.
- H. RTD: Resistance temperature detector.
- I. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, including the following:
 - 1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.

2. Operating characteristics; electrical characteristics; and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation instructions, including factors affecting performance.
5. Product certificates.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of product 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. Number-coded identification system for unique identification of wiring, cable, and tubing ends.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each product requiring a certificate.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For instruments to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Provide parts, as indicated by manufacturer's recommended parts list, for product operation during one-year period following warranty period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 GENERAL REQUIREMENTS FOR FLOW INSTRUMENTS

- A. Air sensors and transmitters shall have an extended range of 10 percent above Project design flow and 10 percent below minimum Project flow to signal abnormal flow conditions and to provide flexibility for changes in operation.
- B. Source Limitations: For flow instruments, obtain products from single source from single manufacturer.
- C. Environmental Conditions:
 - 1. Instruments shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.
 - a. If instrument alone cannot meet requirement, install instrument in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated and cooled, filtered, and ventilated as required by instrument and application.
 - 2. Instruments and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Instrument's installed location shall dictate following NEMA 250 enclosure requirements:
 - a. Outdoors: Type 4 or Type 4X.
 - b. Indoors, Heated with Filtered Ventilation: Type 1 or Type 2.
 - c. Indoors, Heated with Non-Filtered Ventilation: Type 2 or Type 12.
 - d. Indoors, Heated and Air Conditioned: Type 1.
 - e. Mechanical Equipment Rooms:
 - 1) Chiller and Boiler Rooms: Type 12 Type 4 Type 4X.
 - 2) Air-Moving Equipment Rooms: Type 1, Type 2 or Type 12.
 - 3) Rooms with exposed water: Type 4 or Type 4X.
 - 4) Rooms with water or wastewater pumps: Type 4 or Type 4X.
 - f. Localized Areas Exposed to Washdown: Type 4 or Type 4X.
 - g. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 2, Type 3 or Type 12.
 - h. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4 or Type 4X.
 - i. Hazardous Locations: Explosion-proof rating for condition.
 - j. Chemical storage rooms: Type 4X.

2.3 AIRFLOW SWITCHES

- A. Stainless Steel Single Vane Switch:

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. McDonnell & Miller.
 - b. Honeywell.
 - c. Johnson Controls.
 - d. Dwyer Instruments, Inc
 - e. Or equal
2. Description:
 - a. Velocities up to 2000 fpm.
 - b. Suitable for mounting with air direction in horizontal.
3. Performance:
 - a. Voltage: 125-, 240-, and 480-V ac.
 - b. Full Load Current: 9.8 A at 125-V ac.
 - c. Field-Adjustable Velocity Set Point: 400 to 1600 fpm.
 - d. Maximum Process Temperature: 180 deg F.
 - e. Maximum Ambient Temperature: 125 deg F.
4. Construction:
 - a. Stainless steel vane.
 - b. Vane actuates a SPDT snap switch.
 - c. Enclosure Material: Die-cast metal.
 - d. Enclosure with removable cover.
 - e. NEMA 250, Type 1 enclosure.
 - f. Screw set-point adjustment.
 - g. Electrical Connections: Screw terminals.
 - h. Conduit Connections: 1-inch trade size conduit knock outs on top and bottom.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.
- C. Provide the services of an independent inspection agency to confirm that proposed mounting locations comply with requirements indicated and approved submittals.
 1. Indicate dimensioned locations with mounting height for all surface-mounted products to walls and ceilings on shop drawings.
 2. Do not begin installation without submittal approval of mounting location.

- D. Complete installation rough-in only after confirmation by independent inspection is complete and approval of location is documented for review by Owner and Engineer on request.
- E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTRUMENT APPLICATIONS

- A. Select from instrument types to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.
- B. Airflow Switches:
 - 1. Measured Velocities 400 fpm and Less: Stainless-steel single-vane switch.
 - 2. Measured Velocities Greater than 400 fpm: Stainless-steel single-vane switch.

3.3 INSTALLATION, GENERAL

- A. Furnish and install products required to satisfy more stringent of all requirements indicated.
- B. Install products level, plumb, parallel, and perpendicular with building construction.
- C. Properly support instruments, tubing, piping wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a 5-lb force.
- D. Install ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.
- E. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.
- F. Corrosive Environments:
 - 1. Use products that are suitable for environment to which they will be subjected.
 - 2. If possible, avoid or limit use of materials in corrosive environments, including, but not limited to, the following:
 - a. Laboratory exhaust airstreams.
 - b. Process exhaust airstreams.
 - 3. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings with a corrosive-resistant coating that is suitable for environment.

4. Where instruments are located in a corrosive environment and are not corrosive resistant from the manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.4 ELECTRIC POWER

- A. Furnish and install electrical power to products requiring electrical connections.
- B. Furnish and install circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."
- C. Furnish and install power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- D. Furnish and install raceways. Comply with requirements in Section 260533.13 "Conduits for Electrical Systems."

3.5 INSTRUMENTS, GENERAL INSTALLATION REQUIREMENTS

- A. Mounting Location:
 1. Rough-in: Outline instrument-mounting locations before setting instruments and routing cable, wiring, and conduit to final location.
 2. Install switches for air flow associated with individual air-handling units and connected ductwork and piping near air-handlings units co-located in air-handling unit system control panel, to provide service personnel a single and convenient location for inspection and service.
 3. Install airflow switches for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
- B. Mounting Height:
 1. Mount instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
 2. Mount switches located in mechanical equipment rooms and other similar space not subject to code, state, and federal accessibility requirements, within a range of 42 to 72 inches above the adjacent floor, grade, or service catwalk or platform.
 - a. Make every effort to mount at 60 inches.
- C. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.

3.6 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.7 CLEANING

- A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.
- B. Wash and shine glazing.
- C. Polish glossy surfaces to a clean shine.

3.8 CHECKOUT PROCEDURES

- A. Description:
 - 1. Check out installed products before continuity tests, leak tests, and calibration.
 - 2. Check instruments for proper location and accessibility.
 - 3. Check instruments for proper installation with respect to direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
- B. Flow Instrument Checkout:
 - 1. Verify that sensors are installed correctly with respect to flow direction.
 - 2. Verify that sensor attachment is properly secured and sealed.
 - 3. Inspect instrument tag against approved submittal.
 - 4. Verify that recommended upstream and downstream distances have been maintained.

3.9 ADJUSTMENT, CALIBRATION, AND TESTING

- A. Description:
 - 1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
 - 2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
 - 3. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
 - 4. Equipment and procedures used for calibration shall meet instrument manufacturer's recommendations.
 - 5. Provide diagnostic and test equipment for calibration and adjustment.
 - 6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
 - 7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
 - 8. If after-calibration-indicated performance cannot be achieved, replace out-of-tolerance instruments.

9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.
- B. Analog Signals:
1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
 2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
 3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.
- C. Digital Signals:
1. Check digital signals using a jumper wire.
 2. Check digital signals using an ohmmeter to test for contact.
- D. Switches: Calibrate switches to make or break contact at set points indicated.

END OF SECTION 230923.14

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. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.

- 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.

1.3 DEFINITIONS

- A. OSHPD: Office of Statewide Health Planning and Development (State of California).

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:

1. 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 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.

1.5 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 the qualified professional engineer responsible for their preparation for selecting hangers and supports.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. Welding certificates.
- C. Field quality-control reports.

1.7 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. Duct Design: 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. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.
- C. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- E. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- F. 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.
- 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." All longitudinal seams shall be Pittsburgh lock seams unless otherwise specified for specific application.
- 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 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round 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. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round 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."
 - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," 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."

2.4 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. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A1008/A1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A480/A480M, Type 316; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4.
- E. 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.

- F. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- G. Tie Rods: Galvanized steel, 1/4-inch- minimum diameter for lengths 36 inches or less; 3/8-inch- minimum diameter for lengths longer than 36 inches.

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: 4 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 deg F.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
- 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.

- 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: Galvanized-steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- 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 Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A492.
- F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

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. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- 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. Where ducts have external insulation, provide weatherproof aluminum jacket. See Section 230713 "Duct 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 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. For cleaning of existing ductwork, see Section 230130.52 "Existing HVAC Air Distribution System Cleaning."
- C. Use duct cleaning methodology as indicated in NADCA ACR.
- D. 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.
- 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.

3.8 STARTUP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.9 DUCT SCHEDULE

- A. See "Ductwork Schedule" on Drawings.
- B. Intermediate Reinforcement:
 1. Galvanized-Steel Ducts: Galvanized steel.
 2. Stainless-Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
 3. Aluminum Ducts: Aluminum or Type 316 stainless-steel.
- C. Elbow Configuration:
 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vaness and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-

1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Radius-to Diameter Ratio: 1.5.

- b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
- c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.

D. 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.
 - b. Rectangular Main to Round Branch: Conical spin in.
- 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

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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. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Flange connectors.
6. Turning vanes.
7. Duct-mounted access doors.
8. Flexible connectors.

- B. Related Requirements:

1. Section 233346 "Flexible Ducts" for insulated and non-insulated flexible ducts.
2. Section 284621.11 "Addressable Fire-Alarm Systems" for duct-mounted fire and smoke detectors.

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. Manual volume damper installations.
 - c. Control-damper installations.
 - d. Fire-damper, installations, including sleeves; and duct-mounted access doors and remote damper operators.

- e. 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 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- 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. Greenheck Fan Corporation.
 - 2. Pottorff.
 - 3. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
 - 4. Or equal.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2500 fpm.
- D. Maximum System Pressure: 3-inch wg.
- E. Frame: Hat-shaped, 0.063-inch- thick extruded aluminum, with welded corners or mechanically attached and mounting flange.
- F. Blades: Multiple single-piece blades, off-center pivoted, maximum 6-inch width, 0.050-inch-thick aluminum sheet with sealed edges.
- G. Blade Action: Parallel.

- H. Blade Seals: Extruded vinyl, mechanically locked.
- I. Tie Bars and Brackets: Aluminum.
- J. Return Spring: Adjustable tension.
- K. Bearings: Synthetic pivot bushings.
- L. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Electric actuators.
 - 4. Chain pulls.
 - 5. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20 gauge minimum.
 - b. Sleeve Length: 6 inches minimum.
 - 6. Screen Mounting: Rear mounted.
 - 7. Screen Material: Aluminum.
 - 8. Screen Type: Bird.
 - 9. 90-degree stops.

2.2 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 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. Greenheck Fan Corporation.
 - b. McGill AirFlow LLC.
 - c. Pottorff.
 - d. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
 - e. Or equal.
 - 2. Standard leakage rating.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Frame: Hat-shaped.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.

- d. Galvanized-steel, 0.064 inch thick.
 6. Blade Axles: Galvanized steel.
 7. Bearings:
 - a. Oil-impregnated bronze or molded synthetic.
 - b. 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.
 8. Tie Bars and Brackets: Galvanized steel.
- B. Standard, Aluminum, Manual Volume Dampers:
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. Greenheck.
 - b. McGill Airflow LLC.
 - c. Pottorff.
 - d. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
 - e. Or equal.
 2. Standard leakage rating.
 3. Suitable for horizontal or vertical applications.
 4. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
 - e. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
 6. Blade Axles: Stainless steel or nonferrous metal.
 7. Bearings:
 - a. Oil-impregnated bronze or molded synthetic.
 - b. 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.
 8. Tie Bars and Brackets: Aluminum.
- C. Jackshaft:
1. Size: 0.5-inch diameter.
 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

D. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.3 FIRE DAMPERS

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. Greenheck Fan Corporation.
2. Pottorff.
3. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
4. Or equal.

B. Type: Static; rated and labeled according to UL 555 by an NRTL.

C. Fire Rating: 1-1/2 and 3 hours.

D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, galvanized steel; with mitered and interlocking corners; gauge in accordance with UL listing.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel; gauge in accordance with UL listing.

1. Minimum Thickness: 0.05 thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, galvanized sheet steel; gauge in accordance with UL listing.

H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

I. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.4 FLANGE CONNECTORS

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. CL WARD & Family Inc.
2. Ductmate Industries, Inc; a DMI company.
3. Elgen Manufacturing.
4. Or equal.

- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gauge and Shape: Match connecting ductwork.

2.5 TURNING VANES

- 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. Aero-Dyne Sound Control Co.
 - 2. CL WARD & Family Inc.
 - 3. Ductmate Industries, Inc; a DMI company.
 - 4. Elgen Manufacturing.
 - 5. Or equal.
- B. 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.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. 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."
- E. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.6 DUCT-MOUNTED ACCESS DOORS

- 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. CL WARD & Family Inc.
 - 2. Ductmate Industries, Inc; a DMI company.
 - 3. Greenheck Fan Corporation.
 - 4. Pottorff.
 - 5. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
 - 6. Or equal.
- B. 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. Galvanized 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: Galvanized 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 with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

2.7 DUCT ACCESS PANEL ASSEMBLIES

- 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. CL WARD & Family Inc.
 2. Ductmate Industries, Inc; a DMI company.
 3. Flame Gard, Inc.
 4. Or equal.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.
- D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.8 FLEXIBLE CONNECTORS

- 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. CL WARD & Family Inc.
 2. Ductmate Industries, Inc; a DMI company.
 3. Duro Dyne Inc.
 4. Ventfabrics, Inc.
 5. Or equal.

- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. 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 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd..
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.
- G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
 - 1. Minimum Weight: 16 oz./sq. yd..
 - 2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
 - 3. Service Temperature: Minus 67 to plus 500 deg F.
- H. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
 - 1. Minimum Weight: 14 oz./sq. yd..
 - 2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
 - 3. Service Temperature: Minus 67 to plus 500 deg F.
- I. 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.

2.9 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 volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
 - 3. Install Type 304 stainless steel volume dampers in all other ducts.
- 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 fire dampers according to UL listing.
- G. Install duct security bars. Construct duct security bars from 0.164-inch steel sleeve, continuously welded at all joints and 1/2-inch-diameter steel bars, 6 inches o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch hinged access panel with cam lock in duct in each side of sleeve.
- H. 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. Control devices requiring inspection.
 10. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. 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.
- K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- N. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- O. Connect flexible ducts to metal ducts with draw bands.
- P. Install duct test holes where required for testing and balancing purposes.
- Q. 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 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.

END OF SECTION 233300

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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. Inline Centrifugal fans.

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 hangars and 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. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.

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. Seismic Qualification Data: For fans, 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 HVAC power ventilators to include in normal and emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- 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. Belts: One set(s) for each belt-driven unit.

PART 2 - PRODUCTS

2.1 INLINE CENTRIFUGAL FANS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Loren Cook Company.
 2. PennBarry.
 3. Or equal.
- B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

- C. Direct Driven Units: Premium efficiency totally enclosed fan cooled motor mounted in airstream and factory wired to disconnect switch located on outside of fan housing.
- D. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- E. Accessories: See Drawings.

2.2 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.

2.3 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 the AMCA-Certified Ratings Seal.
- C. Fan Sound Ratings: Comply with AMCA 311, and label fans with the AMCA-Certified Ratings Seal. Sound ratings shall comply with AMCA 301. The fans shall be tested according to AMCA 300.
- D. Fan Performance Ratings: Comply with AMCA 211 and label fans with AMCA-Certified Rating Seal. The 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. Secure roof-mounted fans to roof curbs with zinc-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.
- C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

- D. 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."
- E. Install units with clearances for service and maintenance.
- F. 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 according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
 - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- 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. Adjust belt tension.
- C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION 233423

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SECTION 237423.16 - PACKAGED, INDIRECT-FIRED, OUTDOOR, HEATING-ONLY MAKEUP-AIR 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 outdoor, indirect, gas-fired, heating-only, makeup air units, including the following components:

1. Casings.
2. Outdoor-air intake hood.
3. Fans, drives, and motors.
4. Air filtration.
5. Dampers.
6. Indirect, gas-fired burners.
7. Unit control panel.
8. Controls.
9. Accessories.

- B. Related Requirements:

1. Section 033000 "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 230923 "Direct Digital Control (DDC) System for HVAC."
6. Section 231123 "Facility Natural-Gas Piping."
7. Section 233113 "Metal Ducts."
8. Section 233300 "Air Duct Accessories."
9. Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
10. Section 260523 "Control-Voltage Electrical Power Cables."
11. Section 260526 "Grounding and Bonding for Electrical Systems."

1.3 ACTION SUBMITTALS

- A. Product Data: For each outdoor, indirect, gas-fired, heating-only, makeup air unit.
 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

3. Include unit dimensions and weight.
4. 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.
5. Include filters with performance characteristics.
6. Include direct, gas-fired burners with performance characteristics.
7. Include dampers, including housings, linkages, and operators.

B. Shop Drawings: For each outdoor, indirect, gas-fired heating and ventilating 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. Detail fabrication and assembly of gas-fired heating and ventilating units, as well as procedures and diagrams.
4. Include diagrams for power, signal, and control wiring.

1.4 DELEGATED DESIGN SUBMITTALS

A. Delegated-Design Submittal: For vibration isolation 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.

1.5 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 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.

- D. Startup service reports.
- E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For indirect, gas-fired, makeup air units to include in emergency, operation, and maintenance manuals.

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. Filters: One set for each unit.
 - 2. Gaskets: One set for each access door.
 - 3. Fan Belts: One set for each unit.

1.8 WARRANTY

- A. Warranty: Manufacturer agrees to repair or replace components of indirect-fired heating and ventilating units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Entire Unit: Manufacturer's standard, but not less than one year from date of Substantial Completion.
 - 2. Warranty Period for Heat Exchangers: Not less than five years from date of Substantial Completion.
 - 3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
 - 4. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

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 units 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/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

- E. 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.

2.2 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. Greenheck Fan Corporation.
 - 2. Reznor.
 - 3. Trane Inc.
 - 4. Or equal.

2.3 UNIT CASINGS

- A. General Fabrication Requirements for Casings:
 - 1. Forming: Form walls, roofs, and floors with at least two breaks at each joint.
 - 2. Casing Joints: Sheet metal screws or pop rivets, factory sealed with water-resistant sealant.
 - 3. Makeup Air Unit Mounting Frame: Formed galvanized-steel channel or structural channel supports, designed for low deflection, welded with integral lifting lugs.
- B. Configuration: Horizontal unit with horizontal discharge for concrete-base installation.
- C. Double-Wall Construction:
 - 1. Outside Casing Wall: Galvanized steel, minimum 18 gauge thick, with corrosion resistant coating.
 - 2. Inside Casing Wall:
 - a. Inside Casing, Burner Section: Galvanized steel, solid, minimum 14-gauge thick steel.
 - b. Inside Casing, All Other Sections: Galvanized steel steel.
 - 3. Floor Plate: Galvanized steel, minimum 18 gauge thick.
 - 4. Casing Insulation:
 - a. Materials: Glass-fiber blanket or board insulation, Type I or Type II ASTM C1071.
 - b. Casing Panel R-Value: Minimum 7.
 - c. Insulation Thickness: 1 inch.
 - d. Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roof of unit.
 - 5. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- D. Panels and Doors:

1. Doors:
 - a. Fabrication: Formed and reinforced with same materials and insulation thickness as casing.
 - b. 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 airflow. Provide safety latch retainers on doors so that doors do not open uncontrollably.
 - c. Gasket: Neoprene, applied around entire perimeters of panel frames.
 - d. Size: Large enough to allow unobstructed access for inspection and maintenance of unit's internal components.

2. Locations and Applications:
 - a. Fan Section: Doors.
 - b. Access Section: Doors.
 - c. Gas-Fired Burner Section: Doors.
 - d. Damper Section: Doors.
 - e. Filter Section: Doors large enough to allow periodic removal and installation of filters.
 - f. Mixing Section: Doors.

2.4 OUTDOOR-AIR INTAKE HOOD

- A. Type: Manufacturer's standard hood or louver.
- B. Materials: Match cabinet.
- C. Bird Screen: Comply with requirements in ASHRAE 62.1.
- D. Filter: Aluminum, 1 inch cleanable.
- E. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

2.5 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. Fans: Centrifugal, rated according to AMCA 210; galvanized steel; mounted on solid-steel shaft.
 1. Shafts: With field-adjustable alignment.
 2. Shaft Bearings: Heavy-duty, self-aligning, permanently lubricated ball bearings with an L50 rated life of 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.

4. Mounting: For internal vibration isolation. Factory-mount fans with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 1 inch.
 5. Shaft Lubrication Lines: Extended to a location outside the casing.
 6. 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: Factory-mounted V-belt drive, with adjustable alignment and belt tensioning, and with 1.5 service factor based on fan motor.
1. Pulleys: Cast iron or cast steel with split, tapered bushing, dynamically balanced at the factory.
 2. Belts: Oil resistant, non-sparking and nonstatic; in matched sets for multiple-belt drives.
 3. Belt Guards: Comply with requirements specified by OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards"; 0.146-inch- thick, diamond-mesh wire screen, welded to steel angle frame; prime coated.
- D. 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: Maximum sizes 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: See schedules on Drawings.
 4. Efficiency: Premium efficient as defined in NEMA MG 1.
 5. 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.

2.6 AIR FILTRATION

- A. Panel Filters:
1. Description: Pleated factory-fabricated, self-supported, disposable air filters with holding frames.
 2. Media: Interlaced glass, synthetic or cotton fibers coated with nonflammable adhesive and antimicrobial coating.
 3. Filter-Media Frame: Cardboard Frame.

2.7 DAMPERS

- A. Dampers: Comply with requirements in Section 230923.12 "Control Dampers."

2.8 INDIRECT-FIRED GAS BURNER

- A. Description: Factory assembled, piped, and wired; and complying with ANSI Z21.47 and with NFPA 54.
- B. CSA Approval: Designed and certified by and bearing label of CSA.
- C. Burners: Stainless steel.
 - 1. Rated Minimum Turndown Ratio: 10 to 1.
 - 2. Fuel: Natural gas.
 - 3. Ignition: Electronically controlled electric spark with flame sensor.
 - 4. Gas Control Valve: Modulating.
 - 5. Gas Train: Regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, electronic-modulating temperature control valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
 - 6. High-Altitude Model or Kit: For Project elevations more than 2000 feet above sea level.
- D. Venting, Gravity: Gravity vented.
- E. Venting, Power: Power vented, with integral, motorized centrifugal fan interlocked with gas valve.
- F. Heat Exchanger: Stainless steel.
- G. Heat-Exchanger Drain Pan: Stainless steel.
- H. Safety Controls:
 - 1. Gas Manifold: Safety switches and controls complying with ANSI standards.
 - 2. Vent Flow Verification: Differential pressure switch to verify open vent.
 - 3. High Limit: Thermal switch or fuse to stop burner.
 - 4. Purge-period timer shall automatically delay burner ignition and bypass low-limit control.
 - 5. Airflow Proving Switch: Differential pressure switch senses correct airflow before energizing pilot.
 - 6. Automatic-Reset, High-Limit Control Device: Stops burner and closes main gas valve if high-limit temperature is exceeded.
 - 7. Safety Lockout Switch: Locks out ignition sequence if burner fails to light after three tries. Controls are reset manually by turning the unit off and on.
 - 8. Control Transformer: 24 V ac.

2.9 UNIT CONTROL PANEL

- A. Factory-wired, fuse-protected control transformer, connection for power supply and field-wired unit to remote control panel.
- B. Control Panel: Surface-mounted remote panel, with engraved plastic cover and the following lights and switches:

1. On-off-auto fan switch.
2. Heat-vent-off switch.
3. Supply-fan operation indicating light.
4. Heating operation indicating light.
5. Thermostat.
6. Damper position potentiometer.
7. Dirty-filter indicating light operated by unit-mounted differential pressure switch.
8. Safety-lockout indicating light.
9. Enclosure: NEMA 250, Type 4X.

2.10 CONTROLS

A. Comply with requirements in Section 230923 "Direct Digital Control (DDC) System for HVAC."

B. Control Devices:

1. Remote Thermostat: Adjustable room thermostat with temperature readout.
2. Remote Setback Thermostat: Adjustable room thermostat without temperature readout.
3. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
4. Fire-Protection Thermostats: Fixed or adjustable settings to operate at not less than 75 deg F above normal maximum operating temperature.
5. Timers, Seven Day:
 - a. Programming-switch timer with synchronous-timing motor and seven-day dial.
 - b. Continuously charged, nickel-cadmium-battery-driven, eight-hour, power-failure carryover.
 - c. Multiple-switch trippers.
 - d. Minimum of two and maximum of eight signals per day with two normally open and two normally closed output contacts.
6. Timers, Solid State:
 - a. Programmable time control with four separate programs.
 - b. 24-hour battery carryover; individual on-off-auto switches for each program.
 - c. 365-day calendar with 20 programmable holidays.
 - d. Choice of fail-safe operation for each program.
 - e. System fault alarm.
7. Ionization-Type Smoke Detectors:
 - a. 24-V dc, nominal.
 - b. Self-restoring.
 - c. Plug-in arrangement.
 - d. Integral visual-indicating light.
 - e. Sensitivity that can be tested and adjusted in place after installation.
 - f. Integral addressable module.
 - g. Remote controllability.
 - h. Responsive to both visible and invisible products of combustion.

- i. Self-compensating for changes in environmental conditions.
- C. Fan Control, Interlocked: Fan to start automatically with exhaust fan(s) to which this heating and ventilating unit is associated for makeup air.
 - D. Fan Control, Timer: Timer starts and stops indirect-fired heating and ventilating unit and exhaust fan(s).
 - E. Outdoor-Air Damper Control, 100 Percent Outdoor-Air Units: Outdoor-air damper shall open when supply fan starts, and close when fan stops.
 - F. Mixed Outdoor- and Return-Air Damper Control: When fan is running, outdoor- and return-air dampers shall modulate to supply minimum outdoor air as follows:
 1. Minimum 30 percent outdoor air.
 2. Outdoor-air quantity adjusted by potentiometer on control panel.
 3. Outdoor-air quantity to maintain minimum building static pressure.
 - G. Temperature Control:
 1. Operates gas valve to maintain discharge-air temperature with factory-mounted sensor in blower outlet.
 2. Operates gas valve to maintain space temperature with wall-mounting, field-wired sensor with temperature adjustment, and unit-mounted control adjustment.
 3. Timer shall select remote setback thermostat to maintain space temperature at 55 deg F.
 4. Burner Control, Stepped: Two or four steps of control using one or two burner sections in series.
 5. Burner Control, Modulating: 20 to 100 percent modulation of the firing rate. 10 to 100 percent with dual burner units.
 - H. Interface with DDC System for HVAC: Factory-installed hardware and software to enable the DDC system for HVAC to monitor, control, and display status and alarms of heating and ventilating unit.
 1. Hardwired Points:
 - a. Room temperature.
 - b. Discharge-air temperature.
 - c. Burner operating.
 2. ASHRAE 135.1 (BACnet) communication interface with the DDC system for HVAC shall enable the DDC system for HVAC operator to remotely control and monitor the heating and ventilating unit from an operator workstation. Control features and monitoring points displayed locally at heating and ventilating unit control panel shall be available through the DDC system for HVAC.
- ## 2.11 ACCESSORIES
- A. Electric heater with integral thermostat maintains minimum 50 deg F temperature in gas burner compartment.

- B. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.
- C. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.
- D. Hail guards of galvanized steel, painted to match casing.

2.12 MATERIALS

- A. Steel:
 - 1. ASTM A36/A36M for carbon structural steel.
 - 2. ASTM A568/A568M for steel sheet.
- B. Stainless Steel:
 - 1. Manufacturer's standard grade for casing.
 - 2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.
- C. Galvanized Steel: ASTM A653/A653M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.
- C. Verify cleanliness of airflow path to include inner-casing surfaces, filters, coils, turning vanes, fan wheels, and other components.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install gas-fired units in accordance with NFPA 54.
- B. Install controls and equipment shipped by manufacturer for field installation with indirect, gas-fired heating and ventilating units.

3.3 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
 - 1. Gas Piping: Comply with requirements in Section 231123 "Facility Natural-Gas Piping." Connect gas piping with shutoff valve and union, and with sufficient clearance for burner removal and service. Make final connections of gas piping to unit with corrugated, stainless-steel tubing flexible connectors complying with ANSI LC 1/CSA 6.26 equipment connections.
- B. Drain: Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for traps and accessories on piping connections to condensate drain pans under condensing heat exchangers.
- C. Where installing piping adjacent to heating and ventilating units, allow space for service and maintenance.

3.4 DUCTWORK CONNECTIONS

- A. Duct Connections: Connect supply ducts to indirect-fired heating and ventilating units with flexible duct connectors. Comply with requirements in Section 233300 "Air Duct Accessories" for flexible duct connectors.

3.5 ELECTRICAL CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- 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.
 - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
 - 2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.6 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
 - 1. Inspect for visible damage to burner combustion chamber.
 - 2. Inspect casing insulation for integrity, moisture content, and adhesion.
 - 3. Verify that shipping, blocking, and bracing are removed.
 - 4. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete.
 - 5. Verify that clearances have been provided for servicing.
 - 6. Verify that controls are connected and operable.
 - 7. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
 - 8. Verify that labels are clearly visible.
 - 9. Verify that filters are installed.
 - 10. Purge gas line.
 - 11. Inspect and adjust vibration isolators.
 - 12. Verify outdoor-air damper operation.
 - 13. Verify bearing lubrication.
 - 14. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 - 15. Adjust fan belts to proper alignment and tension.
- C. Start unit according to manufacturer's written instructions.
 - 1. Complete startup sheets and attach copy with Contractor's startup report.
 - 2. Inspect and record performance of interlocks and protective devices; verify sequences.
 - 3. Operate unit for run-in period recommended by manufacturer.
 - 4. Perform the following operations for both minimum and maximum firing, and adjust burner for peak efficiency:
 - a. Measure gas pressure at manifold.
 - b. Measure combustion-air temperature at inlet to combustion chamber.
 - c. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
 - d. Measure flue-gas temperature at furnace discharge.
 - e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
 - 5. Calibrate thermostats.
 - 6. Adjust and inspect high-temperature limits.
 - 7. Inspect dampers, if any, for proper stroke and interlock with return-air dampers.
 - 8. Inspect controls for correct sequencing of heating, and normal and emergency shutdown.
 - 9. Measure and record airflow. Plot fan volumes on fan curve.
 - 10. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.
 - 11. Measure and record motor electrical values for voltage and amperage.

12. Verify operation of remote panel, including pilot-operation and failure modes. Inspect the following:
 - a. High-limit heat.
 - b. Alarms.
13. After startup and performance testing, change filters, verify bearing lubrication, and adjust belt tension.
14. Verify drain-pan performance.
15. Verify outdoor-air damper operation.

3.8 ADJUSTING

- A. Adjust initial temperature set points.
- B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.
- C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.9 CLEANING

- A. After completing system installation testing, adjusting, and balancing and after completing startup service:
 1. Clean air-handling units internally to remove foreign material, construction dirt and dust.
 2. Clean fan wheels, cabinets, dampers, coils, and filter housings.
 3. Install new, clean filters.

3.10 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections with the assistance of a factory-authorized service representative.
- C. Units will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.11 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain heating and ventilating units.

END OF SECTION 237423.16

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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 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 03 "Concrete" for cast in place concrete work, including concrete encasements for electrical duct banks, equipment pads, and light pole bases.
 - 4. Division 31 "Earthwork" for excavation and backfilling, including gravel or sand bedding for underground work.
 - 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 SCHEDULING

- A. Per Contract Drawings

1.9 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.

1.10 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.

1.11 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.

1.12 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.

1.13 QUALIFICATIONS

A. Comply with Quality Assurance Articles within each Division 26 Section.

B. Electrical Contractor Minimum Requirements: Regularly engaged in the installation of industrial medium voltage systems for a minimum period of 10 years.

C. On Site Field Superintendent:

1. Minimum of 10 years of experience of industrial low and medium voltage projects of comparable size and complexity.
2. Be present (or designated substitute with minimum experience as above) during medium voltage cable pulling and testing, during medium voltage switching activity, and during medium voltage equipment change over or start-up activities.

1.14 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 to be required to be by a single manufacturer.

1.15 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.

1.16 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.

1.17 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 and Section 260800 "Commissioning of Electrical Systems". 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 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 FIELD CONDITIONS

- A. Altitude:

- 1. Sea level to 1000 ft..

- B. Ambient Temperature:

- 1. 65°.

- C. 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.

- D. 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.

E. Hazardous and / or Corrosive Environmental Conditions: As indicated on the Drawings.

PART 2 - PRODUCTS (Not Used)

PART 3 - 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 024116 "Structure Demolition": Demolition of utilities and other underground items.
2. Section 024119 "Selective Structure Demolition": Removal of designated building equipment and construction.
3. Section 083113 "Access Doors and Frames": Execution requirements for access doors and panels specified by this section.
4. 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.
5. 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; 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 State of New York Public Work's standard.

1.6 PRE-INSTALLATION MEETINGS

- A. Section 013100 "Project Management and Coordination": Pre-installation meeting.

1.7 SEQUENCING

- A. Section 011000 "Summary": Requirements for sequencing.

1.8 SCHEDULING

- A. Section 013100 "Project Management and Coordination" and 013216 "Construction Progress Schedule": Requirements for scheduling.
- B. Schedule work to coincide with new construction.

1.9 COORDINATION

- A. Section 013100 "Project Management and Coordination": Requirements for coordination.
- B. Conduct demolition to minimize interference with adjacent and occupied building areas.
- C. Coordinate demolition work with Owner.
- D. Coordinate and sequence demolition so as not to cause shutdown of operation of surrounding areas.
- E. Equipment, building, or structures scheduled for complete demolition shall be made safe from electrical shock hazard prior to demolition.
- F. 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 Owner.
 - 3. Maintain life-safety systems in full operation in occupied facilities or provide notice minimum 3 days in advance.
- G. 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.

3.4 DEMOLITION

- A. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Engineer/Engineer before disturbing existing installation.

- B. Remove exposed abandoned conduit. 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 or 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. Cut embedded support elements flush with walls and floors.
- L. Clean and repair existing equipment to remain.
- M. Protect and retain power to existing active equipment remaining.
- N. Cap abandoned empty conduit at both ends.

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 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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 building wire.
- 2. Connectors and splices.

- 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 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.

1.3 DEFINITIONS

- A. VFC: Variable-frequency controller. Used interchangeably with VFD.
- B. VFD: Variable frequency drive. See VFC.

1.4 ACTION SUBMITTALS

- A. Product Data: Manufacturer's cut sheet for each type of product used on project.
- B. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- D. Stranding: Refer to CONDUCTOR APPLICATIONS Article in PART 3.
- E. Conductor Insulation:
 - 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.

2.2

2.2 CONNECTORS AND SPLICES

- A. 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.
- B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Material: Tin-plated copper.
 - 2. Type:
 - a. One hole with long barrels for No. 8 AWG to No. 4/0 AWG.
 - b. Two holes with long barrels for 250 kcmil and larger.
 - c. Locking spade for No. 10 AWG and smaller.
 - 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.

PART 3 - EXECUTION

3.1 CONDUCTOR APPLICATIONS

- A. Wires and Cables: Copper; stranded, except for lighting and receptacle wiring which may be solid. Minimum size for power circuits: No. 12 AWG.
- B. Nominal 480/277VAC Power Circuits: Single conductors in raceway. Type XHHW-2.
- C. Nominal 240/208/120V Power Circuits: Single conductors in raceway. Type Type XHHW-2 for No. 8 and larger, Type THHN/THWN-2 for No. 10 AWG and smaller.
- D. Cables and Conductors in Cable Trays: Type TC.
- E. Direct Burial Outdoor Lighting Circuits: Type RHW-2.
- F. Grounding Conductors: Refer to Section 260526 "Grounding and Bonding for Electrical Systems".
- G. Control and Fire Alarm Circuits: Refer to Section 260523 "Control-Voltage Electrical Power Cables".
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- I. VFC Output Circuits: Type TC-ER with shield.

3.2 INSTALLATION, GENERAL

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points in accordance with Section 260533.13 "Conduits for Electrical Systems" 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.

- E. Use of steel fish tapes and/or steel pulling cables in PVC conduit or raceways that terminate into energized enclosures is prohibited.
- F. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- G. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.3 CONNECTIONS

- A. 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.
- B. 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.
- C. Wiring at Outlets:
 - 1. Install conductor at each outlet, with at least 6 inch of slack.
 - 2. Form solid wire into loop to fit around device terminal screw. Do not overlap wire.

3.4 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping".

3.7 FIELD QUALITY CONTROL

- A. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance, and feeder conductors, and 480V power circuit conductors for compliance with requirements.
 2. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 1000 V(dc) for 600 V rated cable for a one-minute duration. Minimum wire insulation resistance: 100 Megohms.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports to record the following:
1. Procedures used.
 2. Results that comply with requirements.
 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

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SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

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. Backboards.
2. Category 6 balanced twisted pair cable.
3. Balanced twisted pair cable hardware.
4. Control-circuit conductors.
5. Instrumentation cable.
6. Industrial Ethernet cable.
7. Termination products.

- 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 ACTION SUBMITTALS

- A. Product Data: Manufacturer's cut sheet for each type of product used on project.
- B. Product Schedule: Indicate type, use, location, and termination locations.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. 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.

- B. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
 - 1. Flame Travel Distance: 60 inches or less.
 - 2. Peak Optical Smoke Density: 0.5 or less.
 - 3. Average Optical Smoke Density: 0.15 or less.
- C. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
- D. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.
- E. RoHS compliant.

2.2 BACKBOARDS

- A. Comply with requirements for plywood backing panels in Section 061000 "Rough Carpentry."
- B. Painting: Paint plywood on all sides and edges with flat, latex paint. Comply with requirements in Section 099123 "Interior Painting."

2.3 CATEGORY 6 BALANCED TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250 MHz.
- B. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.
- C. Conductors: 100 ohm, No. 23 AWG solid copper.
- D. Shielding/Screening: Shielded twisted pairs (FTP).
- E. Cable Rating: Riser.
- F. Jacket: To match existing, thermoplastic.

2.4 BALANCED TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate balanced twisted pair copper communications cable.
- B. General Requirements for Balanced Twisted Pair Cable Hardware:
 - 1. Comply with the performance requirements of Category 6.
 - 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.

3. Cables shall be terminated with connecting hardware of same category or higher.
 - C. Source Limitations: Obtain balanced twisted pair cable hardware from single source from single manufacturer.
 - D. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.
 - E. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 1. Number of Terminals per Field: One for each conductor in assigned cables.
 - F. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
 1. Features:
 - a. Universal T568A and T568B wiring labels.
 - b. Labeling areas adjacent to conductors.
 - c. Replaceable connectors.
 - d. 24 or 48 ports.
 2. Construction: 16-gauge steel and mountable on 19 inch equipment racks.
 3. Number of Jacks per Field: One for each four-pair cable indicated.
 - G. Patch Cords: Factory-made, four-pair cables in 48 inch lengths; terminated with an eight-position modular plug at each end.
 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
 2. Patch cords shall have color-coded boots for circuit identification.
 - H. Legend:
 1. Machine printed, in the field, using adhesive-tape label.
 2. Snap-in, clear-label covers and machine-printed paper inserts.
- 2.5 CONTROL-CIRCUIT CONDUCTORS
- A. Individual Conductors: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
 - B. Multi-conductor Control Cable: NEC type TC, stranded copper, Type THHN/THWN-2, insulated color coded conductors including ground wire, overall PVC jacket. Rated for cable tray or direct burial use and sunlight resistant. Number of conductors as indicated on Drawings.
 - C. Minimum Size: No. 14 AWG for 120V circuits, No. 16 AWG for circuits 50V and less.

2.6 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-Suprenant Cable Corp.
- 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 727.
1. One or Multi-pair, twisted, shielded, No. 16 AWG, stranded, copper conductors.
 2. Voltage Rating: 600V.
 3. Insulation: XLP.
 4. Shield: 100 percent aluminum/polyester foil with drain wire. Pairs individually shielded.
 5. Jacket: PVC with manufacturer's identification.
 6. Standards: UL 1277 Type TC, UL 1581.
 7. Single pair cable maximum overall diameter: 0.297-inches.
- C. Triad (three conductor) Cable: NEC Type ITC (Instrumentation Tray Cable), UL Type TC for instrumentation signals and use under NEC Article 727.
1. Three conductor, twisted, shielded, No. 16 AWG, stranded, tinned copper conductors.
 2. Voltage Rating: 600V.
 3. Insulation: XLP.
 4. Shield: 100 percent aluminum/polyester foil with drain wire. Pairs individually shielded.
 5. Jacket: PVC with manufacturer's identification.
 6. Standards: UL 1277 Type TC, UL 1581.
 7. Triad cable maximum overall diameter: 0.311-inches.

2.7 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. Conductors: 100-ohm, 22 AWG solid copper.
- D. Shielding/Screening: Overall foil shield.
- E. Cable Rating: 600V.
- F. Jacket: PVC.
- G. Standards: UL, UL PLTC, UL AWM 2570 80C 600V, TIA 568B.

2.8 TERMINATIONS

- A. Termination connectors for instrumentation and control conductors:
 - 1. Tin plated copper.
 - 2. Vinyl insulated.
 - 3. Flanged spade / locking fork with upturned leg ends.
 - 4. Crimp / compression installation.
- B. Termination connector for industrial Ethernet cable: match conductor count, RJ45 type, intended for shielded cable. Rockwell Automation Bulletin 1585J or equal.

2.9 EXAMINATION

- A. Test cables on receipt at Project site.
 - 1. Test each pair of twisted pair cable for open and short circuits.

2.10 INSTALLATION OF RACEWAYS AND BOXES

- A. Comply with requirements in Section 260533.13 "Conduits for Electrical Systems" for raceway selection and installation requirements for conduits as supplemented or modified in this Section.
- B. Comply with requirements in Section 260533.16 "Boxes and Covers for Electrical Systems" for raceway selection and installation requirements for boxes as supplemented or modified in this Section.
 - 1. Outlet Boxes: No smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
 - 2. Outlet Boxes for Cables: No smaller than 4 inches square by 1-1/2 inches deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
 - 3. Flexible metal conduit is not allowed.
- C. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.
- D. Install manufactured conduit sweeps and long-radius elbows if possible.
- E. Raceway Installation in Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard if entering the room from overhead.
 - 4. Extend conduits 3 inches above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- F. Backboards: Install backboards with 96 inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

2.11 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with requirements in Section 260519 “Low-Voltage Electrical Power Conductors and Cables” for installation requirements and as supplemented or modified in this Section.
- B. Instrumentation and Ethernet cables may not be spliced and are to be continuous from terminal to terminal.
- C. Install instrumentation and Ethernet cabling in separate raceway from control or power wiring.
- D. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
- E. Separation from EMI Sources:
 - 1. Separation between open instrumentation cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inches.
- F. General Requirements for Telecommunications Cabling:
 - 1. Comply with TIA-568-C Series of standards.
 - 2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
 - 3. Terminate all conductors; cable cannot contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 - 4. Cables: may not be spliced and is to be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
 - 5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
 - 6. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
 - 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
 - 9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
 - 10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
 - 11. Support: Do not allow cables to lie on removable ceiling tiles.
 - 12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
 - 13. Provide strain relief.

14. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
15. Grounding: Ground wire must be copper. Comply with IEEE C2. Demonstrate ground resistance.

G. Balanced Twisted Pair Cable Installation:

1. Comply with TIA-568-C.2.
2. Install termination hardware as specified in Section 271513 "Communications Copper Horizontal Cabling" unless otherwise indicated.
3. Do not untwist balanced twisted pair cables more than 1/2 inch at the point of termination to maintain cable geometry.

2.12 REMOVAL OF CONDUCTORS AND CABLES

- A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified with a tag for future use.

2.13 GROUNDING

- A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
- B. For control-voltage wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- C. For instrumentation wiring, ground shield at one end only as recommended by instrument manufacturer and in accordance with Owner's standard.

2.14 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers comply with UL 969, for label stocks, laminating adhesives, and inks.
- C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.

2.15 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments and inspect cabling connections to confirm compliance with TIA-568-C.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- B. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide or transfer the data from the instrument to the computer, save as text files, print, and submit.
- C. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 260523

SECTION 260526 - GROUNDING AND BONDING 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. Grounding and bonding conductors.
- 2. Grounding and bonding materials and hardware.

- B. Related Requirements:

- 1.
- 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. Product Data: For each type of product used on the project.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

- A. Insulated Grounding and Bonding Conductor: Copper conductor, 600V with insulation type matching the circuit phase conductors called for in Section 260519 "Low-Voltage Electrical Power Conductors and Cables", green color.

- B. ASTM - Bare Copper Grounding and Bonding Conductor:

- 1. Referenced Standards: Complying with one or more of the following:
 - a. Soft or Annealed Copper Wire: ASTM B3.

- b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
- c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.
- d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

2.2 GROUNDING AND BONDING MATERIALS AND HARDWARE

A. Performance Criteria:

1. Regulatory Requirements:

- a. 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.

2. Listing Criteria:

- a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
- b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

B. Ground Rods: Copper clad steel, 3/4-inch by 10-feet, sectionalized as required by Drawings.

C. Grounding Conduit Hubs: Malleable iron type.

D. Water Pipe Ground Clamps: Cast bronze saddle type.

E. Exothermic-welding Kits: CADWELD process or equal.

- a. Manufacturer kits to include molds and powder recommended by kit manufacturer for materials being joined and installation conditions.
- b. Welds used indoors in occupied buildings or confined space to be low emission type, CADWELD EXOLON or equal.

F. Ground Rod Test Wells: As detailed on the Drawings.

G. Ground Enhancement Material (GEM): Low-resistance, non-corrosive, carbon dust based material that improves grounding effectiveness. Contains cement, which hardens when set to provide a permanent, maintenance-free, low-resistant grounding system that never leaches or washes away. Suitable for installation in trenches or backfilling around ground rods. Resistivity of no more than 20 ohm-cm in cured state. ERICO Part No. GEM25A or equal.

H. Bus Bars: Rectangular bar of annealed copper. As detailed on the Drawings.

PART 3 - EXECUTION

3.1 SELECTION OF GROUNDING AND BONDING CONDUCTORS

A. Conductors: Install solid conductor for 10 AWG and smaller, and stranded conductors for 8 AWG and larger unless otherwise indicated.

- B. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch in diameter.
- C. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.
- D. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.
- E. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.
- F. Underground Grounding Conductors: Install bare copper conductor, size as indicated on Drawings.
 - 1. Bury at least 30 inches below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

3.2 SELECTION OF CONNECTORS

- A. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.3 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
 - 1. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.
 - 2. Consult Engineer for resolution of conflicting requirements.
- C. Special Techniques:
 - 1. Grounding Electrode Conductors:
 - a. Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
 - b. Where conductors pass through floor slabs, walls, etc., install in conduit or sleeve.
 - c. When conductors need to be installed in conduit for mechanical protection, use non-ferrous conduit to avoid a choke effect for fault currents.

2. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - b. Make connections with clean, bare metal at points of contact.
 - c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
 - d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
 - f. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1) Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate adjacent parts.
 - 2) Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3) Use exothermic-welded connectors for outdoor locations; if disconnect-type connection is required, use bolted clamp.
 - g. Grounding and Bonding for Piping:
 - 1) Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use bolted clamp connector or bolt lug-type connector to pipe flange by using one of lug bolts of flange. Where dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2) Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with bolted connector.
 - 3) Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
 - h. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
 - i. Grounding for Steel Building Structure: Install as indicated on Drawings.
 - 1) Locate attachment points not subject to mechanical damage, but accessible for inspection.
 - 2) Use exothermic weld process for wire sizes 1/0 AWG and larger. When wire size is smaller than 1/0 AWG, weld a pigtail of 1/0 AWG to structural steel then mechanically connect the two wires.

3. Electrodes:
 - a. Ground Rods: Drive rods until tops are 2 inch below finished floor or final grade unless otherwise indicated.
 - 1) Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2) Use exothermic welds for below-grade connections.
 - 3) Drive rods vertically and do not allow them to be deformed or driven at an angle. Where driving is difficult or rock is encountered, use purpose-designed drilling equipment, install rod into drilled hole and backfill around rod using ground enhancement material (GEM) mixed with water to form a slurry in accordance with manufacturer's instructions.
 - b. Test Wells: Install as indicated on Drawings. Ring Electrode: Install grounding conductor, electrically connected to each building structure ground rod and to each steel column or other indicated item, extending around perimeter of building, area, or item indicated.
 - 1) Bury ring electrode not less than 24 inch from building's foundation.
 - 2) Lay underground conductors slack, and where exposed to mechanical injury, protect by pipes or other substantial guards. If guards are iron pipe or other magnetic material, electrically connect conductors to both ends of the guard.
 - c. Concrete-Encased Electrode (Ufer Ground): Fabricate in accordance with NFPA 70.
4. Grounding at Service:
 - a. Equipment grounding conductors and grounding electrode conductors must be connected to ground bus. Install main bonding jumper between neutral and ground buses.
5. Grounding Separately Derived Systems:
 - a. Transformers: Bond neutral and ground with a bonding jumper at the equipment in accordance with NEC 250.102. Connect to the grounding electrode system via the electrode grounding conductor in accordance with NEC Table 250.66 or as indicated on the Drawings.
 - b. Generators and UPS: When indicated on the Drawings as a separately derived system, bond neutral and ground with a bonding jumper at the equipment in accordance with NEC 250.102. Connect to the grounding electrode system via the electrode grounding conductor in accordance with NEC Table 250.66 or as indicated on the Drawings.
 - c. Generator: Install grounding electrode(s) at generator location. Electrode must be connected to equipment grounding conductor and to frame of generator.
6. Grounding Underground Distribution System Components:
 - a. Comply with IEEE C2 grounding requirements.

7. Grounding and Bonding Manholes and Handholes: Install as indicated on Drawings. Bond exposed-metal parts to ground rod or grounding conductor. Grounding and Bonding of Raceways, Cable Trays, Boxes, and Enclosures:
 - a. Terminate metallic conduit into pressed steel boxes using double locknuts (same metal type as conduit) and insulated grounding bushings.
 - b. Terminate metallic conduit into metallic gasketed enclosures using Meyers grounding type conduit hubs.
 - c. Use insulated throat grounding bushings with lay-in type lugs to terminate metallic conduits containing equipment grounding conductors into sheet steel boxes.
 - d. Bond metallic electrical system components such as cable trays, supports, brackets, braces, boxes, etc. to the raceway system if they are not rigidly secured to and in contact with the raceway system or are subject to vibration and loosening.
 - e. Provide a bonding jumper across hinged metal panels or doors when electrical components in excess of 24 volts are mounted on the moveable panel.
 - f. Provide a grounding bushing at the end of metallic conduits that terminate in free air.
 - g. Provide 12 AWG insulated green wire bonding jumper for metal outlet boxes that contain receptacles. Connect wire from receptacle ground terminal to box using grounding screw.

8. Equipment Grounding:
 - a. Install insulated equipment grounding conductors with feeders and branch circuits.
 - b. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
 - c. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
 - d. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
 - e. Metallic Fences: Comply with requirements of IEEE C2.
 - 1) Grounding Conductor: Bare copper, not less than 6 AWG.
 - 2) Gates: Must be bonded to grounding conductor with flexible bonding jumper.
 - 3) Barbed Wire: Strands must be bonded to grounding conductor.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with calibrated torque wrench in accordance with manufacturer's published instructions.
3. Test completed grounding system at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method in accordance with IEEE Std 81.
 - c. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

B. Nonconforming Work:

1. Grounding system will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective components and retest.

C. Collect, assemble, and submit test and inspection reports.

1. Report measured ground resistances that exceed the following values:
 - a. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 Ω (ohms).
 - b. Power and Lighting Equipment or System with Capacity over 500 kVA: 5 Ω (ohms).

3.5 PROTECTION

- A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260526

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SECTION 260529 - HANGERS AND SUPPORTS 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. Support, anchorage, and attachment components.
- 2. Fabricated metal equipment support assemblies.

- 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 ACTION SUBMITTALS

- A. Product Data: For each type of product used on the project.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following: channel support systems, conduit support hardware, and accessories.
- 2. Include rated capacities and furnished specialties and accessories.

- B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for electrical hangers and support systems.

- 1. Hangers. Include product data for components.
- 2. Slotted support systems.
- 3. Equipment supports.
- 4. 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 hangers and supports for electrical systems.
 - 1. Include design calculations and details of hangers.
 - 2. Include design calculations for seismic restraints.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified structural professional engineer, as defined in Section 014000 “Quality Requirements”, to design hanger and support system.
- B. Surface-Burning Characteristics for Nonmetallic Channel Systems and Accessories: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame Rating: Class 1.
 - 2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- 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. to correspond with channel material as listed in the SELECTION Article. Use of galvanized steel components is only allowed with galvanized steel channel.

- F. Threaded Rod: 3/8-inch diameter, minimum.
- G. Expansion Anchors: 3/8-inch minimum diameter. Equal to “Kwik Bolt”, manufactured by McCulloch Industries; “Wej it” manufactured by Wej it Expansion Products; or “Kwik-Bolt II” manufactured by Hilti Fastening Systems.

PART 3 - EXECUTION

3.1 SELECTION OF CHANNEL

- A. Dry, indoor, conditioned, non-process space: Hot dipped galvanized steel.
- B. Outdoor, process areas, or areas indicated on Drawings as “DUST”, “DAMP”, or WET”: Aluminum and/or stainless steel, depending upon load requirements.
- C. Areas indicated on Drawings as “CORROSIVE”: Nonmetallic.

3.2 INSTALLATION

- A. Comply with the following standards as applicable for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 - 1. NECA NEIS 101: Standard for Installing Steel Conduits.
 - 2. NECA NEIS 102: Standard for Installing Aluminum Rigid Metal Conduits.
 - 3. NECA NEIS 105: Standard for Installing Metal Cable Tray Systems.
 - 4. NECA NEIS 111: Standard for Installing Nonmetallic Raceways.
- B. Attach support systems only to structural components. Use concrete expansion anchors for attachment to concrete surfaces.
- C. Provide a minimum of 1/2-inch clearance between wall and equipment when installing surface mounted panel boxes, junction boxes, conduit, etc.
- D. Space conduit supports, other than for underground raceways, at no more than 8 foot intervals, and as required to obtain rigid construction.
- E. Remove burrs and grind smooth sharp edges from channel support ends. Fit ends with plastic end caps.

3.3 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000 psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.4 PAINTING

A. Touchup:

1. 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.
 - a. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
2. Comply with requirements in Section 099113 "Exterior Painting" Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260529

SECTION 260533.13 - CONDUITS 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: Conduits and fittings.
- B. Products Installed, but Not Furnished, under This Section:
 - 1. Section 260553 "Identification for Electrical Systems" for conduit identification labels.
- C. Related Requirements: Always retain first two subparagraphs below.
 - 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 260533.16 "Boxes and Covers for Electrical Systems" for conduit bodies, outlet and device boxes, pull boxes, and junction boxes.
 - 4. Section 260533.23 "Surface Raceways for Electrical Systems" for wireways and auxiliary gutters.
 - 5. Section 260529 "Hangers and Supports for Electrical Systems" for channel support systems and miscellaneous mounting components.
 - 6. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for underground construction requirements.

1.3 DEFINITIONS

- A. Conduit: A structure containing one or more duct raceways.
- B. Duct Raceway: A single enclosed raceway for conductors or cable.
- C. Duct Bank: An arrangement of conduit providing one or more continuous duct raceways between two points.

1.4 ACTION SUBMITTALS

- A. Product Data: Manufacturer's cut sheet for each type of product used on project. Note some conduit types listed may not be used on the project. Refer to the Conduit Selection Table in PART 3.
- B. Conduit Layouts: For Division 26, 27, and 28 conduits installed underground and concealed within buildings and structures. Show equipment, boxes, handholes, manholes, routing, materials, and sizing. Provide layouts at an appropriate scale for clarity. Submission of separate drawings for power, lighting and control for one area is acceptable. Provide schedule for easy cross check.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

- A. Regulatory Requirements: 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.

2.2 TYPE EMT DUCT RACEWAYS AND ELBOWS

- A. Description: Electrical metallic tubing per NEC Article 358.
- B. Listing Criteria: UL FJMX - Electrical Metallic Tubing, including UL 797.
- C. Material: Hot-dipped galvanized steel (EMT-S).

2.3 TYPE ERMCA DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

- A. Description: Rigid aluminum 6063 alloy conduit, elbows, couplings, and nipples per NEC Article 344.
- B. Listing Criteria: UL DYWV - Rigid Nonferrous Metallic Conduit, including UL 6A.
- C. Long radius elbows as indicated in Section 260543 "Underground Ducts and Raceways for Electrical Systems".
- D. PVC Coated Type: 40 mil PVC on exterior and 2 mil urethane on interior. (ERMCA-PVC).

2.4 TYPE ERMCS DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

- A. Description: Galvanized rigid steel conduit, elbows, couplings, and nipples, with a hot-dipped galvanized finish inside and out and per NEC Article 344.
- B. Listing Criteria:

1. UL DYIX – Rigid Ferrous Metal Conduit, including UL 6.
 2. UL DYJC – Rigid Ferrous Metal Conduit with Polyvinyl Chloride Coating, including UL 6.
- C. Long radius elbows as indicated in Section 260543 “Underground Ducts and Raceways for Electrical Systems”.
- D. PVC Coated Type: 40 mil PVC on exterior and 2 mil urethane on interior. (ERMC-S-PVC).

2.5 TYPE FMC DUCT RACEWAYS

- A. Description: Flexible metal conduit per NEC Article 348.
- B. Listing Criteria: UL DXUZ - Flexible Metal Conduit, including UL 1.
- C. Material: Hot-dipped galvanize steel (FMC-S).

2.6 TYPE FMT DUCT RACEWAYS

- A. Description: Flexible metal tubing composed of hot-dipped galvanized steel strips shaped into interlocking convolutions per NEC Article 360.
- B. Listing Criteria: UL ILJW - Flexible Metallic Tubing, including UL 1652.

2.7 TYPE LFMC DUCT RACEWAYS

- A. Description: Liquidtight Flexible Metal Conduit, Type UA, per NEC Article 350.
- B. Listing Criteria: UL DXHR – Liquid-tight Flexible Metal Conduit, including UL 360.
- C. Material: Steel (LFMC-S).
- D. Manufacturer: Sealtite®, Type UA, as manufactured by Anaconda, continuously interlocked flexible steel conduit with sunlight and chemical resistant PVC jacket.

2.8 TYPE LFNC-B DUCT RACEWAYS

- A. Description: Liquidtight Flexible Nonmetallic Conduit, Type B, suitable for outdoor use and corrosive areas, per NEC Article 356.
- B. Listing Criteria: UL DXOQ – Liquid-tight Flexible Nonmetallic Conduit, including UL 1660.
- C. Manufacturer: Carflex® as manufactured by Carlon, or equal.

2.9 TYPE PVC DUCT RACEWAYS AND FITTINGS

- A. Description: Rigid Polyvinyl Chloride Conduit, sunlight resistant, rated for use with 90 degree C conductors in exposed and direct or concrete encased applications, per NEC Article 352.
- B. Listing Criteria: UL DZYR – Rigid Nonmetallic PVC Conduit, including UL 651.
- C. Type: Schedule 40 and Schedule 80.

2.10 FITTINGS FOR CONDUIT AND TUBING

- A. General: Listed and labeled for type of conduit, location, and use.
 - 1. ERMCA: Use cast aluminum fittings.
 - 2. ERMC-S: Use cast malleable iron fittings.
- B. Listing Criteria as Applicable:
 - 1. UL 514B – Conduit, Tubing, and Cable Fittings.
 - 2. UL 1203 – Standard for Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations.
 - 3. UL DWTT – Conduit Fittings.
 - 4. UL FKAV – Electrical Metallic Tubing Fittings.
 - 5. UL ILNR – Flexible Metallic Tubing Fittings.
 - 6. UL DXAS – Liquid-tight Flexible Metal Conduit Assemblies.
- C. Refer to Section 260533.16 “Boxes and Covers for Electrical Systems” for conduit bodies such as LB’s, T’s, and C’s.
- D. Metal Fittings:
 - 1. EMT Fittings: Die cast, rain and concrete tight, compression type. Set screw type not permitted.
 - 2. RMC Fittings: Threaded type. Threadless fittings and split couplings are not permitted.
 - 3. FMC Fittings: Malleable iron, zinc plated, insulated throat.
 - 4. Fittings for PVC Coated Conduit: Minimum 40 mil thick PVC coating, with overlapping sleeves of one pipe diameter in length to protect threaded joints.
 - 5. LFMC Fittings: Three-piece screw in type, malleable iron.
 - 6. Expansion Fittings: Include flexible external bonding jumper.
 - 7. FMT Bushings: Insulated.
 - 8. Grounding and Bonding Hubs, Bushings, and Hardware:
 - a. Grounding Hub: Meyers type.
 - b. Locknuts: Cast steel or aluminum.
 - c. Bushings: Insulated throat with lay-in type lugs.
- E. Nonmetallic Fittings:
 - 1. PVC Fittings: Comply with NEMA TC 3 and match conduit material.

2. LFNC Fittings: Dust-tight, liquid-tight, chemical resistant thermoplastic/nylon construction with tapered thread hub and neoprene O-ring gasket. Push-on fittings are prohibited.

F. Specialty Fittings:

1. Explosionproof Sealing Fitting: Crouse-Hinds EYS or equal.
2. Explosionproof Flexible Coupling: Crouse-Hinds ECGJH or equal.
3. Deflection/Expansion Fitting: OZ-Gedney Type DX or equal.
4. Expansion Coupling: Crouse-Hinds Type XJG with bonding jumper or equal.
5. Conduit Sealing Bushings: Refer to Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling".

2.11 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT.

- A. Description: Cold galvanizing compound, 95 percent zinc rich paint.
- B. Listing Criteria: UL CCN FOIZ; including UL Subject 2419.

2.12 SOLVENT CEMENTS

- A. Description: Solvent cement to join Type PVC duct raceways and fittings.
- B. Listing Criteria: UL CCN DWTT; including UL 514B.

PART 3 - EXECUTION

3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Refer to Appendix Table 260533.13-1 for conduit application requirements.
- B. Minimum Raceway Size: 3/4-inch trade size.

3.2 INSTALLATION OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following as applicable:
 1. Relevant Article of NFPA 70.
 2. NECA NEIS 101 – Standard for Installing Steel Conduits.
 3. NECA NEIS 102 – Standard for Installing Aluminum Rigid Metal Conduit.
 4. NECA NEIS 111 – Standard for Installing Nonmetallic Raceways.

5. NEMA FB 2.10 – Selection and Installation Guidelines for Fittings for Use with Non-Flexible Metallic Conduit or Tubing.
6. NEMA FB 2.20 – Selection and Installation Guidelines for Fittings for Use with Flexible Electrical Conduit and Cable.
7. NEMA FB 2.40 – Installation Guidelines for Expansion and Expansion/Deflection Fittings.

C. Special Installation Techniques:

1. General Requirements for Installation of Duct Raceways:

- a. Complete duct raceway installation before starting conductor installation.
- b. Underground Installations: Refer to additional requirements in Section 260543 “Underground Ducts and Raceways for Electrical Systems”.
- c. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 feet above finished floor.
- d. Coordinate stub-up locations with approved shop drawings for equipment to position stub-up directly below appropriate section of motor control center, switchboard, or switchgear.
- e. Provide a 4 inch thick concrete housekeeping pad at slab and grade penetrations. Provide a 45 degree, 3/4 inch chamfer at exposed edges.
- f. Install no more than equivalent of three 90-degree bends in conduit run. Support within 12 inches of changes in direction.
- g. Maximum continuous conduit run: 300 feet. Reduce distance by 75 feet for each 90-degree elbow.
- h. Make bends in duct raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
- i. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- j. Support conduit within 12 inches of enclosures to which attached.
- k. Drainage: Arrange conduit system to allow liquids such as water, condensation, etc. to drain away from equipment served. If conduit drainage is not possible, plug conduits using conduit seals.
- l. Hazardous Areas: Install duct sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed duct raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install duct sealing fittings in accordance with NFPA 70.
- m. Moisture Control: Install devices to seal duct raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of duct 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 duct raceway enters a building or structure.
 - 3) Conduit extending from interior to exterior of building.
 - 4) Conduit extending into pressurized duct raceway 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.
- n. Do not install duct raceways or electrical items on "explosion-relief" walls or rotating equipment.
 - o. Do not install conduits within 2 inches of the bottom side of a metal deck roof.
 - p. Keep duct raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal duct raceway runs above water and steam piping.
 - q. Cut conduit perpendicular to the length. For conduits trade size 2 and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
 - r. Install pull wires in empty duct raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inches of slack at both ends of pull wire. Cap underground duct raceways designated as spare above grade alongside duct raceways in use. Use threaded cap.
 - s. Install duct raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
 - t. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to trade size 1-1/4 and insulated throat metal bushings on trade size 1-1/2 and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits. Install Meyers grounding type hubs when conduits terminate at NEMA 3R, 4, and 4X gasketed enclosures.
2. Do not install aluminum duct raceways or fittings in contact with concrete or earth.
 3. Protect metallic finish conduit installed in contact with concrete or below grade with two coats of bitumastic paint, heat shrink tubing, or approved equivalent. Provide protection from 12 inches below bottom of concrete to not less than 6 inches above surface of concrete.
 4. Rigid Metal Conduit (Type ERMC):
 - a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of duct raceway and fittings before making up joints. Follow compound manufacturer's published instructions.
 - b. The use of running threads is prohibited. Where such threads are necessary, use a three piece union.
 5. PVC Coated Rigid Metal Conduit (Type ERMC-A-PVC and ERMC-S-PVC):
 - a. Follow manufacturer's installation instructions for clamping, cutting, threading, bending, and assembly.
 - b. Provide PVC-coated sealing locknut for exposed male threads transitioning into female NPT threads that do not have sealing sleeves, including transitions from PVC couplings/female adapters to PVC-coated ERMC elbows in direct-burial applications. PVC-coated sealing locknuts must not be used in place of conduit hub. PVC-coated sealing locknut must cover exposed threads on PVC-coated ERMC duct raceway.

- c. Coat field-cut threads on PVC-coated duct raceway with manufacturer-approved corrosion-preventing conductive compound prior to assembly.
6. Flexible Conduit Connections (Types FMC, LFMC, and LFNC):
 - a. Provide a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - b. Include adequate slack to allow for thermal expansion and mechanical vibration.
 - c. Orient outdoor flexible connections to provide drip loop to avoid accumulation of water at equipment connection points.
7. Non-Metallic Conduit (Type PVC):
 - a. Do not install Type PVC conduit where ambient temperature exceeds 122 degrees F. Conductor ratings must be limited to 75 degrees C except where installed in a trench outside buildings with concrete encasement, where 90 degrees C conductors are permitted.
 - b. Comply with manufacturer's published instructions for solvent welding and fittings.
8. Duct Raceways Embedded in Slabs:
 - a. Comply with spacing requirements as noted on Structural Drawings.
 - b. Arrange duct raceways to cross building expansion joints with expansion fittings at right angles to the joint.
 - c. Arrange duct raceways to ensure that each is surrounded by minimum of 1 inch of concrete without voids.
9. Stub-ups at Slabs: Arrange stub-ups so curved portions of bends are not visible above finished slab.
10. Stub-ups to Above Recessed Ceilings:
 - a. Provide EMT or ERMC for duct raceways.
 - b. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
11. Duct Raceway Terminations at Locations Subject to Moisture or Vibration:
 - a. Provide insulating bushings to protect conductors, including conductors smaller than 4 AWG..
12. Duct Fittings: Use only fittings listed for use with each type of tubing or conduit and in accordance with specific fittings listed under PART 2.
 - a. ERMC-A-PVC and ERMC-S-PVC: Patch and seal joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Provide sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

13. Expansion-Joint Fittings: Install where necessary to compensate for thermal expansion and contraction and wherever conduits cross building or structure expansion joints.
14. Duct Raceways Penetrating Rooms or Walls with Acoustical Requirements: Seal duct raceway openings on both sides of rooms or walls with acoustically rated putty.
15. Identification: Install identification tags at conduits in accordance with Section 260553 "Identification for Electrical Systems".

D. Interfaces with Other Work:

1. Coordinate installation with other trades in advance of installation.
2. Restore walls, floor, and roof to original condition such as watertight, fire rating, smooth and/or painted finish after duct raceway penetration.
3. Coordinate with Section 260529 "Hangers and Supports for Electrical Systems" for installation of conduit hangers and supports.

3.3 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.4 APPENDICES

A. Table 260533.13-1: Conduit Selection Guidelines

Table 260533.13-1 Conduit Selection Guidelines	
Raceway Type	Location / Application
EMT	Indoor air-conditioned spaces in Administration / Office buildings including electrical rooms, mechanical rooms, control rooms, toilets, and offices.
ERMC-A	Indoor and outdoor applications, except where other types are listed. Exposed, non-corrosive areas. Concealed, non-corrosive areas. Under slabs in slab on grade construction / stub-ups. When installed underground or in contact with concrete, paint with two coats of bitumastic paint or use ERMC-A-PVC.

ERMC-A-PVC	Allowed for use in lieu of painting ERMC-A with two coats of bitumastic paint.
ERMC-S	Not used on this project.
ERMC-S-PVC	Not used on this project.
FMC	Flexible connections used in conjunction with EMT.
FMT	Flexible connections to light fixtures in conjunction with EMT.
LFMC	Flexible connections used in conjunction with ERMC types.
LFNC-B	Flexible connections used in designated corrosive areas. Limited to 2-inch trade size.
PVC-40	Concrete encased duct banks. Embedded in concrete slabs or structures. Underground elbows are to be ERMC type.
PVC-80	Direct buried. Areas designated as corrosive. Protection of grounding electrode conductors. Protection of lightning conductors. Underground elbows are to be ERMC type.

END OF SECTION 260533.13

SECTION 260533.16 - BOXES AND COVERS 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. Conduit bodies.
2. Metallic outlet boxes, device boxes, rings, and covers.
3. Nonmetallic outlet boxes, device boxes, rings, and covers.
4. Junction boxes and pull boxes.
5. Cover plates for device boxes.
6. Hoods for outlet boxes.

- B. Products Installed, but Not Furnished, under This Section:

1. See Section 260553 "Identification for Electrical Systems" for electrical equipment labels.

- 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.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product used on the project.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

- A. Regulatory Requirements: 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.

B. Listing Criteria as Applicable:

1. UL 514A – Metallic Outlet Boxes.
2. UL 514B – Conduit, Tubing, and Cable Fittings.
3. UL 514C – Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
4. UL 514D – Cover Plates for Flush-Mounted Wiring Devices.
5. UL BGUZ – Junction and Pull Boxes.
6. UL QCIT – Metallic Outlet Boxes.
7. UL QCMZ – Nonmetallic Outlet Boxes.

2.2 CONDUIT BODIES

- A. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point.
- B. Listed and labeled for type of conduit, location, and use. Refer to Section 260533.13 “Conduits for Electrical Systems” for conduit types and fittings used on the project.
- C. Use mogul type (with rollers) for metal conduit bodies sizes 2-1/2 inch and larger by Appleton Electric.

2.3 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

- A. Outlet and Device Box Description: Box having pry out openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover. Outlet boxes do not include provisions to mount devices. Device boxes include provisions to mount a device to the box.
- B. Extension Ring Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.
- C. Pressed Steel Boxes: Hot dipped galvanized with hot-dipped galvanized tile rings. For use when recessed in walls or indoors exposed in non-process ceiling areas.
 1. Lighting outlet boxes: 4-11/16-inch square, 2 1/8 inch deep, minimum.
 2. Device boxes with electronics device (i.e. smart switch or receptacle, occupancy sensor, dimmer, etc.): Largest size for number of gangs required.
- D. Cast Boxes: Type FD (deep) only. Type FS not permitted. malleable iron with zinc finish. PVC coated when used with PVC coated conduits. Gasketed cover when used outdoors. Stainless steel screws for covers.
- E. Explosionproof Type Box for Class 1, Division 1 Areas: malleable iron with zinc finish. PVC coated when used with PVC coated conduits. Internal ground screw and O-ring. Pry notches on cover for bar or wrench.
- F. Pedestal Device Boxes: Cast aluminum, polished finished. Used for laboratory bench receptacles.
- G. Floor Boxes: Concrete tight. Number and type of devices as indicated on Drawings.

2.4 NONMETALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

- A. Outlet and Device Box Description: Box having pry out openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover. Outlet boxes do not include provisions to mount devices. Device boxes include provisions to mount a device to the box.
- B. Only allowed in conjunction with PVC schedule 80 exposed conduit installations.
- C. Type FD (deep) box only. Type FS (shallow) box not allowed.

2.5 JUNCTION BOXES AND PULL BOXES

- A. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable. Boxes that contain terminals, relays, surge protective devices, or devices mounted on the cover are specified under Section 262716 “Electrical Cabinets and Enclosures”.
- B. NEMA 1 and NEMA 12 Junction and Pull 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, hinged, fastened with quick connect door clamp.
- C. NEMA 4X Junction and Pull 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, hinged, fastened with quick connect door clamp.
- D. NEMA 4X Chemical Area Junction and Pull Boxes: When Drawings classify the area as CORROSIVE, ultraviolet resistant fiberglass reinforced plastic (FRP) with stainless steel hardware and gasketed covers.
- E. NEMA 6/6P Junction and Pull Boxes: When Drawings call out for NEMA 6 (temporary submersion at limited depth) or NEMA 6P (prolonged submersion at limited depth), die cast aluminum or nonmetallic, coordinated with conduit material.
- F. NEMA 7/4 Junction and Pull Boxes: When Drawings classify the area for Class 1, Division 1, Group D hazardous area, cast aluminum, cover gasket to meet NEMA 4 requirements, stainless steel hinged cover, stainless steel bolts. Crouse-Hinds Type EJB or equal.

2.6 COVER PLATES FOR DEVICES BOXES

- A. Single Source: Obtain wall plates from same manufacturer of wiring device. Refer to Section 262726 “Wiring Devices” for requirements.
- B. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.

2. Material for Flush Mounted Devices in Indoor Administrative Spaces: Includes offices, conference rooms, break rooms, restrooms, and control rooms. Smooth, high impact thermoplastic or nylon. Color to match wiring device.
3. Material for Flush Mounted Devices in Indoor Industrial Spaces: Includes electrical rooms, mechanical rooms, janitor closets, and indoor process areas. Type 302 (18-8) high nickel stainless steel.
4. Material for Surface Mounted Devices: Match box material.

2.7 HOODS FOR OUTLET BOXES

- A. Description: Hood to mount to box for to create weatherproof while in use condition.
- B. Wet-Location, Weatherproof Cover Plates (Hoods) for Switches and Receptacles: NEMA 250, complying with Type 3R, in-use weather-resistance, die-cast aluminum with lockable cover.

PART 3 - EXECUTION

3.1 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Engineer for resolution of conflicting requirements.
- B. Conduit bodies: Match associated conduit type.
- C. Outlet boxes recessed in walls or indoors exposed in non-process ceiling areas: Pressed steel.
- D. Exposed outlet and device boxes: Cast metal except where PVC-80 is used. Use PVC coated cast metal when conduit is PVC coated. Use non-metallic when PVC-80 is used.
- E. Junction and pull boxes: Suitable for the location and conform to the NEMA enclosure ratings and material descriptions included on Drawings. Where no size is indicated, size in accordance with NEC Article 314.

3.2 INSTALLATION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Comply with manufacturer's published instructions.
- B. Special Installation Techniques:
 1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
 2. 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.
 3. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat

- surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.
4. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
 5. Locate boxes so that cover or plate will not span different building finishes.
 6. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
 7. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
 8. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
 9. Set metal floor boxes level and flush with finished floor surface.
 10. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
 11. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
 12. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
 13. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:
 - a. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
 - b. Provide gaskets for wallplates and covers.
 14. Identification: Install labels and nameplates in accordance with Section 260553 "Identification for Electrical Systems".
 15. .

3.3 CLEANING

- A. Remove construction dust and debris from boxes before installing wallplates, covers, and hoods.

3.4 PROTECTION

- A. After installation, protect boxes from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260533.16

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SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS 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: Manholes, handholes, and duct accessories.
- B. Products Installed, but Not Furnished, under This Section:
 - 1. Section 260533.13 "Conduits for Electrical Systems" for conduits.
 - 2. Section 260553 "Identification for Electrical Systems" for underground-line warning tape.
- 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. Division 03 for concrete and reinforcing steel.
 - 4. Division 31 for groundwater control, trenching, excavation and backfilling including gravel and sand bedding, and surface restoration.
 - 5. Division 33 for additional requirements associated with manholes and utilities.

1.3 DEFINITIONS

- A. Duct: A single raceway or multiple raceways, installed singly or as components of a duct bank.
- B. Duct Bank: Two or more ducts installed in parallel, direct buried or with additional casing materials such as concrete.
- C. Handhole: An underground chamber containing electrical cables, sized such that personnel are not required to enter in order to access the cables.
- D. Manhole: An underground chamber containing electrical cables and equipment, sized to provide access with working space clearances.
- E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include duct-bank materials, including spacers and miscellaneous components.
 - 2. Include accessories for manholes and handholes.
 - 3. Include underground-line warning tape.
- B. Shop Drawings:
 - 1. Handholes or Manholes:
 - a. Include plans, elevations, sections, details, and accessories.
 - b. Include duct entry provisions showing locations and duct sizes.
 - c. Include frame, cover, entry extensions if applicable, and grounding details.
 - d. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
 - 2. Underground Conduit Layouts: In accordance with Section 260533.13 "Conduits for Electrical Systems".

1.5 INFORMATIONAL SUBMITTALS

- A. Buoyancy calculations for manholes. Calculations must be signed and sealed by a qualified professional engineer.
- B. Field quality control reports.

PART 2 - PRODUCTS

2.1 CONDUIT AND FITTINGS

- A. Comply with Section 260533.13 "Conduits for Electrical Systems" for conduits and fittings.

2.2 DUCT ACCESSORIES

- A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
- B. Underground-Line Warning Tape: In accordance with Section 260553 "Identification for Electrical Systems."

2.3 PRECAST CONCRETE HANDHOLES AND BOXES

- A. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover must form top of enclosure and must have load rating consistent with that of handhole or box.
 - 1. Load Rating: Class H-20.
 - 2. Cover Legend: "ELECTRIC", unless otherwise indicated.
 - 3. Comply with details shown on Drawings.
- B. 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. Oldcastle Infrastructure.
- C. Comply with ASTM C858 "Standard Specification for Underground Precast Concrete Utility Structures" for design and manufacturing process.
- D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.4 POLYMER CONCRETE HANDHOLES AND BOXES WITH POLYMER CONCRETE COVER

- A. Description: Molded of sand, concrete, and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or combination.
 - 1. Load Rating: Class H-20.
 - 2. Cover Legend: "ELECTRIC", unless otherwise indicated.
 - 3. Comply with details shown on Drawings.
- B. 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. Oldcastle Polymer; Oldcastle Infrastructure.
 - 2. Quazite; Hubbell Power Systems.
- C. Standard: Comply with ANSI / SCTE 77 "Specification for Underground Enclosure Integrity".
- D. Color: Green.
- E. Configuration: Flush burial and open bottom unless otherwise indicated.

2.5 PRECAST MANHOLES

- A. Description: One-piece units and units with interlocking mating sections, complete with accessories, hardware, and features.
 - 1. Load Rating: Class H-20.

2. Cover Legend: "ELECTRIC", unless otherwise indicated.
 3. Comply with details shown on Drawings.
- B. 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. Oldcastle Infrastructure Inc.
- C. Comply with ASTM C858 for design and manufacturing process.
- D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in field. Notify Engineer if there is conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Engineer.
- C. Clear and grub vegetation to be removed, and protect vegetation to remain in accordance with Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication in accordance with Section 311000 "Site Clearing."

3.2 SELECTION OF UNDERGROUND DUCTS

- A. Direct Buried Duct: Type PVC-80 rigid non-metallic conduit, with RMC long radius sweep elbows.
- B. Concrete Encased Duct: Type PVC-40 rigid non-metallic conduit, with RMC long radius sweep elbows.
- C. Rigid Metal Conduit (RMC) type in accordance with Section 260533.13 "Conduits for Electrical Systems" with two coats of bitumastic paint or PVC coated where:
1. Direct buried conduit enters buildings, structures, and vaults (except manholes and handholes) with not less than a 10-foot length of conduit.
 2. Direct buried conduits run below floor slabs in slab-on-grade construction.
 3. Stub-ups outdoors or through concrete slabs.

3.3 EARTHWORK

- A. Excavation and Backfill: Comply with Section 312000 "Earthwork," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restoration: Restore area immediately after backfilling is completed or after construction vehicle traffic in immediate area is complete.
- C. Restore surface features at areas disturbed by excavation and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."
- E. Cut and patch existing pavement in path of underground duct, duct bank, and underground structures.

3.4 INSTALLATION OF DUCTS AND DUCT BANKS

- A. Reference Standards:
 - 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NEMA TCB 2 for installation of underground ducts and duct banks.
 - 2. Consult Engineer for resolution of conflicting requirements.
- B. General Requirements:
 - 1. Comply with installation requirements for conduits in Section 260533.13 "Conduits for Electrical Systems" and as supplemented herein.
 - 2. Ductbank routing and manhole / handhole locations indicated on Drawings are diagrammatically depicted. Coordinate with other utilities, yard piping, yard structures and field conditions to determine required paths and depths at no additional cost to Owner.
 - 3. Where conditions do not allow neat and consistent duct bank cross sections in accordance with Drawings due to existing underground conflicts, provide Engineer with proposed solution for approval that complies with minimum NEC installation cover requirements. For example, where the Drawings indicate direct buried PVC conduits are to be installed at a certain depth below finished grade, a concrete cap or concrete encasement may be permitted to achieve an equivalent protection. Do not deviate from Drawing details without Engineer approval.
 - 4. Reinforce ductbanks as indicated on Drawings. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
 - 5. 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.
 - 6. Plug conduit ends during and after installation to prevent water, mud, and debris from entering conduit.

7. After duct installation is complete and before any cables are pulled, remove obstructions using appropriately sized mandrel for conduits 2 inch and larger. Swab clean interior of all sized conduits. Refer to CLEANING Article.

C. Special Techniques:

1. Where indicated on Drawings, install duct, spacers, and accessories into duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.
2. Slope: Pitch duct minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from high point between two manholes to drain in both directions.
3. Curves and Bends: Use long radius elbows, sweeps, and offsets for 2 inch and larger conduits.
4. Joints: Use solvent-cemented joints in nonmetallic duct and fittings and make watertight in accordance with manufacturer's published instructions. Stagger couplings so those of adjacent duct do not lie in same plane.
5. Terminations at Manholes: Use end bells for PVC conduit and insulated throat grounding bushings with lay-in type lugs for RMC.
6. Building Wall Penetrations: Make transition from underground duct to RMC at least 10 feet outside building wall, without reducing duct line slope away from building and without forming trap in line. Use fittings manufactured for transition to RMC type installed. Install RMC penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
7. Underground-Line Warning Tape: Bury underground line specified in Section 260553 "Identification for Electrical Systems" above concrete-encased duct and direct buried duct banks as shown on detail Drawings. Align tape parallel to and within 3 inches of centerline of duct bank. Provide additional warning tape for each 12 inch increment of duct-bank width over nominal 18 inches. Space additional tapes 12 inches apart, horizontally across width of ducts.
8. Ground ducts and duct banks in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

D. Concrete-Encased Ducts and Duct Bank Special Techniques:

1. Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms as specified in Section 312000 "Earthwork" for pipes 6 inches or less in nominal diameter.
2. Depth: Install so top of duct envelope is as shown on detail Drawing.
3. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
4. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
6. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

- a. Start at one end and finish at other, allowing for expansion and contraction of duct as its temperature changes during and after pour. Use expansion fittings installed in accordance with manufacturer's published instructions or use other specific measures to prevent expansion-contraction damage.
 - b. If more than one pour is necessary, terminate each pour in vertical plane and install 3/4 inch reinforcing-rod dowels extending minimum of 18 inches into concrete on both sides of joint near corners of envelope.
7. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.
 8. Concrete Color: Red. Dye color added to concrete during batching; or dye mixed with water and applied to top of ductbank with a sprayer while concrete is wet (prior to curing); or raked into the exposed top layer of concrete.

E. Direct-Buried Duct and Duct Bank Special Techniques:

1. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Earthwork" for preparation of trench bottoms for pipes less than 6 inch in nominal diameter.
2. Depth: Install top of duct as shown on detail Drawing.
3. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
4. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to ducts to prevent floating during backfill. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
5. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earthwork" for installation of backfill materials.

3.5 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Reference Standards:

1. Precast Concrete Handholes: Comply with ASTM C891 unless otherwise indicated.
2. Consult Engineer for resolution of conflicting requirements.

B. Special Techniques:

1. Precast Concrete Handholes and Manholes:
 - a. Install units level and plumb and with orientation and depth coordinated with connecting duct to minimize bends and deflections required for proper entrances.
 - b. Unless otherwise indicated, support units on level bed of crushed stone or gravel graded from 1 inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
 - c. Field-cut openings for conduits in accordance with enclosure manufacturer's published instructions. Cut wall of enclosure with tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
2. Elevations:
 - a. Manhole Roof: Install with rooftop at least 15 inches below finished grade.
 - b. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
 - c. Install handholes with bottom below frost line.
 - d. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
 - e. Where indicated, cast handhole cover frame integrally with handhole structure.
3. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
4. Manhole Access: Circular opening in manhole roof; sized to match cover size.
 - a. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
 - b. Install chimney, constructed of precast concrete collars and rings, and cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight joints and waterproof grouting for frame and chimney.
5. Dampproofing: Apply dampproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Dampproofing materials and installation are specified in Section 071113 "Bituminous Dampproofing." After ducts are connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.
6. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.
7. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.
8. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in field. Use minimum of two anchors for each cable stanchion.
9. Ground manholes, handholes, and boxes in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Special Techniques:

1. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.
2. Unless otherwise indicated, support units on level bed of crushed stone or gravel, graded from 1/2 inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
3. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch above finished grade.
4. Install handholes and boxes with bottom below frost line.
5. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
6. Field cut openings for duct in accordance with enclosure manufacturer's published instructions. Cut wall of enclosure with tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
7. Ground handholes and boxes in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Nonconforming Work:

1. Underground ducts, raceways, and structures will be considered defective if they do not pass tests and inspections.
2. Correct deficiencies and retest as specified above to demonstrate compliance.

C. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

3.8 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump, and building interiors affected by Work.

1. Sweep floor, removing dirt and debris.
2. Remove foreign material.

END OF SECTION 260543

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

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. Round sleeves.
2. Rectangular sleeves.
3. Conduit sealing bushings.
4. Sleeve-seal systems.
5. Sleeve-seal fittings.
6. Grout.
7. Pourable sealants.
8. Foam sealants.

- 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 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

- A. Steel Wall Sleeves:

1. General Characteristics: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.
- B. Cast-Iron Wall Sleeves:
 1. General Characteristics: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral double waterstop. OZ-Gedney type WSK Thru Wall Floor Seal or equal for new installations with poured concrete.
- C. PVC Pipe Sleeves:
 1. General Characteristics: ASTM D1785, Schedule 40.
- D. PVC Molded Sleeves:
 1. General Characteristics: With nailing flange for attaching to wooden forms.
- E. PE or PP Molded Sleeves:
 1. General Characteristics: Removable, tapered cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Round, Galvanized-Steel, Sheet Metal Sleeves:
 1. General Characteristics: Galvanized-steel sheet; thickness not less than 0.0239 inch; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.2 RECTANGULAR SLEEVES

- A. Rectangular, Galvanized-Steel, Sheet Metal Sleeves:
 1. General Characteristics:
 - a. Material: Galvanized sheet steel.
 - b. Minimum Metal Thickness:
 - 1) For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness is to be 0.052 inch.
 - 2) For sleeve cross-section rectangle perimeter not less than 50 inches or with one or more sides larger than 16 inches, thickness is to be 0.138 inch.

2.3 CONDUIT SEALING BUSHINGS

- A. General Characteristics: Malleable iron collar, one piece neoprene sealing ring, stainless steel hardware, designed for field assembly, to prevent passage of fluids and gases as conduits pass through walls and function as a sleeve-seal system. Rated for Class 1, Division 2 locations. OZ-Gedney CSB Series or CSM Series, or equal, depending upon application.

2.4 SLEEVE-SEAL SYSTEMS

- A. General Characteristics: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.
- B. Options:
 - 1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Stainless steel.
 - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.5 SLEEVE-SEAL FITTINGS

- A. General Characteristics: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit must have plastic or rubber waterstop collar with center opening to match piping OD.

2.6 GROUT

- A. General Characteristics: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
 - 1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
 - 2. Design Mix: 5000 psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.7 POURABLE SEALANTS

- A. Performance Criteria:
 - 1. General Characteristics: Single-component, neutral-curing elastomeric sealants of grade indicated below.
 - a. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2.8 FOAM SEALANTS

- A. Performance Criteria:
 - 1. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion cannot damage cables or crack penetrated structure.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:
1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 3. Size pipe sleeves to provide 1/4 inch annular clear space between sleeve and raceway or cable, unless sleeve-seal system is to be installed or seismic criteria require different clearance.
 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Wall Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- C. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve-seal systems. Size sleeves to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- E. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

- A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.

- B. Install conduits and cable with no crossings within the sleeve.
- C. Fill opening around conduits and cables with expanding foam without leaving voids.
- D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.3 INSTALLATION OF CONDUIT SEALING BUSHINGS

- A. Install where a sleeve-seal system or seal-fitting installation is required in an NEC Class 1, Division 2 hazardous location.

3.4 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.5 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

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SECTION 260553 - IDENTIFICATION 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: Identification products along with color and legend 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.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Note that not all products listed may be utilized on this project.
- B. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1 and IEEE C2.
- B. Comply with 29 CFR 1910.144 for color identification of hazards; 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs and tags; and the following where applicable:
 - 1. Fire-protection and fire-alarm equipment must be finished, painted, or suitably marked safety red.
 - 2. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than 7.7 feet above finished floor.

- C. Signs, labels, and tags required for personnel safety must comply with the following standards:
 - 1. Safety Colors: NEMA Z535.1.
 - 2. Facility Safety Signs: NEMA Z535.2.
 - 3. Safety Symbols: NEMA Z535.3.
 - 4. Product Safety Signs and Labels: NEMA Z535.4.
 - 5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.
- D. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 degrees F, ambient; 180 degrees F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed for conductors.
 - 1. Color must be factory applied or field applied for sizes larger than 8 AWG.
 - 2. Colors for 208Y/120 V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral: White.
 - 3. Colors for 240/120 V Circuits (Single Phase):
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Neutral: White.
 - 4. Colors for 240 Δ /120 V Circuits (Three Phase, Four Wire, High Leg, Center Tap):
 - a. Phase A: Black.
 - b. Phase B: Orange (high leg).
 - c. Phase C: Blue.
 - d. Neutral: White.
 - 5. Colors for 480Y/277 V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - d. Neutral: Gray.

6. Colors for DC Circuits:
 - a. Positive: Red.
 - b. Negative: Black.
 7. Color for Equipment Grounding Conductors: Green.
- B. Color-Coding for Phase- and Voltage-Level Identification, Over 1000 V: Use double colors listed for conductors.
1. Colors for 5 kV Rated Circuits:
 - a. Phase A: Black/Red.
 - b. Phase B: Red/Red.
 - c. Phase C: Blue/Red.
 2. Colors for 15 kV Rated Circuits:
 - a. Phase A: Brown/Red.
 - b. Phase B: Orange/Red.
 - c. Phase C: Yellow/Red.
 3. Color for Equipment Grounding Conductor (600V rated): Green.
- C. Warning Label Colors:
1. Identify system voltage with black letters on orange background.
- D. Warning labels and nameplates/signs must include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
- E. Equipment Identification and Source Nameplate:
1. Color: Black letters on a white field.
 2. Material: See NAMEPLATES Article.
 3. Equipment furnished under Divisions 26, 27, 28 and equipment control panels furnished under other Divisions must include equipment identification nameplates. Equipment includes, but is not limited to switchgear, switchboards, motor control centers, panelboards, transformers, disconnect switches, separately mounted motor controllers, transfer switches, control panels, and named enclosures or cabinets. Nameplate to match designation indicated on Drawings.
 4. Power source must be identified at all applicable equipment. Nameplate may be separate from identification nameplate or information may be contained on one nameplate. For example, a local disconnect switch for a pump motor could have one nameplate reading "EFFLUENT PUMP NO. 4" for the identification nameplate and a second nameplate reading "FED FROM MCC-2". Or a two-line nameplate combining the information for both identification and source.

F. Device Identification Labels:

1. Color: Black letters on a white field..
2. Material: Self-adhesive type, machine generated, 1/4 inch high letters.
3. Devices to be labeled with panel and branch circuit number include receptacles, wall switches, lighting fixtures, photocells, emergency lights, exit lights, instruments, etc. For example, a light switch powered from panelboard LP-2 and branch circuit 4 would have the label “LP-2/4” or “LP-2/CKT 4”.

2.3 NAMEPLATES

A. Material:

1. Engraved, engraved plastic (lamicoid).
2. Minimum size: Not less than 1/16 inch thick by 3/4 inch high by 2-1/2 inches wide.
3. Lettering: Upper case, 3/16 inch high minimum.

2.4 LABELS, BANDS, TUBES, AND SLEEVES

A. Self-Adhesive Wraparound Labels: Machine-printed, 3 mil thick, polyester or vinyl flexible label with acrylic pressure-sensitive adhesive. Printed text is black, permanent, and waterproof.

1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over legend. Labels sized such that clear shield overlaps entire printed legend.

B. Self-Adhesive Labels: Polyester or Vinyl, thermal, transfer-printed, 3 mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

C. Heat-Shrink Preprinted Tubes (Sleeve Type): Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 degrees F. Comply with UL 224. Printed text is black, permanent, and waterproof.

2.5 TAPES

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil thick by 1 to 2 inches wide; compounded for outdoor use.

C. Underground-Line Warning Tape:

1. Tape:
 - a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape must be permanent and may not be damaged by burial operations.

- c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
2. Color and Printing:
 - a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
 - b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".
 - c. Inscriptions for Orange Tapes: "CAUTION BURIED COMMUNICATION LINE BELOW".
 3. Detectable Tape:
 - a. Detectable three-layer laminate, consisting of printed pigmented polyolefin film, solid aluminum-foil core, and clear protective film that allows inspection of continuity of conductive core; bright colored, continuous-printed on one side with inscription of utility, compounded for direct-burial service.
 - b. Width: 6 inches.
 - c. Overall Thickness: 5 mil.
 - d. Foil Core Thickness: 0.35 mil.

2.6 TAGS

- A. Metal Tags: Embossed, Type 316 stainless steel, 0.01 inch thick, punched for use with tie fastener. Secure with 0.048 inch diameter stainless steel band fastened with compression wire clamps
- B. Nonmetallic Preprinted Tags: Polyester or Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory screened permanent designations; punched for use with self-locking cable tie fastener.

2.7 CABLE TIES

- A. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength at 73 degrees F in accordance with ASTM D638: 12,000 psi.
 3. Temperature Range: Minus 40 to plus 185 degrees F.
 4. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Nameplates/Signs: Self-tapping, stainless steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 SELECTION OF IDENTIFICATION PRODUCTS

- A. Power-Circuit Conductor Identification, 1000 V or Less: For conductors at termination points and in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive vinyl tape if conductor is not factory colored to identify phase, neutral, and ground conductors. Use self-adhesive labels to identify circuit.
- B. Power-Circuit Conductor Identification, More Than 1000 V: For conductors at termination points and in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive vinyl tape to identify phase conductors. Use nameplate or nonmetallic tag secured with cable ties to indicate phase and indicate circuit designation.
- C. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with conductor or cable designation, origin, and destination.
- D. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes or self-adhesive labels with conductor designation.
- E. Spare Conductors or Cables: Attach nonmetallic tags or self-adhesive labels to conductors and list source.
- F. SCADA Systems, Communication Systems, Fire Alarm Systems or Other Auxiliary Electrical Systems Conductor Identification: For identification at terminations, provide heat-shrink preprinted tubes or self-adhesive labels with conductor designation.
- G. Conduit Identification: For designated identification as indicated on Drawings provide metal tags.
- H. Pull Boxes and Junction Boxes, 24 inches by 24 inches and Larger: For voltage identification provide nameplates using 1 inch high minimum letters, white letters on red background.
- I. Equipment Identification: For identification and source information provide nameplate(s) per COLOR AND LEGEND REQUIREMENTS Article.
- J. Device Identification: For source and circuit information provide self-adhesive label per COLOR AND LEGEND REQUIREMENTS Article.

3.3 INSTALLATION

- A. Install identification product in accordance with manufacturer's instructions.

- B. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Verify identity of item before installing identification products.
- E. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- F. Apply identification devices to surfaces that require finish after completing finish work.
- G. Apply wire markers so entire designation is clearly visible.
- H. Install Arc Flash Labels in accordance with Section 250573 "Power System Studies".
- I. Identify the system voltage (e.g. 208/120 VOLTS, 480 VOLTS, 4160 VOLTS) at the covers of large pull boxes or junction boxes.
- J. Install field device (instruments, receptacles, switches, etc.) labels.
- K. Install equipment nameplates. Nameplate fastening requirements:
 - 1. NEMA 1 and 12 Enclosures: Screw mounted using stainless steel screws.
 - 2. Other Enclosure Types: Bonded using epoxy or similar permanent waterproof adhesive. Two sided foam adhesive tape is not acceptable.
- L. Panelboard and Transformer Panel Assembly Identification:
 - 1. Provide equipment identification nameplates as previously described.
 - 2. Label branch circuit phase and neutral wires with associated pole number using self-adhesive labels or type written sleeve type labels.
 - 3. Install typed as built circuit directory listing with unique load identification.
- M. Underground Line Warning Tape:
 - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in common trench or concrete envelope exceeds 18 inch overall.
 - 2. Install underground-line warning tape for direct-buried cables and cables in raceways.
- N. Install Tags. Fastening Requirements:
 - 1. Secure metal tags using stainless steel ties.
 - 2. Secure nonmetallic tags with UV-stabilized cable ties.

END OF SECTION 260553

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SECTION 260573 - POWER SYSTEM STUDIES

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. Motor starting report.
 - 4. Arc flash report..
- B. Study encompasses the modifications to the power distribution system of the City of Rome Water Resource Recovery Facility. Facility is located in Oneida County, NY.
- C. Study includes the modifications to the power distribution system. Equipment included, but not limited to:
 - 1. Switchgear, switchboards, and panelboards.
 - 2. Motor control centers.
 - 3. Variable frequency controllers.
 - 4. Disconnect switches.
 - 5. Transfer switches.
 - 6. 480V control panels.
- D. 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.
- E. 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. Motor Starting.
 6. Arc Flash Hazard Analysis.
 7. Harmonic Analysis.
 8. Utility Data.
 9. 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 MOTOR STARTING

- A. Comply with IEEE 141 (new IEEE 3001 series) for recommended light flicker limits and IEEE 3002.7 for motor starting studies.
- B. Provide motor starting study for all large electric drives (100 horsepower and larger). Include all operating modes.
- C. Identify any concerns about voltage drop or power inrush limitations due to the starting of motors.

2.7 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. 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.
- I. Provide arc flash label sample with preliminary report.
- J. Do not be print the labels until equipment is energized and protective devices set according to the approved final protective device coordination study.

2.8 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.
- 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 260800 - COMMISSIONING OF 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 procurement of the services of an Electrical Testing Firm Supplier (ETFS) to provide all materials, equipment, labor, and services required to achieve a fully commissioned electrical system.
- B. The intent of the Section is to:
 - 1. Provide electrical system construction planning.
 - 2. Provide summary qualifications of the testing firm.
 - 3. Summarize division of responsibility for electrical commissioning.
 - 4. Define additional testing, inspections, and adjustments.
- C. The following Division 26 Sections include testing and/or settings requirements:
 - 1. Section 260516 "Low-Voltage Electrical Power Conductors and Cables".
 - 2. Section 260523 "Control-Voltage Electrical Power Cables".
 - 3. Section 260526 "Grounding and Bonding for Electrical Systems".
- D. Other Divisions include electrical testing requirements for equipment with electrical components. These include:
 - 1. Automation Equipment – Division 40.
 - 2. Process Mechanical Equipment and Associated Motors – Divisions 40 through 46.
- E. 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. Electrical Testing Firm Supplier (ETFS): The firm responsible for providing specialty and independent testing and adjustments of electrical systems on the project..
- B. Low Voltage: 600 V and below.

- C. Maintenance of Plant Operations (MOPO): A construction plan which prevents or limits process disruptions during construction.
- D. Medium Voltage (MV): 601 V and above.
- E. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they mean "as-built" systems, assemblies, subsystems, equipment, and components.

1.4 MEETINGS

- A. Conduct a project kickoff coordination meeting within two weeks after submitting the MV Master Project Plan. The purpose of the meeting is to discuss the ETFS's MV Master Project Plan, regarding installation and testing associated with the medium voltage system.
- B. Hold meeting at Owner's designated location. Attendance to include representatives of the Owner, Engineer, Contractor (general, electrical, EFTS), and Equipment Manufacturer(s).
- C. As MV system construction is done in phases, hold additional meetings as required during construction. The purpose of these meetings are to ensure MOPO and safety by proper planning of upcoming construction and testing activities.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For electrical testing firm supplier (ETFS) and personnel intended for the project.
- B. Field Quality-Control Reports:
 - 1. Table of contents / Executive summary.
 - 2. Test procedures and equipment used, include calibration dates.
 - 3. Test results that comply with requirements.
 - 4. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
 - 5. Typed test forms, no handwritten entries.
- C. Certification that all relays on MV equipment have been adjusted to the power system study final approved setting.
- D. Certification that all adjustable circuit breakers have been adjusted to the power system study final approved setting.
- E. Certification that arc flash labels that correspond to the final approved power system study have been applied.

1.6 ACTION SUBMITTALS

- A. MV Master Project Plan.

1. Submit, within 60 calendar days after Notice to Proceed, the MV Master Project Plan. Plan to include the following:
 - a. Informational submittal qualification data.
 - b. Detailed construction phasing for the MV system.
 - c. Required shutdowns and estimated durations.
 - d. Temporary power plans for MOPO.

B. Additional MV Project Plans.

1. Submit, no later than 30 calendar days prior to a requested MV system shutdown, a MV Project Plan for upcoming shutdown activities. Plan to include the following:
 - a. Shutdown and Re-Energization Switching Procedures. Shutdown Procedures will include areas intended to be shutdown, expected duration of shutdown, staffing, safety plans, one line diagrams showing associated breakers or switches with their status (opened, closed, racked out, temporary grounds) and lockout-tagout locations. Re-Energization Procedures will include same information as Shutdown Procedures, but also phasing and rotation check locations upon re-energization.
 - b. Failure to submit plan in a timely manner will cause the shutdown to be rescheduled.

C. Switchgear and Generator Test Plan.

1. Submit, no later than 30 calendar days prior to first equipment start-up, a plan for operational checks.

D. Power Monitoring / SCADA Verification Plan.

1. Submit, no later than 30 calendar days prior to substantial completion, the list of SCADA points to confirm. Confirmation of actual data (i.e. the breaker is open/closed; amps / volts / kVA readings are correct) is to be done when load is running.

1.7 QUALITY ASSURANCE

- A. ETFS Qualifications: Corporately and financially independent testing organization, to provide unbiased test results, and is professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm. Firm must have not only electrical technicians on staff, but also electrical engineers. The ETFS, may be but is not required to be the same firm as the power system study supplier.
- B. ETFS: Electrical Engineer Qualifications: Senior level electrical engineer, experienced in medium voltage industrial electrical systems with source transfer switchgear.
- C. ETFS Electrical Technician Qualifications: NETA or ETT Certified Technician Level III or NICET Electrical Power Testing Level II Certification.

1.8 DIVISION OF RESPONSIBILITY

- A. Electrical Contractor Responsibilities Include:

1. Routine insulation-resistance, continuity, and rotation checks prior to and in addition to manufacturer or EFTS testing.
2. Transformer voltage checks and adjustment of taps.
3. Phasing checks across tie breakers and transfer switches.
4. Motor rotation and ampacity checks, overload settings, field test reports.
5. Provide suitable and stable source of electrical power required for testing.
6. Coordination and scheduling with Owner, Engineer, Equipment Manufacturers/Suppliers, and ETFS.
7. Obtain the power system study. Engineer must review and approve study prior to placing any new equipment in service.

B. Equipment Manufacturer Responsibilities:

1. Installation checks and testing as listed per individual Section.

C. ETFS Responsibilities:

1. Installation checks and testing as listed per individual Section.
2. Switchgear and Generator commissioning as a system.
3. Verification of correct power monitoring on the SCADA system.
4. Setting and adjustments to protective devices and adjustable circuit breakers per the final approved power system study.
5. Installation of arc flash labels.
6. Final infrared testing as listed per individual Section of all new, relocated, or re-terminated equipment.

D. Additional Testing, Inspections, and Adjustments:

1. Infrared testing of non-modified equipment is not included / required.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL TESTING REQUIREMENTS

- A. Field testing and commissioning is intended to follow the latest revisions of NETA Standard ATS, ECS, and MTS as applicable unless otherwise modified in these Sections.
- B. Site standard phase rotation is clockwise. That is when phases A, B, C are connected to terminals 1, 2, 3 the phase rotation will be clockwise. If phase rotation must be corrected, it should be done at the end device, i.e. the motor.
- C. Where two in-house potential sources are present and may be connected, regardless of the safety interlocks provided, testing to verify correct phasing is required. Without checking this, one source may have clockwise rotation with a 123-ABC and the second source may have a clockwise rotation with a 123-BCA installation. A three-phase short would result if safety

interlocks fail and these two sources are connected inadvertently. Hot phase testing is required at all two source locations.

3.2 FIELD QUALITY CONTROL

- A. Verify electrical equipment and systems have been tested in compliance with Contract Documents.
- B. Provide reports.

END OF SECTION 260800

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SECTION 262416 - PANELBOARDS

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. Power panelboards.
2. Lighting and appliance branch circuit panelboards.
3. Load centers.
4. Circuit breakers.
5. Accessories and special construction.

- 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 264313 "Surge Protection for Low-Voltage Electrical Power Circuits" for performance requirements of factory installed SPDs.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product used on project. Note this Section may include products not required for the project.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

- B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.

4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for SPD as installed in panelboard.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Key interlock scheme drawing and sequence of operations.
10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Include Internet link for electronic access to downloadable PDF of coordination curves.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. Include the following:
 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.
- B. Warranty documentation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to equipment manufacturer restrictions listed in Section 260010 "Supplemental Requirements for Electrical", panelboards from the following manufacturers are approved:
 1. Eaton.
 2. GE by ABB.
 3. Siemens.
 4. Square D by Schneider Electric.
- B. Source Limitations:
 1. Obtain new panelboards from single source from single manufacturer.
 2. Obtain retrofit disconnecting and overcurrent protective devices from existing panelboard manufacturer or subsequent responsible manufacturer, to maintain overall UL listing of panelboard.

2.2 GENERAL REQUIREMENTS

- 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. NEMA PB 1, Panelboards.
 - 2. UL 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
 - 3. UL 50E, Enclosures for Electrical Equipment, Environmental Considerations.
 - 4. UL 67, Standard for Panelboards, CCN QEUY.
 - 5. UL 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
 - 6. UL 1449, Surge Protective Devices.
- C. Ratings:
 - 1. Ratings are indicated on the Drawings.
 - 2. Series rated panelboards are prohibited. Circuit breakers must be fully rated for the short circuit rating listed for the panelboard.
- D. Construction:
 - 1. NEMA1 enclosure, unless noted otherwise on Drawings. See ACCESSORIES AND SPECIAL CONSTRUCTION Article for enclosures other than NEMA 1.
 - 2. Copper equipment grounding bar, separate and distinct from neutral bar.
 - 3. Conductor Lugs:
 - a. Mechanical type.
 - b. Size suitable for indicated conductor sizes.
 - c. Neutral (when present) and ground lug quantity equal to each pole in panelboard.
 - 4. Where Drawings indicate space for future circuit breaker, equip panelboard with bus bars, blank covers, and mounting hardware so only the future breaker need be provided.
- E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearance between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

2.3 POWER PANELBOARDS

- A. Manufacturer's power distribution panelboard using molded-case bolt-on circuit breakers, where available. Drawing designation using "PP" or "DP".
- B. Doors: Hinged cover or door-in-door trim when available. Secure door with flush keyed lock and catch, except doors over 36 inches in height to use a vault-type latch with tumbler lock and 3-point catch. All locks keyed alike.
- C. Bus: Tin-plated copper.

2.4 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

- A. Manufacturer's lighting and appliance panelboard using molded-case bolt-on circuit breakers.
- B. Doors: Door-in-door construction with concealed hinges; secured with flush keyed lock and catch, except doors over 48 inches in height to use a vault-type latch with tumbler lock and 3-point catch. All locks keyed alike.
- C. Bus: Tin-plated copper.

2.5 LOAD CENTERS

- A. Manufacturer's load center using molded-case plug-on circuit breakers.
- B. Load center type construction when indicated on Drawings.
- C. Doors: Concealed hinges secured with flush latch with tumbler lock; keyed alike.

2.6 CIRCUIT BREAKERS

- A. Molded case, manufactured by panelboard manufacturer.
- B. Plug-in or bolt-on as listed in associated panelboard Article.
- C. Configuration, frame size, trip, and special features such as GFCI (Class A trip, 4-6 mA) or GFI (Class B trip, 30 mA) as shown on Drawings.
- D. Provide breaker lugs to accommodate wire sizes shown on Drawings.
- E. Multi-pole breakers to have common trip. Do not convert single pole breakers to multi-pole using handle ties, use multi-pole breaker.
- F. Thermal-Magnetic Circuit Breakers:
 - 1. Inverse time-current element for low-level overloads.
 - 2. Instantaneous magnetic trip element for short circuits.
 - 3. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- G. Electronic Trip Circuit Breakers:
 - 1. RMS sensing.
 - 2. Field-replaceable rating plug or electronic trip.
 - 3. Adjustable trip functions as indicated on Drawings.

2.7 ACCESSORIES AND SPECIAL CONSTRUCTION

- A. Accessories such as breaker lockout devices or key interlocks are indicated on the Drawings.
- B. Integral Surge Protective Device:

1. By panelboard manufacturer, factory installed.
 2. Type 2.
 3. SCCR: Equal to SCCR of panelboard where installed.
 4. Performance: Comply with Section 264313 “Surge Protection for Low-Voltage Electrical Power Circuits”.
- C. Electronic Grade:
1. Integral SPD.
 2. Neutrals: 200 percent rated.
- D. NEMA 3R or 12 Enclosure:
1. Material: galvanized steel.
- E. NEMA 4X Enclosure:
1. Material: 316 stainless steel.
 2. When available, 3-point latch door.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- 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 requirements are specified in Contract Documents or manufacturer’s published instructions, comply with the following:
 1. ANSI/NEMA PB 1.1 – General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
 2. NECA NEIS 407 – Standard for Installing and Maintaining Panelboards.
- C. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment,

raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

D. Equipment Mounting:

1. Attach panelboard to the vertical finished or structural surface behind panelboard.
2. Mount back box plumb and level, and surface or flush mount as indicated on Drawings.
3. Mount surface-mounted panelboards to supports to allow a minimum of 1/2 inch air space between the box and the mounting surface.
4. Mount flush-mounted panelboards with front cover uniformly flush with wall finish and mating with back box.
5. Mount top of trim 72 inches above finished floor unless otherwise indicated.

E. Install circuit breakers not already factory installed. Rearrange circuit breakers to correspond to panel schedules shown on Drawings.

F. Tighten bolted connections and wiring connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

G. Install filler plates in unused spaces.

H. Plug abandoned or unused entry holes.

I. Do not leave cut off wires at breakers, neutral bar terminal, or ground bar terminal.

J. Identify panelboards in accordance with Section 260553 "Identification for Electrical Systems".

1. Identify equipment by name designation and fed from source nameplates.
2. Identify pole numbers.
3. Color code wiring.
4. Identify branch circuit phase and neutral wires by circuit number.
5. Provide as built typed panelboard directory.

K. Adjust circuit breakers with adjustable trips in accordance with the final approved submittal of Section 260573 "Power System Studies".

L. Install Arc Flash Labels in accordance with Section 260573 "Power System Studies".

3.3 FIELD QUALITY CONTROL

A. Perform checkout and testing activities recommended by and in accordance with manufacturer's instructions, NECA 407, and as specified herein. Correct deficiencies, make adjustments, and retest until requirements are met.

B. Visual and Mechanical Inspection:

1. Compare equipment nameplate data with Drawings and Specifications.
2. Inspect physical and mechanical condition.
3. Inspect anchorage, alignment, and grounding.
4. Verify unit is clean.

5. Verify breakers operate smoothly.

C. Electrical Tests:

1. Perform insulation resistance test on buswork in accordance with manufacturer's instructions.
2. Verify correct voltage and phasing at each panelboard.
3. Verify load currents are balanced across the three phases.

D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of panelboard connections for new or modified panelboards.

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 panelboards, at 11 months after Substantial Completion.
3. Prepare a certified report identifying panelboard checked and describing results of scanning. Include a notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

3.4 CLEANING

- A. Remove rubbish and debris from inside and around equipment. Vacuum clean interior.

END OF SECTION 262416

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SECTION 262419 - MOTOR CONTROL CENTERS

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.
- 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 260800 "Commissioning of Electrical Systems" for startup and commissioning of motor control centers.
 - 4. Section 262923 "Variable-Frequency Motor Controllers" for performance requirements associated with VFCs installed in motor control centers.
 - 5. Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits" for performance requirements of motor control center manufacturer provided SPDs.

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 each motor control center.
 - 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.

A. Seismic Qualification Data: Certificates, for MCCs, 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.

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.
 - c. Testing, adjusting, and programming RVSS and VFC motor controllers.
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.
 - c. Parameters set for RVSS and VFC motor controllers.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media/drive complete with data files.
3. Device address list.

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.
5. Control Power Transformers: One of each size furnished.
6. Control Relays: Two of each type and size furnished.
7. Starter Coils: Two for each size furnished.
8. Overload devices: Two for each size furnished.

B. Touchup paint: half-pint container of paint matching the enclosure exterior finish.

C. Closed-Door Racking Unit Handle: One for each MCC with closed-door racking.

D. Closed-Door Racking Unit Remote Operator and Control Pendant: One for each electrical room with closed-door racking.

E. One full function portable solid state circuit breaker test set.

F. One hand-held programming unit and interface cable to set/change network communication address for each device, adjust network parameters, display device information, and display monitored values. Require password protection for programming time / current set points and to perform functional testing of the phase and ground trip characteristics. The programmer shall be self-powered by an internal battery.

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 centers from the following manufacturers are approved:
 1. ABB – ReliaGear LV MCC.
 2. Eaton – Freedom Series.
 3. Rockwell Automation - Allen-Bradley CENTERLINE 2100.
 4. Schneider Electric - Square D Model 6.
 5. Siemens - tiastar.
- 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/277 V ac, three phase, fourwire, 60 Hz, solidly grounded. Service entrance requirement as indicated on Drawings. Where a neutral bus is indicated, provide 100 percent rating unless noted otherwise.
 2. Overall MCC Short Circuit Rating: 65 kA, rms symmetrical at 480 V unless noted otherwise on Drawings. 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. Enclosure: NEMA Type 1A enclosure unless otherwise indicated on drawings.
- B. 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.
 9. Where NEMA 3R enclosure is indicated or MCC is located in a non-conditioned area, provide thermostatically controlled space heaters, operating at 120 VAC and powered from internal control power transformer. Provide space heater in each vertical section to prevent condensation.
- C. Maximum Dimensions: As indicated on drawings.
- D. Exterior Enclosure Finish: Factory-applied finish in manufacturer's standard color over a rust-inhibiting primer on treated metal surface.
- E. Interior Enclosure Finishes:
1. Control and power cell compartment: high gloss white for easier visibility.
 2. Unpainted steel parts, plated for corrosion resistance.
- F. 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.
- G. 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.

H. 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.

I. 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.

J. Internal Communication for Intelligent MCC

1. Use industrial Ethernet Cat 5e (minimum) shielded cable, rated for 600V, and configured in a star topology to communicate to a central managed switch. Label cables at each termination point with origin and destination point.
2. Locate central managed switch in a separate prepared space.
3. Control and communication protocol: Ethernet/IP.
4. Supply motor starter, VFC, and soft starter unit with means to control and communicate via Ethernet and capable of monitoring at least two input points.
5. Barrier communication cable from the unit spaces and field wireway spaces.
6. Provide UPS/ battery backup to communications network to allow for ride-through for plant generator start and transfer.
7. Provide N+1 redundancy of communications power supplies to enable continued communication and control in the event of one power supply failure.
8. Motor starter units will have an electronic overload relay that includes monitoring of motor current and voltage.
9. VFC units will include monitoring of drive parameters such as current, voltage, and kW.
10. Provide an external RJ45 port for local interface to allow for local set-up with a hand held 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 I^2t settings.
 - 3. Adjustable instantaneous pick-up.
 - 4. Independently adjustable ground fault pick-up, delay and I^2t 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 I^2t settings.
 3. Adjustable instantaneous pick-up.
 4. Independently adjustable ground fault pick-up, delay and I^2t 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 SURGE PROTECTION

- A. Integral Surge Protective Device: To protect input AC line from transients.
1. By MCC manufacturer, factory installed, with integral disconnect.
 2. Type 2.
 3. SCCR: Equal to SCCR of MCC.
 4. Performance: Comply with Section 264313 “Surge Protection for Low-Voltage Electrical Power Circuits”.

2.8 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. Multi-speed and Reversing Starters: Provide two motor rated contactors mechanically and electrically interlocked so only one device may be energized at a time.
- D. Reduced Voltage Starters: Reduced voltage solid state (RVSS), six SCR, full wave type with adjustable current limit and voltage ramp to control starting torque, automatic load sensing to minimize energy consumption, line and load side surge protection and noise suppression, and

controlled deceleration adjustment to reduce effects of surges caused by centrifugal pump loads. Provide heat sinks and ventilation to remove heat from structure. Include a motor horsepower rated isolation contactor to positively disconnect line voltage when SCR control is off.

- E. 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.
- e. Over/under voltage.
- f. Voltage imbalance.
- g. Over/under power.

2. Diagnostic features:

- a. Percent full load amperes.
- b. Percent thermal capacity utilization.
- c. Voltage.
- d. Power.
- e. Energy.

3. Network Communications: No.

- F. Motor Protection and Management Relays:

2.9 VARIABLE FREQUENCY CONTROLLER UNITS

- A. Description: Combination circuit breaker/VFC unit, to provide integral disconnect, overcurrent protection, variable frequency motor control, overload protection, MCC-style. Comply with VFC performance as specified in Section 262923 “Variable-Frequency Motor Controllers” Articles RATINGS and ADJUSTABLE SPEED MOTOR CONTROL.
- B. Application and compatibility: Constant or variable torque as indicated by application. VFC to supply required full load current and torque to supplied driven equipment.
- C. VFCs rated <100> HP and below shall include an input line reactor. VFCs rated <110> HP and above shall be 18-pulse, buffered design with input phase shifting transformer. 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. 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 MCC enclosure and come factory wired.

- E. All VFCs shall include as a minimum an output dV/dT filter.
- F. 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 MCC enclosure and come factory wired.
- G. Controls and Indication: 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.
- H. 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.
- I. 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.
- J. Serial Communications Port: RS-485.

K. Network Communication / SCADA System Interface:

1. Control will be via hardwired signal.
2. Digital communication signal will utilize copper Ethernet cable using Modbus TCP/IP communications protocol. Communication between individual VFCs and SCADA system will be in a star configuration.
3. Provide 24 V dc UPS / battery backup to allow ride-through control during plant generator start and transfer, up to 60 second power interruption.

2.10 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 (octal) and bases.

2.11 INSTRUMENTATION AND METERING

A. Current Transformers: 600V, 5 A secondary, bar or window type, single secondary winding and secondary shorting device and in compliance with IEEE C57.13. Burden and accuracy shall be consistent with connected metering and relay devices.

B. Control Power Transformers: Two winding type, 120 Vac secondary, sized for additional load where indicated. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure. Mount in separate compartments for units larger than 3 kVA.

C. Digital Metering (Power Monitors): Provide as indicated on Drawings. Schneider Electric PowerLogic PM5000 Series or equal for basic multi-functioning metering. Locate top of power quality meter cubicle at 60-inches from bottom of MCC, plus or minus 6-inches. Include the following optional features:

2.12 INTEGRATED EQUIPMENT

A. Integrate the following equipment where shown on the Drawings.

- B. General Purpose Transformers: Open, dry type, in compliance with NEMA ST 20, UL 1561, and US Department of Energy. Include primary and secondary overcurrent protection in accordance with NEC using copper conductors for interconnecting wiring. Copper windings, 115 degree Celsius temperature rise. Configuration, kVA, and voltage shown on Drawings.
- C. Lighting and Appliance Panelboards: Factory wired from MCC internal mount transformer, main lug only, and in compliance with NEMA PB 1, UL 67, and UL 489. Tin plated copper bus, bolt on molded case branch circuit breakers, configuration and ratings shown on Drawings.
- D. Power Factor Correction Capacitors: Installed by MCC manufacturer, furnished by motor manufacturer.
- E. Lighting Contactors: Mechanically held, 120 Vac coil operator, suitable for tungsten, ballast, or resistive non-motor loads. Include overcurrent protection, control transformer and contact ratings and poles as shown on Drawings.

2.13 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 digital communications signal.
- C. Digital communication signal will utilize copper Ethernet cable using Modbus TCP/IP communications protocol..
- D. Provide 24 V dc UPS / battery backup to allow ride-through control during plant generator start and transfer, up to 60 second power interruption.

2.14 SOURCE QUALITY CONTROL

- A. Test and inspect equipment according to UL, NEMA, and manufacturer.
- B. 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.
- C. 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.

- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Upon delivery of MCCs 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. Provide equipment housekeeping pads as detailed on the Drawings.
- D. Bolt MCC floor sills directly to finished floor or equipment pad. Make structure level, plumb, and secure. Use 1/2-inch (minimum) anchor bolts. Provide necessary hardware and shims.
- E. Remove temporary lifting angles, lugs, and shipping braces. Touch up damaged paint finishes.
- F. 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.
- G. 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.
- H. Install conduits to prevent water from entering enclosure. Seal voids around conduit stub-ups.

- I. Neatly group field installed interior wiring by circuit using plastic tie wraps. Support circuit groups to avoid stress at terminations.
- J. Make wiring interconnections between shipping splits. Install bus splice plates.
- K. Tighten bolted connections and wiring connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- L. Switch operating handles located above 79 inches above operating floor to have operating arm extension.
- M. 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.
 - 3. Engage a qualified testing agency as defined in this Section to perform activities defined in Section 260800 "Commissioning of Electrical Systems".
- 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. Motor starting and stopping parameters for RVSS and VFC controllers as needed by the driven load and Owner requirements.

4. 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 AND TRAINING

A. Engage a factory-authorized service representative to demonstrate correct operation, adjust settings, and maintain MCCs to Owner.

B. Provide 8-hour man day[s] for instruction. Time instruction to cover all working shifts.

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 262726 - WIRING DEVICES

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 receptacles, toggle switches, cover plates, and cord and plug sets.
- 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 ACTION SUBMITTALS

- A. Product Data: For each type of product used on project. Note this Section may include products not required for the project.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

- B. Comply with the following standards and UL Category Control Number (CCN) listing criteria as applicable:
 - 1. UL 20, Standard for General-Use Snap Switches, CCN WMUZ.
 - 2. UL 498, Standard for Attachment Plugs and Receptacles, CCN RTRT.
 - 3. UL 894, Standard for Safety Switches for Use in Hazardous (Classified) Locations.
 - 4. UL 943, Standard for Ground-Fault Circuit-Interrupters (Class A), CCN KCXS.
 - 5. UL 1010, Standard for Safety Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations.
 - 6. ANSI/NEMA WD 6 for dimensional requirements for receptacles and plugs rated up to 60A and 600V.
 - 7. NEMA WD 1 for colors.
 - 8. Federal Specifications:
 - a. FS W-S-896 for switches.
 - b. FS W-C-596 for receptacles.
- C. Device Color:
 - 1. White: Devices located in administrative office areas, conference rooms, break rooms, restrooms, and control rooms.
 - 2. Gray: Devices located in electrical rooms, mechanical rooms, process areas, and outdoors.
- D. Wall Plate Color: For non-metallic covers, match device color.
- E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 INDUSTRIAL SPECIFICATION GRADE RECEPTACLES, 125V, 20A

- A. Duplex Receptacles, 125V, 20A
 - 1. Manufacturers or equal:
 - a. Arrow-Hart (Eaton), 5362 Series.
 - b. Hubbell, 5362 Series.
 - c. Leviton, 5362 Series.
 - 2. Description: Heavy duty, industrial, specification grade, two-pole, three-wire, and self-grounding, NEMA 5-20R.
- B. Duplex Weather-Resistant Receptacles, 120V, 20A. Drawing Designation: WP.
 - 1. Hubbell, HBL5362WR Series or equal.
 - 2. Description: Heavy duty, industrial, specification grade, weather-resistant, two-pole, three-wire, and self-grounding, NEMA 5-20R.
- C. Duplex GFCI Receptacles, 125V, 20A. Drawing Designations GFCI.
 - 1. Manufacturers or equal:

- a. Hubbell GF5362SG Series.
 - b. Arrow-Hart (Eaton) TWRS GF20 Series.
 - c. Leviton GFTR2-3L Series.
2. Description: Extra heavy duty, industrial, specification grade, tamper-resistant, weather resistant, ground-fault circuit-interrupter receptacle, two-pole, three-wire, and self-grounding, NEMA 5-20R. Integral GFCI with “Test” and “Reset” buttons. Three LED indicators: power solid green, GF/trip solid red, ending of life flashing red.

2.3 HAZARDOUS (CLASSIFIED) LOCATION DEVICES

A. Hazardous (Classified) Locations Receptacles and Switches. Drawing Designation: XP.

1. Enclosure Rating: NEC Hazardous Area Class I, Divisions 1 and 2, Groups C and D (NEMA 7) and wet locations.
2. Receptacle Description: Explosion-proof factory sealed, pin and sleeve receptacle, 20A, for use at 125 or 250V, two wire, 3 pole. Complete with cast box and matching plug. Appleton Contender CPS152 Series with matching cover and CPP plug or equivalent by Crouse-Hinds. With optional GFCI if noted on Drawing.
3. Switch Description: Explosion-proof factory sealed, control station switch, 20A, for use at 120/277V, single pole. Complete with cast box. Appleton Contender EDS Series or equivalent by Crouse-Hinds.

2.4 INDUSTRIAL SPECIFICATION GRADE TOGGLE SWITCHES, 120/277V, 20A

A. Manufacturers as listed below or equal.

1. Arrow-Hart (Eaton), 1220 Series.
2. Hubbell, HBL1220 Series.
3. Leviton, 1220 Series.

B. Description: Extra heavy duty, industrial, specification grade, switch, 120/277V, 20A, toggle action, flush mounting, quiet type. Single pole, double pole, three-way, or four-way, as indicated on Drawings.

2.5 WALL PLATES

- A. Match gang configuration as indicated on Drawings.
- B. Obtain wall plates from same manufacturer as wiring device.
- C. Plate-Securing Screws: Metal with head color to match plate finish.
- D. Material for administrative offices, conference rooms, break rooms, restrooms, and control rooms: Smooth, high impact thermoplastic or nylon.
- E. Material for flush mounted devices in electrical rooms, mechanical rooms, and indoor process areas: Type 302 (18-8) high nickel stainless steel.

- F. Material for surface mounted device plates: Same material as box.
- G. WP Receptacle Cover Plates: In-use weather-resistant, heavy duty UV-resistant polycarbonate with lockable cover.
- H. WP Switch Cover Plates: Weatherproof switch cover, listed to UL514D, non-metallic UV-resistant, operable without opening cover, lockable. Arrow-Hart (Eaton) S2983 or equal.

2.6 CORD AND PLUG SETS

- A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
- B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
- C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install devices in accordance with NFPA 70, manufacturer's instructions, and listing for each device.
- B. Install switch and receptacle outlets flush with finished wall for new wall construction and where existing wall is stud and sheetrock construction.
- C. Drawings show the general location of devices unless dimensioned. Adjust and coordinate location to avoid piping or other obstructions.
- D. Use of one GFCI receptacle to protect downstream conventional receptacles is prohibited.
- E. Device Mounting Heights (as measured to the center of the device box):
 - 1. Switches and occupancy sensors: 48 inches AFF, located on strike side of door.
 - 2. Wall receptacles, unless otherwise noted on Drawings:
 - a. Process areas and shops: 36 inches AFF.
 - b. Administration office areas: 18 inches AFF.
 - c. Corridors and hallways: 18 inches AFF.
 - d. Electrical and mechanical rooms: 18 inches AFF.
 - e. Restrooms: 18 inches AFF.
 - f. Above counters: 8 inches above countertop or at backsplash level.
 - g. Exterior walls: 24 inches AFG.
 - 3. Where walls are unplastered brick or masonry, adjust mounting height above so one horizontal edge of device box lines up with a horizontal joint in the masonry.

F. Device Boxes:

1. Install correct size and type box for the device(s) and location, allowing for adequate space for conductors, connectors, clamps, devices, and barriers, where required.
2. Install boxes level, plumb, and secure. Do not install boxes back-to-back in walls.

G. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install wiring devices after all wall preparation, including painting, is complete.

H. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. Provide adequate length of free conductors at boxes for devices without pigtails. Pigtailing existing conductors is permitted, provided the box is large enough.

I. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Make equipment grounding conductor connections and splices so removal or disconnection of any wiring devices does not interrupt continuity of the branch circuit equipment grounding conductor.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw. Do not overlap conductors.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. Tighten unused terminal screws on the device.
8. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

J. Orientation and Arrangement:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
2. Group adjacent switches under single, multi-gang wall plates.

K. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

3.2 IDENTIFICATION

- A. Label receptacles and switches with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."
- B. Label receptacles that are non-GFCI type but GFCI protected, such as from a GFCI circuit breaker, with a label "GFCI Protected".

3.3 FIELD QUALITY CONTROL

- A. Verify correct operation of GFCI receptacles using GFCI tester.
- B. Verify correct voltage and phasing at receptacles.
 - 1. Use receptacle circuit tester for NEMA 5-20R receptacles. Use voltmeter for other receptacles.
 - 2. Use phase sequence meter for three phase receptacles.
- C. Correct deficiencies found and reverify.
- D. Prepare field quality report certifying verification of correct installation.

END OF SECTION 262726

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. Control circuits.
 - b. Motor-control centers.
 - c. Panelboards.
 - d. Switchboards.
 - e. Enclosed controllers.
 - f. Enclosed switches.

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 electronic format suitable for use in coordination software and 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 017700 "Closeout Procedures," 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 electronic format suitable for use in coordination software and 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 or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bussmann; Eaton, Electrical Sector.
 2. Littlefuse, Inc.
 3. Mersen USA.
 4. Or approved equal.
- 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, time delay.
 4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC, time delay.
 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, very fast acting.
- 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. Feeders: Class J, time delay.
 2. Control Transformer Circuits: Class CC, time delay, control transformer duty.
 3. 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. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Molded-case switches.
7. 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 and not exceeding 104 deg F.
 2. Altitude: Not exceeding 6600 feet.

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 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 and the unit will be fully operational after the seismic event."

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, provide products by one of the following:
 - 1. Eaton.
 - 2. Siemens Industry, Inc., Energy Management Division.
 - 3. Square D; Schneider Electric USA.
 - 4. Or approved equal.
- B. Type HD, Heavy Duty:
 - 1. Single throw.
 - 2. Three pole.
 - 3. 600-V AC.
 - 4. 1200 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: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 240 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, provide products by one of the following:
 - 1. Eaton.
 - 2. Siemens Industry, Inc., Energy Management Division.

3. Square D; Schneider Electric USA.
 4. Or approved equal.
- 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. 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: TwoNO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 240-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 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton.
 2. Siemens Industry, Inc., Energy Management Division.
 3. Square D; Schneider Electric USA.
 4. Or approved equal.
- B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.
- D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated.

- E. MCCBs shall be equipped with a device for locking in the isolated position.
- F. Lugs shall be suitable for 90 deg C (194 deg F) rated wire, sized according to the 167 deg F temperature rating in NFPA 70.
- G. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- J. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I-squared t response.
- K. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- L. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- M. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (5-mA trip).
- N. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- O. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 - 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 - 6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

7. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
8. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
9. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

2.6 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 rated as required by the Contract Drawings.
- 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 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.
- F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

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 12.
 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. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections.
- E. 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."

F. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and clearances.
- d. Verify that the unit is clean.
- e. Operate the circuit breaker to ensure smooth operation.
- f. 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.
- g. Inspect operating mechanism, contacts, and chutes in unsealed units.

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. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker 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.
 - c. Perform a contact/pole resistance test. 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.
 - d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
 - e. Determine the following by primary current injection:
 - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
 - f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
 - g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
 - h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
 - i. Verify operation of charging mechanism. Investigate units that do not function as designed.
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.
- G. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- H. 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.
- B. Set field-adjustable circuit-breaker trip ranges to values indicated on the Drawings.

END OF SECTION 262816

SECTION 262913.06 - SOFT-START 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 soft-start motor controllers that are designed for reduced-voltage start and full-voltage run duty.
 - 1. Enclosed soft-start controllers.
 - 2. Combination soft-start controllers.
 - 3. Bypass motor controller.
 - 4. Enclosures.
 - 5. Accessories.
 - 6. Identification.
- 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. CPT: Control power transformer.
- B. FLA: Full-load current.
- C. MCCB: Molded-case circuit breaker.
- D. MCP: Motor circuit protector.
- E. NC: Normally closed.
- F. NO: Normally open.
- G. OCPD: Overcurrent protective device.
- H. SCCR: Short-circuit current rating.
- I. SCPD: Short-circuit protective device.

- J. SCR: Silicon-controlled rectifier.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

- B. Shop Drawings: For each type of controller.

- 1. Include plans, elevations, sections, and mounting details.
- 2. Indicate dimensions, weights, required clearances, and location and size of each field connection.
- 3. Wire Termination Diagrams and Schedules: Include diagrams for signal and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
- 4. Include features, characteristics, ratings, and factory settings of individual OCPD and auxiliary components.

- C. Product Schedule: For each enclosed controller.

- 1. Each installed soft-start controller type.
- 2. Nationally Recognized Testing Laboratory (NRTL) listing.
- 3. Factory-installed accessories.
- 4. Nameplate legends.
- 5. SCCR of integrated unit.
 - a. For each combination soft-start controller, include features, characteristics, ratings, and factory setting of the SCPD and OCPD.
 - 1) Listing document proving Type 2 coordination.
 - b. For each series-rated combination, state the listed integrated SCCR (withstand) of SCPDs and OCPDs by an NRTL acceptable to authorities having jurisdiction.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.

- B. Seismic Qualification Data: Certificates, for soft-start controllers, 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. Source quality-control reports.
- D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For soft-start controllers to include in operation and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Routine maintenance requirements for soft-start controllers and installed components.
 - b. Manufacturer's written instructions for testing and adjusting circuit-breaker and MCP trip settings.
 - c. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage soft-start controllers.
 - d. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate FLAs.
 - e. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

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 for Fused Switches: 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.
 - 4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
 - 5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed..

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store soft-start controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect soft-start controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover soft-start controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least per controller.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than 32 deg F and not exceeding 104 deg F, humidity noncondensing.
 - 2. Altitude: Not exceeding 3300 feet.
 - 3. The effect of solar radiation is insignificant..

PART 2 - PRODUCTS

2.1 MOTOR CONTROLLER PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. UL Compliance: Fabricate and label enclosed controllers to comply with UL 508.
- C. NEMA Compliance: Fabricate motor controllers to comply with NEMA ICS 2.
- D. Seismic Performance: Soft-start controllers 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 when subjected to the seismic forces specified."
 - 2. Component Importance Factor: 1.0.

2.2 ENCLOSED SOFT-START MOTOR CONTROLLERS

- A. Description: Controllers designed for reduced-voltage start, full-voltage run, and optional soft stop. The controller shall be an integrated unit with power SCRs, heat sink, microprocessor logic board, door-mounted digital display and user interface module, run-bypass contactor, and overload relay(s); suitable for use with NEMA MG 1, Design B, polyphase, medium induction motors.
 - 1. Run-Bypass Contactor: Magnetic contactor in parallel with the SCR of the soft-start controller, bypassing the SCR when full voltage is achieved.

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB.
 2. Eaton.
 3. Rockwell Automation, Inc.
 4. Siemens Industry, Inc., Energy Management Division.
 5. Square D; Schneider Electric USA.
- C. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- D. Configuration: Standard duty.
1. At least two SCRs per phase to control the starting and stopping of the motor.
 2. Microprocessor control shall continuously monitor current and proper operation of the SCRs.
 3. Bypass Contactor: Operates automatically when full voltage is applied to motor, and bypasses the SCRs. Soft-start controller protective features and deceleration controls shall remain active when this contactor is in the bypass mode.
 4. Power Electronics Disconnect Contactor. Where indicated, installed ahead of the power electronics equipment, and shall open automatically when the motor is stopped, or a controller fault is detected, or when an SCR shorts.
 5. Logic Board: Identical for all ampere ratings and voltage classes, with environmental protective coating.
 6. Surge Protection: Comply with NEMA ICS 2 requirements for surge suppression.
- E. Control Power:
1. For on-board control power, obtain from line circuit or from integral CPT. The CPT shall have capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 2. Spare CPT Capacity: As indicated on Drawings, available in increments of 100 VA, from 100 to 500 VA.
- F. Controller Diagnostics and Protection:
1. Microprocessor-based thermal-protection system for monitoring SCR and motor thermal characteristics and providing controller overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
 2. Protection from line-side reverse phasing; line-side and motor-side phase loss; motor jam, stall, and under-load conditions; and line frequency over or under normal.
 3. Input isolation contactor that opens when the controller diagnostics detect a faulted soft-start component or when the motor is stopped.
- G. Cover mounted-controller status panel with LED lights or alphanumeric display to show the following:
1. Starter Status: "Ready," "starting," "stopping," or "run."
 2. Motor current in amperes.
 3. Faults:

- a. Motor overcurrent trip.
- b. Motor thermal overload.
- c. Starter thermal fault.
- d. Low line voltage.
- e. Loss of a phase.
- f. Phases reversed.
- g. Maximum stator time exceeded.
- h. Serial communications error.

H. Interface Panel: Mounted on controller door.

1. Guarded adjustable set points, not readily accessible.
 - a. Motor FLA, adjustable from 40 to 110 percent of the controller's rating.
 - b. Current limitation on starting, adjustable from 200 to 500 percent of FLA, typically set at 300 percent.
 - c. NEMA ICS 2 overload class. Selections shall include the following tripping classes: Class 5, Class 10, Class 15, Class 20, and Class 30.
2. Adjustable set points, readily accessible.
 - a. Linear acceleration, adjustable from 1 to 60 s.
 - b. Maximum start time, adjustable from 1 to 250 s.
 - c. Selector switch; select coast to stop or soft stop.
 - d. Linear deceleration, adjustable from 1 to 60 s.

I. Remote Output Features. All outputs shall be prewired to terminal blocks.

1. Analog output for field-selectable assignment of motor operating characteristics; 4- to 20-mA dc.
2. Form C status contacts that change state when controller is running.
3. Form C alarm contacts that change state when a fault condition occurs.

J. Digital Communication Module: RS-485 Modbus, RTU protocol, 4-wire connection to host devices with a compatible port to transmit the following to the LAN:

1. Instantaneous root mean square (rms) current each phase, and three-phase average.
2. Voltage: L-L for each phase, L-L three-phase average, L-N each phase, and L-N three-phase average - rms.
3. Active Energy (kilowatt-hour): Three-phase total.
4. Power Factor: three-phase total.

2.3 COMBINATION SOFT-START MOTOR CONTROLLERS

- A. Description: Factory-assembled, combination, reduced-voltage soft-start controller with a disconnecting means, SCPD and OCPD, in a single enclosure. The reduced-voltage soft-start controller shall consist of an integrated unit with power SCRs, heat sink, microprocessor logic board, door-mounted digital display and user interface module, run-bypass contactor, and overload relay(s); suitable for use with NEMA MG 1, Design B, polyphase, medium induction motors.

1. Run-Bypass Contactor: Magnetic contactor in parallel with the SCR of the soft-start controller, bypassing the SCR when full voltage is achieved.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB, Electrification Business.
 2. Eaton.
 3. Rockwell Automation, Inc.
 4. Siemens Industry, Inc., Energy Management Division.
 5. Square D; Schneider Electric USA.
- C. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- D. Configuration: Standard duty.
1. At least two SCRs per phase to control the starting and stopping of the motor.
 2. Microprocessor control shall continuously monitor current and proper operation of the SCRs.
 3. Bypass Contactor: Operates automatically when full voltage is applied to motor, and bypasses the SCRs. Soft-start controller protective features and deceleration controls shall remain active when this contactor is in the bypass mode.
 4. Power Electronics Disconnect Contactor. Where indicated, installed ahead of the power electronics equipment, and shall open automatically when the motor is stopped, or a controller fault is detected, or when an SCR shorts.
 5. Logic Board: Identical for all ampere ratings and voltage classes, with environmental protective coating.
 6. Surge Protection: Comply with NEMA ICS 2 requirements for surge suppression.
- E. Control Power:
1. For on-board control power, obtain from line circuit or from integral CPT. The CPT shall have capacity to operate integral devices and remotely located pilot, indicating, and control devices.
 2. Spare CPT Capacity: As indicated on Drawings, available in increments of 100 VA, from 100 to 500 VA.
- F. Controller Diagnostics and Protection:
1. Microprocessor-based thermal-protection system for monitoring SCR and motor thermal characteristics and providing controller overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
 2. Protection from line-side reverse phasing; line-side and motor-side phase loss; motor jam, stall, and under-load conditions; and line frequency over or under normal.
 3. Input isolation contactor that opens when the controller diagnostics detect a faulted soft-start component or when the motor is stopped.
- G. Cover mounted-controller status panel with LED lights or alphanumeric display to show the following:
1. Starter Status: "Ready," "starting," "stopping," or "run."

2. Motor current in amperes.
 3. Faults:
 - a. Motor overcurrent trip.
 - b. Motor thermal overload.
 - c. Starter thermal fault.
 - d. Low line voltage.
 - e. Loss of a phase.
 - f. Phases reversed.
 - g. Maximum staving time exceeded.
 - h. Serial communications error.
- H. Interface Panel: Mounted on controller door.
1. Guarded adjustable set points, not readily accessible.
 - a. Motor FLA, adjustable from 40 to 110 percent of the controller's rating.
 - b. Current limitation on starting, adjustable from 200 to 500 percent of FLA, typically set at 300 percent.
 - c. NEMA ICS 2 overload class. Selections shall include the following tripping classes: Class 5, Class 10, Class 15, Class 20, and Class 30.
 2. Adjustable set points, readily accessible.
 - a. Linear acceleration, adjustable from 1 to 60 s.
 - b. Maximum start time, adjustable from 1 to 250 s.
 - c. Selector switch; select coast to stop or soft stop.
 - d. Linear deceleration, adjustable from 1 to 60 s.
- I. Remote Output Features: All outputs shall be prewired to terminal blocks.
1. Analog output for field-selectable assignment of motor operating characteristics; 4- to 20-mA dc.
 2. Form C status contacts that change state when controller is running.
 3. Form C alarm contacts that change state when a fault condition occurs.
 4. Refer to schematics for additional requirements.
- J. Digital Communication Module: RS-485 Modbus, RTU protocol, 4-wire connection to host devices with a compatible port to transmit the following to the LAN:
1. Instantaneous rms current each phase, and three-phase average.
 2. Voltage: L-L for each phase, L-L three-phase average, L-N each phase, and L-N three-phase average - rms.
 3. Active Energy (kilowatt-hour): Three-phase total.
 4. Power Factor: three-phase total.
- K. Fusible Disconnecting Means:
1. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
 2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

3. Auxiliary Contacts: NO or NC, arranged to activate before switch blades open.

L. MCP Disconnecting Means:

1. UL 489 and NEMA AB 3 (with interrupting capacity to comply with available fault currents) instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
3. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
4. NC alarm contact that operates only when MCP has tripped.
 - a. Current-limiting module to increase controller SCCR (withstand) to 100 kA.

M. MCCB Disconnecting Means:

1. UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
2. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
3. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
4. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
5. NC alarm contact that operates only when MCCB has tripped.

N. Molded-Case Switch Disconnecting Means:

1. UL 489 and NEMA AB 3, with in-line fuse block for Class J or Class L power fuses (depending on ampere rating), providing an interrupting capacity to comply with available fault currents; MCCB with fixed, high-set instantaneous trip only.
2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
3. Auxiliary contacts "a" and "b" arranged to activate with molded-case switch handle.
4. NC alarm contact that operates only when molded-case switch has tripped.

2.4 ENCLOSURES

- A. Comply with NEMA 250, Type designations as indicated on Drawings, to comply with environmental conditions at installed location.
- B. Construction of the enclosures shall comply with NEMA ICS 6.
- C. Controllers in hazardous (classified) locations shall comply with UL 1203.

2.5 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
 1. Push Buttons, Pilot Lights, and Selector Switches: Standard duty, except as needed to match enclosure type. Heavy-duty or oiltight where indicated in the controller schedule.

- a. Push Buttons: As indicated in the controller schedule.
 - b. Pilot Lights: As indicated in the controller schedule.
2. Elapsed Time Meters: Heavy duty with digital readout in hours; resettable.
 3. Meters: Panel type, 2-1/2-inch minimum size with 90- or 120-degree scale and plus or minus 2 percent accuracy. Where indicated, provide selector switches with an off position.
- B. Breather assemblies, to maintain interior pressure and release condensation in Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- C. Space heaters, with NC auxiliary contacts, to mitigate condensation in Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- D. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

2.6 IDENTIFICATION

- A. Controller Nameplates: Laminated acrylic or melamine plastic signs, as described in Section 260553 "Identification for Electrical Systems," for each compartment, mounted with corrosion-resistant screws.
- B. Arc-Flash Warning Labels:
1. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3-1/2-by-5-inch self-adhesive equipment label for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.
 - a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
 - 1) Location designation.
 - 2) Nominal voltage.
 - 3) Flash protection boundary.
 - 4) Hazard risk category.
 - 5) Incident energy.
 - 6) Working distance.
 - 7) Engineering report number, revision number, and issue date.
 - b. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and space conditions for compliance with requirements for motor controllers, their relationship with the motors, and other conditions affecting performance of the Work.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Wall-Mounted Controllers: Install controllers on walls with tops at uniform height indicated, and by bolting units to wall or mounting on slotted support systems complying with Section 260529 "Hangers and Supports for Electrical Systems," and bolted to wall.
- C. Freestanding Controllers: Provide slotted support systems complying with Section 260529 "Hangers and Supports for Electrical Systems."
- D. Floor-Mounted Controllers: Install controllers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
- E. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- F. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.
- G. Control Wiring: Separate control wiring from power wiring. Where unavoidable, use twisted pair cabling or shielded cables for control wiring.
- H. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- I. Setting of Overload Relays: Select and set overloads on the basis of FLA rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for high-torque, high-efficiency, and so on motors.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 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. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
- E. Tests and Inspections:
 - 1. Comply with provisions of NFPA 70B, Chapter "Testing and Test Methods."
 - 2. Visual and Mechanical Inspection:
 - a. Compare equipment nameplate data with Drawings and the Specifications.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, and grounding.
 - d. Verify that the unit is clean.
 - e. Ensure that vent path openings are free from debris and that heat-transfer surfaces are clean.
 - f. Verify correct connections of circuit boards, wiring, disconnects, and ribbon cables.
 - g. Inspect Contactors:
 - 1) Verify mechanical operation.
 - 2) Verify that contact gap, wipe, alignment, and pressure are according to manufacturer's published data.
 - h. Motor-Running Protection:
 - 1) Verify that motor FLA is at, or under, the controller current rating.
 - 2) Verify that overload element setting is correct for its application.
 - 3) Apply minimum- and maximum-speed set points. Verify that set points are within limitations of the load coupled to the motor.
 - 4) If motor-running protection is provided by fuses, verify correct fuse rating.
 - i. Inspect bolted electrical connections for high resistance using one of the following two methods:
 - 1) Use a low-resistance ohmmeter. 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 according to manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS, Table 100.12.
 - j. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

3. Electrical Tests:

- a. 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. Insulation-resistance values shall be according to manufacturer's published data or NETA ATS, Table 100.1. In the absence of manufacturer's published data, use Table 100.5. Values of insulation resistance less than this table or manufacturer's written instructions shall be investigated and corrected.
- b. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
- c. Test motor protection devices according to manufacturer's published data.
- d. Test circuit breakers as follows:
 - 1) Operate the circuit breaker to ensure smooth operation.
 - 2) For adjustable circuit breakers, adjust protective device settings according to the coordination study. Comply with coordination study recommendations.
- e. Test the electronic motor overload relay elements by injecting primary current through the overload circuit and monitoring trip time of the overload element.
- f. Test the following parameters according to NETA relay calibration procedures, or as recommended by manufacturer:
 - 1) ANSI No. 49R, Overtemperature Protection:
 - a) Determine time delay at 300 percent of setting.
 - b) Determine a second point on the operating curve.
 - c) Determine pickup.
 - 2) ANSI No. 47, Input Phase Loss and Reversed Phases Protection:
 - a) Determine positive sequence voltage to close the NO contact.
 - b) Determine positive sequence voltage to open the NC contact (undervoltage trip).
 - c) Verify negative sequence trip.
 - d) Determine time delay to close the NO contact with sudden application of 120 percent of pickup.
 - e) Determine time delay to close the NC contact on removal of voltage when previously set to rated system voltage.
 - 3) ANSI No. 81, Overfrequency Protection:
 - a) Verify frequency set points.
 - b) Determine time delay.
 - c) Determine undervoltage cutoff.
 - 4) Fault Alarm Outputs: Verify that each relay contact performs its intended function in the control scheme including breaker trip tests, close inhibit tests, lockout tests, and alarm functions.
- g. Perform operational tests by initiating control devices.

4. Infrared Inspection: Perform the survey during periods of maximum possible loading. Remove all necessary covers prior to the inspection.
 - a. Comply with recommendations of NFPA 70B, Chapter "Testing and Test Methods," Article "Infrared Inspection."
 - b. After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared inspection of the electrical power connections of each motor controller.
 - c. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each motor controller 11 months after date of Substantial Completion.
 - d. Report of Infrared Inspection: Prepare a certified report that identifies the testing technician and equipment used, and lists the following results:
 - 1) Description of equipment to be tested.
 - 2) Discrepancies.
 - 3) Temperature difference between the area of concern and the reference area.
 - 4) Probable cause of temperature difference.
 - 5) Areas inspected. Identify inaccessible and unobservable areas and equipment.
 - 6) Identify load conditions at time of inspection.
 - 7) Provide photographs and thermograms of the deficient area.
 - 8) Recommended action.
 - e. Equipment: Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1 deg C at 30 deg C. The equipment shall detect emitted radiation and convert detected radiation to a visual signal.
 - f. Act on inspection results, recommended action, and considering recommendations of NETA ATS, Table 100.18. Correct possible and probable deficiencies as soon as Owner's operations permit. Retest until deficiencies are corrected.
- F. Motor controllers will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports.

3.5 SYSTEM FUNCTION TESTS

- A. System function tests shall prove the correct interaction of sensing, processing, and action devices. Perform system function tests after field quality-control tests have been completed and all components have passed specified tests.
 1. Develop test parameters and perform tests for the purpose of evaluating performance of integral components and their functioning as a complete unit within design requirements and manufacturer's published data.
 2. Verify the correct operation of interlock safety devices for fail-safe functions in addition to design function.
 3. Verify the correct operation of sensing devices, alarms, and indicating devices.
- B. Motor controllers will be considered defective if they do not pass the system function tests and inspections.

- C. Prepare test and inspection reports.

3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain motor controllers.

END OF SECTION 262913.06

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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 260800 "Commissioning of Electrical Systems" for startup and commissioning of VFCs.
 - 4. Section 262419 "Motor-Control Centers" for VFCs installed in motor-control centers.
 - 5. Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits" for performance requirements of VFC manufacturer provided SPDs..
- 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.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Product Certificates: For each VFC from manufacturer.
- C. 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.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. 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.

1.8 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. ABB.
 2. Danfoss.
 3. Eaton.
 4. Rockwell Automation (Allen-Bradley).
 5. Schneider Electric.
 6. Siemens.
 7. Toshiba.
 8. 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 and the unit will be fully operational after the seismic event."

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 508A, Industrial Control Equipment.
 - 4. UL 61800-5-1, Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal and Energy.
 - 5. 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.
 1. Indoor non-process locations: Type 12.
 2. Indoor process locations: Type 12.
 3. Outdoor locations: Type 4X stainless steel, factory painted white.
- 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, instantaneous 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.
- 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. Serial Communications Port: RS-485.

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 Modbus TCP/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.

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.
 - 4. .
- 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 AND TRAINING

- A. Engage a factory-authorized service representative to demonstrate correct operation, adjust parameters, reprogram, and maintain VFCs to Owner.
- B. Provide 8-hour man days for instruction. Time instruction to cover all working shifts.

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

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SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

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. Provide a complete lightning protection system (LPS) for the following new structures:
1. Waste Handling Storage Tank.
 2. Waste Transfer Station.
- B. LPS for buildings and structures consists of conductors, air terminals, and accessories bonded together and grounded to the electrical system ground grid at regular intervals. Submittal of alternate methods of lightning protection must provide equal or greater lightning protection than specified.
- C. Employ an LPS company to design and install the LPS in compliance with NFPA 780 and UL 96A. Design to include detailed installation drawings and material specifications. Provide for UL field inspection upon completed installation and UL Master label. Make all corrections and additions required by UL inspector. Pay all costs for UL inspection and any subsequent re-inspections.
- D. Visit and inspect all areas of existing buildings and structures on the site relevant to the work.
- E. 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 260526 "Grounding and Bonding for Electrical Systems" for grounding and bonding materials and installation.
 4. Section 260533.13 "Conduits for Electrical Systems" for conduit.

1.3 ACTION SUBMITTALS

- A. Product Data: For shop drawing LPS products.
- B. Shop Drawings:

1. Include plan views showing locations of air terminals and associated zone of protection, roof mounted equipment, conductors, grounding electrodes, and grounding connection points to grounding system.
2. Include sufficient detail on drawings to verify materials and installation comply with specification.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For LPS Company.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For lightning protection system to include in maintenance manuals.
 1. Include the following:
 - a. Dimensioned site plan showing dimensioned route of the ground loop conductor and the ground rod locations.
 - b. A system testing and inspection record, listing the results of inspections and ground resistance tests, as recommended by NFPA 780, Annex D.
- B. UL Master Label Certificate.

1.6 QUALITY ASSURANCE

- A. LPS Company Qualifications:
 1. UL-listed installer, CCN OWAY; or LPI Master Installer.
 2. Minimum ten years' experience in LPS design and installation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General:
 1. Class I materials for structures 75 feet and less in height, Class II materials for higher structures. Comply with minimum weight, size, and composition requirements of UL 96 and NFPA 780 unless higher standard is included herein.
 2. Material selection of air terminals, air terminal bases, adhesives, and conductors to be compatible with roof materials and surrounding environment.
 3. Comply with Section 260526 "Grounding and Bonding for Electrical Systems" for ground rods.
 4. Comply with Section 260533.13 "Conduits for Electrical Systems" for PVC conduit. Use PVC schedule 80.

B. Franklin Rod Air Terminals:

1. Class I (Up to 75 feet in height):
 - a. Solid aluminum, 1/2-inch minimum diameter, blunt tip, 18 inch minimum length.
 - b. Nickel plated solid copper, 3/8-inch minimum diameter, blunt tip, 18 inch minimum length.

C. Main Conductors:

1. Class I (Up to 75 feet in height):
 - a. Aluminum, 14 AWG, 28 strand, 115 kcmil, 115 pounds per 1,000 feet weight.
 - b. Tinned Copper, 17 AWG, 32 strand, 65.5 kcmil, 215 pounds per 1,000 feet weight.

D. Conductor Connections: Bolted, exothermic weld, high-compression, or crimp type (Class I conductors only).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install materials in accordance with approved shop drawings, and UL 96A and NFPA 780 recommended practices in a neat and inconspicuous manner.
- B. Coordinate work with electrical contractor and other trade contractors to install LPS.
- C. Coordinate mounting and penetration of roof surface with roofing contractor to assure maximum roofing guarantee. Through-roof penetration flashings are to be furnished, sealed, and guaranteed by a qualified roofing contractor.
- D. Excavate and backfill as required. Finish grade and restore to original condition.
- E. Bond metal bodies with 6 feet of the LPS conductor to the LPS with approved fittings and conductors.
- F. Record field changes on a set of project contract drawings as work progresses. Furnish "As-Built" drawings for the Project Record Documents.
- G. Dissimilar Metals and Corrosion Protection:
 1. Do not install copper LPS materials on aluminum roofing, siding, or other aluminum surfaces.
 2. Do not install aluminum LPS materials on surfaces painted with alkaline-based paint, embedded in concrete or masonry, buried, or on or below copper surfaces.
 3. Use approved bimetallic connectors for connections between dissimilar metals.

H. Air Terminals:

1. Space air terminals to not exceed 20 feet apart around the outside perimeter of the roof or ridge and not over 50 feet apart through the center of flat roof areas.
2. Do not project air terminals less than 10 inches above the protected object.

I. Conductor Routing:

1. Maintain a downward or horizontal course on main conductors, free from "U" or "V" pockets.
2. Do not form conductors with an angle of less than 90 degrees nor less than an 8-inch radius bend.
3. Do not use metal roofing and siding, eave downspouts, or other metal parts subject to displacement as part of the lightning conductor system.
4. Space fasteners not more than 3 feet horizontally or vertically.
5. Use fasteners of the same material or compatible with the conductor.
6. Use bimetallic fittings for connections between dissimilar metals.

J. Down Conductors:

1. Follow the most direct path possible between roof conductors and ground terminals.
2. Provide a minimum of two down conductors installed at diagonally opposed corners of building for buildings with a ground perimeter less than 250 feet.
3. Provide down conductors as required so the distance between the conductors does not exceed 100 feet for buildings with a ground perimeter exceeding 250 feet.
4. Conceal down conductors to greatest extent practical.
5. Use Schedule 80 PVC conduit for physical protection of down conductors.
6. Install down conductors within a building within the wall and provide physical protection within the wall.
7. Where down conductors are installed on the exterior of structures, provide physical protection of the conductor from grade level to a height of at least 6 feet.
8. Make connections through the roof with through-roof connectors.
9. Splices are not permitted on conductors embedded in concrete.

K. Roof Conductors:

1. Interconnect and provide a two-way path from air terminals.
2. Bond together air terminals and install exposed except that where connections are made to equipment located under roof.
3. Form closed loops on perimeters of flat roofs.
4. Dead end air terminals are not permitted.
5. Interconnecting cables from air terminals to roof conductors or metal roof decks to be similar to roof conductor.

L. Roof Penetrations and Pitch Pockets: By a qualified roofing contractor.

M. Grounding System:

1. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for installation.

2. Provide ground rods at each down conductor, a minimum of 3 feet away from the foundation walls.
3. Provide LPS ground rods in addition to the ground rods provided for the system grounding grid as required. Grounding electrode system is shown on the Drawings.
4. Interconnect ground terminals with the electric system grounding grid and all grounding mediums. This includes electric and telecommunications service grounds and underground metallic piping systems.
5. Use an exothermic weld process to bond down conductors to ground rods and any bonds or splices in buried or concealed locations.
6. Notify Engineer prior to concealment for Engineer's inspection.

N. Identification:

1. Attach corrosion resistant stamped metal tags to, or adjacent to, each down conductor indicating in feet the exact vertical depth in the ground of each ground terminal.
2. Indicate location of down leads connected to water pipes.
3. Place tags at a height of 5 feet above finished grade.

3.2 FIELD QUALITY CONTROL

A. Perform required tests and inspections to obtain UL Master Label, including:

1. Verification of continuity of conductors and air terminals.
2. Ground resistance test in accordance with Section 260526 "Grounding and Bonding for Electrical Systems". Maximum resistance to be 5 ohms or less unless otherwise specified or scheduled.

B. Prepare test and inspection reports and certificates.

END OF SECTION 264113

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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, Schneider Electric, 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 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 265000 - LIGHTING

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: Luminaires, components, and accessories.
- 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.

1.3 DEFINITIONS

- A. BUG Rating: Backlight, uplight, and glare rating for light pollution from exterior luminaires.
- B. Correlated Color Temperature (CCT): The absolute temperature (in kelvins) of a blackbody whose chromaticity (color quality) most nearly resembles that of the light source.
- C. Color Rendering Index (CRI): The measure of the degree of color shift objects undergo when illuminated by the light source as compared with the color of those same objects when illuminated by a reference light source. The lower the CRI of a light source, the more difficult it is to identify colors and stripes on electronic components and wiring.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product used on project.
 - 1. Include physical data to confirm compliance with luminaire schedule. Include description, features, accessories, finishes, and dimensions of luminaires.
 - 2. Include electrical and lighting data to confirm compliance with luminaire schedule. Include voltage, design life, lumen output, CCT, CRI, photometric data, and energy efficiency data.
 - 3. Organize luminaire data in sequential order based on the luminaire schedule. Use same designations indicated on Drawings.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include support accessories as applicable.
- B. Shop Drawings:

1. Where exterior luminaires deviate in lumen output or photometrics from the basis of design luminaire, submit site photometric plan to verify performance requirements and compliance with local lighting ordinances at property line boundaries.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturers' published instructions.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
- B. Warranty documentation.

1.7 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each LED luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect exposed surface finishes on lighting equipment by applying strippable, temporary protective covering before shipping.
- B. Store luminaires in a dry location in their original packaging, until ready for installation.

1.9 WARRANTY

- A. Warranty period for LED luminaires and emergency luminaires with batteries shall be as indicated on the Drawings.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Luminaires, Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Comply with the following standards and UL Category Control Number (CCN) listing criteria as applicable:
 - 1. UL 844, Standard for Luminaires for Use in Hazardous (Classified) Locations, UL CCN IFUX.
 - 2. UL 924, Standard for Emergency Lighting and Power Equipment.
 - a. UL CCN FTBR, emergency lighting.
 - b. UL CCN FWBO, exit lighting.
 - 3. UL 1598, Luminaires (non-hazardous locations).
 - a. UL CCN HYXT, general luminaires and fittings.
 - b. UL CCN IFAM, surface mount LED luminaires.
 - c. UL CCN IFAW, canopy luminaires.
 - d. UL CCN IFAO, recess mount LED luminaires.
 - 4. UL 8750, Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products.
- C. Comply with NEMA LE 4 for recessed luminaires.

2.2 LUMINAIRES

- A. Refer to luminaire schedule on Drawings for detailed requirements for each luminaire type. Catalog numbers listed on schedules are provided as a design basis for performance and quality desired. Equivalent design and quality from other manufacturers will be acceptable upon Engineer's approval.
- B. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components to be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
 - 4. Steel: ASTM A36/A36M for carbon structural steel, ASTM A568/A568M for sheet steel.
 - 5. Stainless Steel: Manufacturer's standard grade, ASTM A240/A240M.
 - 6. Galvanized Steel: ASTM A653/A653M.
 - 7. Aluminum: ASTM B209.
- C. Variations in metal finishes are unacceptable in the same piece.
- D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to

prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position.

2.3 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Refer to Drawings for support details.
- C. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish to match fixture.
- D. Wires: ASTM A641/A641M, Class 3, soft-temper, zinc-coated steel, 12 gage.
- E. Rod Hangers: 3/16-inch- minimum diameter, cadmium-plated, threaded steel rod.
- F. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

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 the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Engineer, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting.

3.3 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
 - 1. Relevant Article of NFPA 70.
 - 2. NECA NEIS 500 – Standard for Installing Indoor Commercial Lighting Systems.

3. NECA NEIS 501 – Standard for Installing Exterior Lighting Systems.
4. NECA NEIS 502 – Standard for Installing Industrial Lighting Systems.

C. Special Installation Techniques:

1. Install luminaires level, plumb, and square with finished floor or grade unless otherwise indicated.
2. Fasten luminaire to structural support. Comply with requirements in Section 260529 “Hangers and Supports for Electrical Systems”.
3. Comply with requirements in Section 260519 “Low-Voltage Electrical Power Conductors and Cables” and Section 260533.13 “Conduits for Electrical Systems” for wiring connections and wiring methods.
4. Install luminaires at height and aiming angle as indicated on Drawings.
5. Coordinate layout and installation of luminaires with other construction.
6. Comply with details indicated on Drawings.
7. Comply with requirements in Section 260553 “Identification for Electrical Systems” to identify luminaires, system components, wiring, cabling, and terminals.

D. Systems Integration: Integrate lighting control devices and equipment with electrical power connections for operation of luminaires as specified.

3.4 FIELD QUALITY CONTROL

- A. Inspect each luminaire for damage and cleanliness. Replace damaged luminaires and components. Remove debris and clean luminaire prior to tests, inspections, and acceptance by Engineer.
- B. Perform the following tests and inspections:
 1. General Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper control operation in all modes.
 2. Emergency Lighting Operational Test: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
 3. Emergency Lighting Discharge Test: Interrupt normal power supply and confirm adequate illumination is provided for 90 minutes while on battery power.
- C. Luminaire will be considered defective if it does not pass tests and inspections.
- D. Prepare field quality report certifying verification of correct installation.

END OF SECTION 265000

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SECTION 310515 - SOILS AND AGGREGATES FOR EARTHWORK

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. New York Department of Transportation “Revised Standard Specifications, Section 703 Aggregates”, latest edition.

1.2 SUMMARY

- A. Section Includes:
 - 1. Soils: Soil materials and topsoil materials.
 - 2. Aggregates: Coarse aggregate materials and fine aggregate materials.
- B. Related Sections:
 - 1. Section 312000 “Earthwork.”
 - 2. Section 312333 “Trenching and Backfilling”
 - 3. Section 312500 “Erosion and Sedimentation Control.”
 - 4. Section 334113 “Public Storm Utility Drainage Piping.”

1.3 ACTION SUBMITTALS

- A. Section 013300 “Submittal Procedures” for requirements of submittals.
- B. Samples - Soils: Submit in 5-gallon air-tight containers, 50 lbs. sample of each type of topsoil and fill to testing laboratory.
- C. Samples - Aggregates: Submit, in 5-gallon air-tight containers, 50 lbs. sample of each type of aggregate fill to testing laboratory at least 15 days prior to placement of backfill or fill.
- D. Quality Control Testing: Submit conformance testing performed by a certified independent laboratory engaged by Contractor for all fill materials. Verify maximum density, gradation, Atterberg limits, sand equivalent, and other applicable criteria at least 72 hours prior to importing or placing any fill. Perform additional conformance testing at a minimum frequency of 1 per every 2000 cubic yards or change in material.

1.4 INFORMATIONAL SUBMITTALS

- A. Materials Source: Submit name and location of imported materials suppliers.

- B. Source's Certificate: Certify materials meet or exceed specified requirements.
- C. Material Test Reports: For each on-site and borrow soil and aggregate material proposed for fill and backfill as follows:
 - 1. Classification according to ASTM D2487.
 - 2. Particle size analysis according to ASTM C136 or D6913.
 - 3. Laboratory compaction curve according to ASTM D1557.
 - 4. Test Reports: Submit any test reports required by this Section to the Engineer.

1.5 QUALITY ASSURANCE

- A. Furnish each subsoil and topsoil material from single source throughout the Work unless an alternate source is approved by the Engineer.
- B. Furnish each coarse and fine aggregate material from single source throughout the Work unless an alternate source is approved by the Engineer.
- C. Perform Work according to New York State Department of Transportation standards.
- D. Quality Control and Quality Assurance consists of laboratory conformance testing of samples supplied from each coarse and fine aggregate source and quality control during installation.
 - 1. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.
- E. Maintain one copy of each standard affecting Work of this Section on Site.

1.6 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Common Fill: Approved on site excavated material or imported fill material that is composed of durable soil free of debris, organic matter, or other deleterious materials. Provide fill with no granite blocks, broken concrete, masonry rubble, or other similar materials and with physical properties such that it can be readily spread and compacted during filling. The material passing the No. 200 sieve shall be non-plastic. Common Fill should conform to the following gradation:

<u>Sieve Size</u>	<u>Percent Finer by Weight</u>
6-inch	100
3-inch	80-100
No. 4	20 to 100.
No. 200	0 to 20

- B. Select Common Fill: As specified above for common fill, except containing no stones larger than 2 inches in largest diameter.
- C. Structural Fill: Consist of mineral soil free of organic material, loam, debris, frozen soil or other deleterious material which may be compressible, or which cannot be properly compacted, with the following gradation:

<u>Sieve Size</u>	<u>Percent Finer by Weight</u>
3-inch	100
½-inch	50-100
No. 4:	20 to 70.
No. 40	5 to 35.
No. 200	0 to 10

- D. Provide structural fill with a maximum liquid limit of 50 percent, maximum plasticity index of 10 percent, and a maximum dry density of at least 95 pcf as determined by ASTM D1557.

2.2 TOPSOIL MATERIALS

A. Topsoil :

1. Excavated and reused material or imported borrow.
2. Friable loam.
3. Reasonably free of roots, rocks larger than 1/2 inch, subsoil, debris, large weeds, and foreign matter.
 - a. Screening: Single screened.
4. Acidity range (pH) of 5.5 to 7.5.
5. Containing minimum of 4 percent and maximum of 25 percent inorganic matter.

2.3 COARSE AGGREGATE MATERIALS

- A. Coarse Aggregate - Crushed Stone: Natural stone; free of clay, shale, organic matter; conforming to New York State Department of Transportation size 3A crushed stone 703-0201.
- B. Coarse Aggregate - Screened Gravel: Natural stone; hard, durable, rounded, or sub-angular particles of proper size and gradation, and shall be free from sand, loam, clay, excess fines, and other deleterious materials; to the following gradation limits:

<u>Sieve Size</u>	<u>Percent Finer by Weight</u>
5/8- inch	100
1/2-inch:	40 to 100
3/8-inch	15 to 45 percent.
No. 10	0 to 5 percent.

- C. Coarse Aggregate – Pea Gravel - Natural stone; washed, free of clay, shale, organic matter; graded according to ASTM C136; to the following gradation limits:

<u>Sieve Size</u>	<u>Percent Finer by Weight</u>
1/2 inch	100
3/8-inch	85 to 100
No. 4	10 to 30
No. 8	0 to 15
No. 16	0 to 5

2.4 FINE AGGREGATE MATERIALS

- A. Fine Aggregate - Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter; graded according to ASTM C33; within the following gradation limits:

<u>Sieve Size</u>	<u>Percent Finer by Weight</u>
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

2.5 SOURCE QUALITY CONTROL

- A. Soil Material - Testing and Analysis: Perform in accordance with ASTM D6913 and D1557.
- B. Topsoil Material - Testing and Analysis: Perform in accordance with ASTM D6913.
- C. Coarse Aggregate Material - Testing and Analysis: Perform according to ASTM C136.
- D. Fine Aggregate Material - Testing and Analysis: Perform according to ASTM C136.
- E. When tests indicate materials do not meet specified requirements, change material and retest.
- F. Furnish materials of each type from same source throughout the Work.

PART 3 - EXECUTION

3.1 EXCAVATION - SOILS

- A. Excavate subsoil and topsoil from areas designated. Strip topsoil to full depth of topsoil in designated areas.
- B. Stockpile excavated material meeting requirements for subsoil materials and topsoil materials.
- C. Remove excess excavated materials not intended for reuse, from site.
- D. Remove excavated materials not meeting requirements for subsoil materials] and topsoil materials from site.

3.2 STOCKPILING

- A. Stockpile materials on site at locations designated by Engineer.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate different soil and aggregate materials with dividers or stockpile individually to prevent mixing. Prevent intermixing of soil types or contamination.
- D. Stockpile topsoil 8 feet high maximum.
- E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

3.3 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION 310515

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SECTION 310519.13 - GEOTEXTILES FOR EARTHWORK

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. Nonwoven geotextile material.
- B. Related Requirements:
 - 1. Section 310515 “Soils and Aggregates for Earthwork” for fill and grading materials.
 - 2. Section 312000 “Earthwork” for excavation and backfilling procedures.
 - 3. Section 312333 “Trenching and Backfilling” for trenching and backfilling procedures.
 - 4. Section 312500 “Erosion and Sedimentation Controls” for erosion and sedimentation control devices.

1.3 ACTION SUBMITTALS

- A. Submit items in this Article at least 30 days prior to installation.
- B. Product Data: Submit certified test results from the manufacturer including tensile strength, elongation, thickness, UV resistance, and other material properties.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- B. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures and quality control and quality assurance.
- C. Manufacturer’s quality control program and manual, including a description of laboratory facilities.
- D. Source Quality-Control Submittals: Provide results of factory tests and inspections, including test results that indicate materials meet the requirements of PART 2.
- E. Qualifications Statements:
 - 1. Submit qualifications for manufacturer and installer.

1.5 QUALITY ASSURANCE

- A. Perform Work according to NYSDOT standards and the recommendations of the Manufacturer.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging that identifies the manufacturer/supplier's name, style, and roll number. Inspect for damage.
- B. Comply with ASTM D4873.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture, dust, chemicals, UV radiation or other environmental conditions that might damage the geotextile by storing at least 3 inches off the ground in a clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.8 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace geotextile related products that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 2.1 MATERIALS - NONWOVEN GEOTEXTILES

- 1. Furnish materials according to New York Department of Transportation standards.
- B. Description:
 - 1. Non-biodegradable, non-reactive (for pH of three to eleven), UV-resistant, insect/rodent-resistant nonwoven needle punched material consisting of filaments formed into a stable network.
 - 2. Edges: Selvaged or finished to prevent separation of outer material.
- C. Performance and Design Criteria:

1. When tested in accordance with ASTM D4759, test results from any sampled roll in the lot shall meet or exceed the values listed in Table 1. Strength values are in the weaker principal direction.

TABLE 1: NONWOVEN GEOTEXTILE MINIMUM AVERAGE ROLL VALUES

PROPERTIES	TEST METHOD	UNIT	4 oz	6 oz	8 oz	10 oz
Mass per Unit Area	ASTM D5261	oz/yd ²	4	6	8	10
Thickness	ASTM D5199	mils	40	75	90	108
Grab Strength	ASTM D4632	lbs	120	160	220	260
Grab Elongation	ASTM D4632	percent	50	50	50	50
Trapezoid Tear Strength	ASTM D4533	lbs	50	60	80	100
Puncture Strength	ASTM D4833/ D6241	lbs	310	90	120	165
Water Flow Rate	ASTM D4491	gpm/ft ²	135	110	95	75
Permittivity	ASTM D4491	sec-1	1.7	1.5	1.2	1.0
Apparent Opening Size (Max)	ASTM D4751	inch US Std. Sieve	0.008 70	0.008 70	0.007 80	0.006 100
UV Resistance	ASTM D4355	percent strength retained	70	70	70	70

2.2 MATERIALS - ACCESSORIES

- A. Use products to secure geotextile fabrics as recommended by geotextile manufacturer.

2.3 SOURCE QUALITY CONTROL

- A. If requested by the Owner, provide materials for Quality Assurance Laboratory (QAL) testing by an independent GRI accredited laboratory to confirm conformance testing results.
- 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 AND PREPARATION

- A. Engineer shall inspect subgrade to verify that underlying surface is smooth and free of ruts or protrusions that could damage geotextile material and that subgrade has been properly prepared.
- B. Subgrade Material and Compaction Requirements: As specified in Section 312333 "Trenching and Backfilling." and 312000 "Earthwork"

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's published installation instructions. Do not install damaged materials.
- B. Geotextile Material:
 - 1. Lay and maintain smooth and free of tensile stresses, folds, wrinkles, or creases.
 - 2. Ensure that material is in direct contact with subgrade.
 - 3. Minimum Unseamed Joints Overlap: 18 inches.
- C. Repairing Damaged Geotextiles:
 - 1. Repair torn or damaged geotextile by placing patch of same type of geotextile over damaged area minimum of 18 inches beyond edge of damaged area and fasten as recommended by geotextile manufacturer.
 - 2. Remove and replace geotextile rolls which cannot be repaired.
- D. Fill and Cover:
 - 1. Place fill to prevent tensile stress or wrinkles in geotextile.
 - 2. Place fill from bottom of side-slopes upward.
 - 3. Do not drop fill from height greater than 3 feet.

3.3 PROTECTION

- A. Ballast: Adequate to prevent uplift of material by wind.
- B. UV Exposure: Do not leave material uncovered for more than 14 days after installation.
- C. Do not use staples or pins to hold geotextiles in place where located adjacent to other geosynthetic layers that could be damaged.
- D. Do not operate equipment directly on top of geotextile.

END OF SECTION 310519

SECTION 310900 - GEOTECHNICAL INSTRUMENTATION AND MONITORING

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 performing pre-construction surveys and installing and monitoring geotechnical instrumentation and survey markers to monitor movements and measure :
 - 1. Performance of excavation support systems.
 - 2. Groundwater levels inside and outside excavation limits.
 - 3. Vertical deformation of ground surface adjacent to and directly over the Work.
 - 4. Vertical and horizontal deformation of existing utilities and structures adjacent to and over the Work.
 - 5. Ground vibration levels at adjacent facilities due to Contractor activities, including but not limited to demolition, pile installation, and rock excavation.
- B. Related Requirements:
 - 1. Section 312000 "Earthwork" for earthwork materials and operations.
 - 2. Section 312316 "Rock Removal" for removal of existing rock.
 - 3. Section 312319 "Dewatering" for dewatering and drainage.
 - 4. Section 312333 "Trenching and Backfilling" for those procedures.
 - 5. Section 315000 "Excavation Support and Protection" for temporary procedures.
 - 6. Various Sections in Division 02 relating to different types of demolition.

1.3 DEFINITIONS

- A. Crack Gauges: Transducers mounted across cracks identified on existing structures during the preconstruction survey to monitor the crack width.
- B. Deformation Monitoring Points (DMPs): Fixed markers placed on existing utilities and structures to measure both vertical and horizontal movement. Initial coordinate locations and vertical controls are determined by optical survey methods.
- C. Excavation Support Monitoring Points (ESMPs): Inscribed marking or fixed markers placed on excavation support systems to measure horizontal movement of the excavation support system.
- D. Seismographs: Electronic recording device with vibration transducer capable of monitoring and recording ground vibrations induced by construction activity.

- E. Surface Monitoring Points (SMPs): Inscribed marking or approved surveyor's nail installed to measure vertical (elevation) movement.

1.4 ACTION SUBMITTALS

- A. Submit for the Engineer's review four weeks prior to instrument installation:
 - 1. Installation Plan and Schedule: Full details and plan/layout of proposed instruments/points, schedule for installing and monitoring instruments/points, equipment types, installation methods, reference points, and monitoring and data reporting schedule for instruments/points, and instrumentation protection.
 - 2. Description of methods for installing and protecting all instrumentation including but not limited to seismographs, crack gauges, monitoring points, and reference points.
- B. Installations Records: Within five working days of installing each instrument, submit to the Engineer, specified as-built instrument location and its corresponding installation record sheet.
 - 1. Include in installation record sheet, location with instrument identification numbers, established elevations, initial elevations and coordinates (baseline readings), installation and monitoring date and time.
 - 2. Furnish details of installed instruments showing dimensions, materials used, and as-built drawings of each instrument.
 - 3. Submit field calibrations.
- C. Reports and Records: Provide reports of monitoring data to the Engineer. include following minimum information:
 - 1. Preconstruction survey.
 - 2. As-installed location plan, installation records, and baseline values for instrumentation.
 - 3. Monitoring data for instruments with plots against threshold values.
 - 4. Weekly records of crack monitors and including photographs with readings.
 - 5. Event reports and summary from vibration monitoring.
 - 6. Discussion and associated action related to results exceeding threshold values.
- D. Submit proposed remedial measures to the Engineer of action to be taken in event that instrument Threshold Values are reached.

1.5 INFORMATIONAL SUBMITTALS

- A. Submit names, qualifications, and experience of personnel who will install instruments, perform optical level survey and vibration monitoring, read instruments, and report data to the Engineer demonstrating compliance with "Quality Assurance" Article in this Section.
- B. Certificates: Submit for each seismograph or other necessary instrument that manufacturer has inspected and tested each instrument before it leaves the factory confirming that it is working correctly without defects or missing parts and current calibration records.

1.6 QUALITY ASSURANCE

- A. Geotechnical Instrumentation Engineer Qualifications: Professional engineer registered in the State of New York with at least 5 years' experience in installation of specified instrumentation and will supervise and direct technicians and be responsible for instrument installation. Be present at installation sites to direct and supervise installations, oversee instrumentation reading, and supervise geotechnical instrumentation data interpretations.
- B. Surveyor Qualifications: Professional Land Surveyor registered in the State of New York with at least 3 years' experience in surveying of similar instruments. Establish Deformation Monitoring Points, Surface Monitoring Points, Utility Monitoring Points, and Excavation Support Monitoring Points and take baseline readings.
- C. Manufacturer Qualifications: Provide instruments and components from an approved manufacturer currently engaged in manufacturing specified geotechnical instrumentation hardware.
- D. Preconstruction Survey Engineer Qualifications: Professional engineer registered in the State of New York with at least 5 years' experience in structural evaluations and condition surveys.
- E. Monitoring Technicians Qualifications: Minimum 3 years' experience for personnel responsible for optical level surveys, instrument readings, and report data.
- F. Vibration Monitoring Qualifications: Persons trained in use of a seismograph along with reporting results of analyzing and reporting frequency content of a seismograph record.
- G. Instrument Installation Technicians: Experienced in installation and reading of specified geotechnical instrumentation and equipment.
- H. Factory Calibration: Conduct factory calibration on instruments prior to shipment with certification submitted to indicate that test equipment used for this purpose is calibrated and maintained in accordance with test equipment manufacturer's calibration requirements and that, where applicable, calibrations are traceable to U.S. National Institute of Standards and Technology.
 - 1. Include a calibration curve with data points clearly indicated and a tabulation of data. Mark each instrument with a unique identification number.
- I. Perform instrument installations in presence of the Engineer.
- J. Be responsible for installation, maintenance, and monitoring of geotechnical instrumentation.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE REQUIREMENTS

- A. Project Requirements:

1. Install geotechnical instrumentation to monitor ground conditions, ground response, and facilities to achieve specified project requirements and prevent damage to facilities potentially affected.
2. Install instrumentation in accordance with approved Instrumentation Schedule.
3. Engineer's monitoring of installed instruments does not relieve Contractor of its obligation to complete project within the requirements specified herein taking necessary additional measurements.

B. Pre-Construction Survey:

1. Prior to start of demolition, excavation work, installation of excavation support and dewatering work, engage the services of an independent licensed professional engineer, to conduct a pre-construction survey of existing structures and conditions within 100 feet of the anticipated demolition, excavation work, installation of excavation support, and dewatering work.
 - a. Coordinate activities, issue notices, obtain clearances and provide photographic and secretarial assistance necessary to accomplish the survey.
 - b. Give notice in writing, to property owners and representatives of local authorities required to be present at such survey. Notify in writing the dates on which surveys are planned so that representatives are present during the examination. Provide copies of notices to Owner and the Engineer
2. Record observations of the existing conditions for residences, buildings, and other structures, which are affected.
 - a. Provide the survey consisting of a description of interior and exterior conditions. Locate cracks, damage or other defects existing and include information to make it possible to determine the effect, if any, of the construction operations on the defect. Where significant cracks or damage exists, or for defects too complicated to describe in words, photographs shall be taken and made part of the record.
 - b. Records of each property examined must be signed by the representatives present and, if practicable, by property owners, whether or not they are present at the examinations.
3. Record of the pre-construction survey shall consist of written documentation, video and photographs of the conditions identified. At the completion of the survey, submit copies of the documentation to Owner.
4. Upon completion of all excavation work, installation of excavation support and dewatering work, the complete a similar examination of properties and structures where complaints of damage have been received or damage claims have been filed. Give notice to interested parties so that they may be present during the final examinations. Records of the final examination shall be signed and distributed as the original pre-construction survey.
5. Retain records in Contractor's file for at least 3 years after completion of the Contract. In the event of damage claims, prepare a report on the particular structures as requested by the Engineer from those notes and photographs and submitted to Owner. Repair damage attributed to Contractor's activity promptly and completely to property owners' satisfaction to restore the conditions of the property to that existing prior to work.

- C. Provide and facilitate safe access to the instruments at all times. Engineer may perform additional monitoring in a manner that will minimize unnecessary work delays. Allow and facilitate instrument monitoring as required by the Engineer. No claim for lost production time due to this activity will be allowed.
- D. Maintain instrumentation. Report damaged or non-functional instrumentation to the Engineer within 24 hours. Replace damaged instruments within 24 hours.
- E. Availability of Data:
 - 1. Instrumentation readings shall be collected by the Contractor's Geotechnical Instrumentation Monitoring Firm. Contractor may take their own supplementary readings in addition to those specified.
 - 2. Monitoring data is the property of Owner and is not to be disclosed or published to third parties without Owner's written permission.
 - 3. Contractor is expected to make their own interpretations for their own purposes without additional compensation.
 - 4. Coordinate with the Engineer to verify consistency of collected data.

2.2 INSTRUMENTATION - GENERAL

- A. Instruments and materials, including readout units, installation tools, materials, and miscellaneous instrumentation components.
- B. Provide surface protection for instruments flush with surface in paved or other ground surface areas at the time that work is completed.
- C. Minimum Quantity of Instruments: While quantities in following Paragraph are considered minimums, obtain data from instrumentation in quantity to monitor construction, performance, and safety aspects of the Work.
- D. Following subparagraphs identify instrument type, minimum number to be provided, and approximate installed depth from of excavation / tunnel invert:

	<u>Instrument Type:</u>	<u>Number:</u>	<u>Depth:</u>
1.	Seismographs:	1	N/A.
2.	Surface Monitoring Points:	5	N/A.
3.	Deformation Monitoring Points:	5	N/A.
4.	Excavation Support Monitoring Points:	As Needed	N/A.
5.	Crack Gauges:	(As required to monitor existing cracks)	

- E. Locate instruments and obtain approval from the Engineer.

2.3 MONITORING POINTS

- A. Surface Monitoring Points (SMPs):
 - 1. Use to monitor vertical deformation at or near ground surface, clearly identifying points with permanent easily readable letters and numbers as approved by the Engineer.

2. Paved Areas: 2 inches long masonry nail, manufactured from hardened zinc-plated steel and driven into an asphalt covered surface. Identify each nail individually with an identification tag or surface marking.
3. Non-Paved Areas: 3 feet 3/4-inch diameter steel rod driven into ground or set in concrete such that no more than 3 inches of rod is exposed above ground surface. Round top of rod and punch-mark it at its center. Identify each rod with a surface marking.
4. Utility Manholes: Observable cross mark or welded bead on top horizontal surface of manhole rim. Clean surface within 3 inches of point and mark it using fluorescent spray paint adjacent to point to permit easy identification of exact location.

B. Deformation Monitoring Points (DMPs):

1. Use to monitor vertical and horizontal movement of adjacent utilities and structures with following approved by the Engineer.
2. Materials: Nails, screws, reinforcing bars, bolts, and similar materials with well-defined measurement points.
3. Firmly attach and protect from damage and vandalism. Remove or cover points protruding more than 1/4 inch with a protective box or cap.
4. Clearly identify with permanent easily readable letters and numbers.

C. Excavation Support Monitoring Points (ESMPs):

1. Use as fixed markers on vertical elements of excavation support system and to monitor horizontal deformation of excavation support system designed by Contractor.
2. Clearly identified points with permanent easily readable letters and numbers as approved by the Engineer.
3. Clean surface within 3 inches of each point and clearly identify using fluorescent spray paint adjacent to point.

D. Non-Shrink Cement Grout: Suitable for intended application.

2.4 SEISMOGRAPHS

A. Portable for monitoring ground vibrations velocities resulting from construction activities, calibrated within the previous six months, and having following characteristics:

1. Measure three mutually perpendicular components of particle velocity in directions vertical, radial, and perpendicular to vibration source.
2. Measure and display maximum peak particle velocity continuously during vibration-generating activities.
3. Have a low frequency omnidirectional transducer for measuring air blast overpressure with a flat frequency response within the limits of 2 Hertz to 200 Hertz with a tolerance equal to or better than plus or minus 10 percent.
4. Seismic Range: Range to have accuracy of plus or minus 5 percent of measured peak particle velocity or better at frequencies between 10 Hertz and 100 Hertz, and with a resolution of 0.01 inch per second or less.
5. Acoustic Range: 110 dB to 140 dB (referenced to 20 micro-Pascals) with an accuracy and resolution of plus or minus 1 dB.
6. Frequency Response (plus or minus 3 dB): 2 Hertz to 200 Hertz.

7. Two Power Sources: Internal rechargeable battery and charger capable of supplying power to monitor vibrations continuously for up to 24 hours at 115 volts AC.
 8. Self-triggering wave form capture mode that provides plot of wave forms, peak particle velocities, peak overpressure, and frequencies of peaks.
 9. Continuous monitoring mode capable of recording single-component peak particle velocities and frequency of peaks with an interval of 1 minute or less.
- B. Provide for full-time use on the project during vibration causing construction activities.

2.5 CRACK MONITORS

- A. Crack Gauges:
1. Threaded Anchors: Include ball joints which can be grouted to each side of crack in any orientation.
 2. Transducer: Range of at least 1 inch and an accuracy of less than 0.1 percent and a non-linearity of no more than 0.5 percent.
 3. Gauge: Capable of operating in temperatures ranging from minus 68 degrees F to 176 degrees F Provide a solid steel cover over each gauge which does not touch or otherwise interfere with gage operation.
- B. Basis-of-Design Manufacturer - Crack Gauges: Provide Model 4420 as manufactured by Geokon, Inc., or equal for monitoring width of existing cracks and joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with the Engineer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Existing Conditions: Locate vaults, structures, conduits, and underground utilities in areas where wells are to be drilled and installed. Conduct utility clearance and contact utility companies prior to any drilling.
1. Modify instrument locations, as approved by the Engineer, to avoid interference with existing vaults, structures, conduits, and utilities.
 2. Repair damage to existing facilities resulting from instrument installations without additional compensation.
- B. Prior to commencing installation of demolition, excavation support, excavation, rock excavation, and dewatering work, furnish instrumentation and related components that are to be installed during construction and conduct pre-construction surveys.

- C. Protect from damage and maintain instruments. Repair or replace damaged instruments.
- D. Drilling from Ground Surface: Obtain necessary permits for each instrument and conform to permit requirements during drilling and installation.
- E. Implement remedial measures based on interpretations of monitoring data program.

3.3 GENERAL REQUIREMENTS

- A. Perform a pre-construction survey prior to any dewatering, excavation, demolition, or installation of excavation support.
- B. Install instruments at the Engineer approved locations in accordance with approved installation procedures. Engineer may modify instrument locations depending on field conditions and monitoring objectives. Install instrumentation in accordance with approved installation schedule. Install instruments and obtain baseline data before construction starts.
- C. Allow the Engineer access to instrument locations and assistance required in obtaining monitoring data.
- D. Clearly mark and label instruments and protected to avoid being obstructed or otherwise damaged by construction operations or general public. Immediately following installation, survey location and top of instruments to provide horizontal and vertical coordinates.
 - 1. Resurvey if the Engineer questions instrument locations.
- E. Assign a unique identification number to each instrument and each point that is clearly marked in a non-destructible manner.
- F. Initial Reading: Immediately following instrument installation take two sets of initial readings in the Engineer's presence to provide baseline readings and to demonstrate adequacy of completed installation.

3.4 MONITORING POINTS

- A. Monitoring Points: Include but not be limited to SMPs, DMPs and ESMPs. Monitor these control points using surveying methods. Modify locations to meet site constraints with the Engineer's approval.
- B. SMPs and DMPs: Install as described below near excavations and open trench locations. Additional SMPs and DMPs may be required by the Engineer.
- C. Additional SMPs:
 - 1. Install in pavement or ground surface within 10 feet along each side of trench excavations that is over 12 feet deep and/or that is within 50 feet of structures. Install at spacing not exceeding 25 feet.
 - 2. Install on rim of utility manhole covers located within 50 feet of trenchless crossings or within 30 feet of open excavations.

D. DMPs:

1. Install on exterior walls of buildings or structures located within 30 feet of open excavations, 100 feet of pile installation, or 50 feet of shafts or trenchless crossing alignments. Preferred installations are on supporting walls or columns. Avoid installation in brick, unless no other option exists.
2. As a minimum, install on exterior wall corners of buildings, structures, or property boundary walls at not more than 25 feet spacing. Install additional DMPs to monitor building movement at other locations when determined by the Engineer.
3. Install DMPs in cooperation with property Owners so that installations are inconspicuous and acceptable to them. Existing features of building foundations that are permanent and can be repeatedly surveyed may be substituted for DMPs, if approved by the Engineer.

E. ESMPs:

1. Install on excavation support systems other than trench box along support walls at spacing not more than 25 feet.
2. Install prior to excavation within excavation support system.
3. Take reading at least daily during associated excavation and twice a week until backfill is completed.

F. SMPs and DMPs:

1. Obtain two sets of measurements within three days of installation for each monitoring point to establish baseline data. Make measurements at least 24 hours apart, but not more than 48 hours apart.
2. Check monitoring points with initial surveyed elevations or offsets as appropriate differing by more than 0.10 inch for secure installation and resurvey.
3. Read monitoring points prior to installing excavation support, beginning demolition, excavation, operation of groundwater control system or start of installation of excavation support at the site.
4. Read daily during demolition, excavation, dewatering, filling and backfilling, rock excavation, and excavation support installation located within 50 feet of the work, then at least twice a week until excavation, dewatering, and backfill has been completed.

G. Crack Gauges:

1. Install on exterior walls of buildings or structures with existing cracks located within 30 feet of open excavations.
2. Install DMPs in accordance with manufacturer's recommendations and in cooperation with property Owners so that installations are inconspicuous and acceptable to them.

3.5 VIBRATION MONITORING

- A. Take seismograph readings during demolition, rock excavation, and excavation support installation or other activities causing ground vibrations within 50 feet of existing structures to document that peak particle velocities do not exceed specified limit criteria.

- B. Install seismographs near existing structures when vibratory or impact hammers are used for the installation of excavation support within 50 feet of existing structures, and as directed by the Engineer.

3.6 INSTRUMENT PROTECTION, MAINTENANCE AND REPAIR

- A. Protect instruments from damage. Replace damaged or destroyed instruments within 48 hours of damage, without additional compensation. If necessary, suspend work in areas being monitored by damaged instrument and take remedial action.
- B. Maintain instruments by draining water and flushing debris from under protective covers and keeping covers locked and sealed at all times.

3.7 MONITORING

- A. Collect, tabulate, plot, and interpret survey monitoring data and provide the Engineer with tabulated and plotted data. Report status of demolition, excavation, bracing, groundwater levels, and backfilling at time of data collection with each report.
- B. Monitoring frequency may be modified as directed and approved by the Engineer.
- C. Submit data from readings of monitoring points to the Engineer within 24 hours of reading. Communicate verbally with the Engineer immediately after visual observations or data collection if excessive movements or other anomalies are indicated.
- D. For seismograph data, submit a summary report with event summary of peak particle velocity and frequency. Submit a strip chart indicating time and magnitude of maximum single-component peak particle velocity measured during each 5-minute interval of monitoring period. List a summary of vibration producing activities for that week along with specific events causing anomalous readings.
- E. Make visual observations of ground conditions and building conditions in site vicinity and communicate immediately with the Engineer if signs of ground or building movements are observed.
- F. Engineer may take independent instrumentation measurements. Cooperate with the Engineer during instrumentation monitoring by providing access to instrumentation locations in a timely manner and by providing and maintaining safe means of access to instrumentation locations for data collection. Data acquired by the Engineer will be made available to Contractor in a timely manner.
- G. Contractor may make their own interpretations of monitoring data for their own purposes. Do not publish or disclose data or interpretations shall to other parties without advance written permission of Owner.
- H. For data collected from an instrument that has been installed to replace a damaged instrument, use formal initial reading as an initial reading for replacement instrument so that data are continuously plotted, without an offset at time of damage. Note time of damage and replacement on plot.

3.8 INTERPRETATION AND RESPONSE VALUES

- A. Make interpretations of data resulting from monitoring programs.
- B. Threshold and Limiting Values for Instruments:

	<u>Instrument</u>	<u>Threshold Value</u>	<u>Limiting Value</u>
1.	Seismographs:	1.0 in/sec over 40 Hz 0.75 in/sec at 30 to 40 Hz 0.50 in/sec at 20 to 30 Hz 0.25 in/sec under 20 Hz	2.0 in/sec over 40 Hz. 1.5 in/sec at 30 to 40 Hz. 1.0 in/sec at 20 to 30 Hz. 0.5 in/sec under 20 Hz.
2.	Surface Monitoring Points:	0.5 inch	1.0 inch.
7.	Deformation Monitoring Points:	0.25 inch	0.5 inch.
4.	Excavation Support:	1.0 inch	2.0 inches

Values are subject to adjustment by the Engineer as indicated by prevailing conditions or project circumstances. Crack Gauge criteria will be established based upon existing conditions identified during preconstruction survey.

- C. If a Threshold Value is reached:
 - 1. Engineer and Contractor will meet to discuss remedial measures.
 - 2. Increase instrument monitoring frequency as directed by the Engineer.
 - 3. Install and monitor additional instruments as directed by the Engineer.
 - 4. Implement remedial measures in event Threshold Value is reached, so Limiting Value is not reached.
- D. Take necessary steps so Limiting Value is not exceeded. Engineer may direct Contractor to suspend activities in affected area with exception of those actions necessary to avoid exceeding Limiting Value.

3.9 TOLERANCES

- A. Survey Measurements: Initial location of each instrumentation elements consisting of determining elevation and horizontal positions with respect to the Engineer approved benchmarks.
- B. Monitoring Points (SMPs, DMPs, and ESMPs):
 - 1. Instrumentation Elevations: Determine to accuracy of plus/minus 0.01 foot.
 - 2. Horizontal Position of Surface Monitoring Points: Determine to accuracy of plus/minus 0.1 foot.
 - 3. Horizontal Position of Deformation Monitoring Points and Excavation Support Monitoring Points: Determine to accuracy of plus/minus 0.01 foot
 - 4. If actual field conditions prohibit installation at location and specified elevations, obtain prior acceptance from the Engineer for new instrument location and elevations.

3.10 DISPOSITION OF INSTRUMENTS

- A. Monitoring Points and Crack Gauges: Remove monitoring points and crack gauges during cleanup and restoration work, unless directed otherwise by the Engineer.
- B. Seismographs: Remove units following completion of demolition, rock excavation, installation of excavation support, and excavation.

END OF SECTION 310900

SECTION 311000 - SITE CLEARING

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. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing, and abandoning site utilities in place.
8. Temporary erosion and sedimentation control.

- B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.
2. Section 312316 "Rock Removal" for rock and boulder excavation.
3. Section 312500 "Erosion and Sedimentation Controls" for temporary protection of erosion and sedimentation.

1.3 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.
- D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.6 INFORMATIONAL SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - 1. Use sufficiently detailed photographs or video recordings.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.
- B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.7 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed roadways if required by Owner or authorities having jurisdiction.
- B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises.
- C. Utility Locator Service: Notify Dig Safe System for area where Project is located before site clearing.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.
- E. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earthwork."
 - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.
- C. Call Local Utility Line Information service not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 EXISTING UTILITIES

- A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
 - 1. Arrange with utility companies to shut off indicated utilities.

- B. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner and Engineer not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Engineer's written permission.
- D. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Grind down stumps and remove roots larger than 3 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
 - 3. Use only hand methods or air spade for grubbing within protection zones.
 - 4. Chip removed tree branches and dispose of off-site.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to depth in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
 - 1. Limit height of topsoil stockpiles to 72 inches.
 - 2. Do not stockpile topsoil within protection zones.
 - 3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.

3.6 STOCKPILING ROCK

- A. Remove from construction area naturally formed rocks that measure more than 1 foot across in least dimension. Do not include excavated or crushed rock.
 - 1. Separate or wash off non-rock materials from rocks, including soil, clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- B. Stockpile rock away from edge of excavations without intermixing with other materials. Cover to prevent windblown debris from accumulating among rocks.
 - 1. Limit height of rock stockpiles to 36 inches.
 - 2. Do not stockpile rock within protection zones.
 - 3. Dispose of surplus rock. Surplus rock is that which exceeds quantity indicated to be stockpiled or reused.

3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other project work.

END OF SECTION 311000

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SECTION 312000 – EARTHWORK

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. General: Earthwork includes clearing and stripping, procurement of on-site and imported fill material, excavating, placing, and compacting fill and backfill, structural excavating and backfilling, transportation, and storage of excess earthwork materials; disposal of unsuitable, waste, and surplus materials; restoration of excavation and trench surfaces; and subsidiary work necessary to complete the grading of developed areas to conform with required lines, grades, and slopes.
- B. Work includes but is not necessarily limited to; excavation for structures, tanks, foundations, manholes, vaults, pipes, paving; embankments; grading; and related work such as sheeting, bracing and dewatering.
- C. Provide services of a licensed Professional Engineer registered in the State of New York to prepare temporary excavation support system, dewatering system designs, and submittals.
- D. Provide temporary excavation support systems, including sheeting, shoring, and bracing, to ensure the safety of personnel and protect adjacent structures, piping, and other materials in accordance with Federal, State, and local laws, regulations, and requirements. Temporary excavation support systems are specified in Section 315000 “Excavation Support and Protection.”
- E. Provide temporary dewatering, surface water control systems, and operate to dewater and maintain excavations in a dry condition. Control drainage into excavations and remove seepage water and rainwater. Dewatering and surface water control are specified in Section 312319 “Dewatering.”
- F. Examine site and review available geotechnical report prior to submitting a proposal, taking into consideration project conditions that may affect the work. Owner and Design Engineer do not assume responsibility for variations of subsurface conditions at locations other than places shown and at the time investigations were made.
- G. Do not initiate extra work without written notification to Owner and Engineer and receiving Owner’s written approval in response.
- H. Protect existing structures and utilities that remain.
- I. Related Requirements:

1. Section 013200 "Construction Progress Documentation."
2. Section 013233 "Photographic Documentation" for recording pre-excavation and earthwork progress.
3. Section 310515 "Soils and Aggregates for Earthwork" for fill materials.
4. Section 310519 "Geotextiles for Earthwork" for geotextile materials.
5. Section 311000 "Site Clearing" for site preparation work, including stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
6. Section 312333 "Trenching and Backfilling" for stated work.
7. Section 312316 "Rock Removal" for excavation of rock and boulders.
8. Section 312319 "Dewatering" for controlling surface and groundwater and disposing of water during construction.
9. Section 312500 "Erosion and Sedimentation Controls" for temporary stated work.
10. Section 315000 "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
11. Section 321216 "Asphalt Paving" for flexible paving system.

1.3 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- C. Coverage: Pass of compaction equipment over the complete surface area of exposed lift or subgrade to receive compaction.
- D. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 2. Unauthorized Additional Excavation: Excavation as directed by Engineer to correct Contractor's work not in compliance with Contract Documents, which will be performed without additional compensation.
 3. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
 4. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be provided without additional compensation.
- E. Finished Grade: Required final grade elevation indicated on Drawings. Spot elevations take precedent over proposed contours.
- F. In-the-Dry: An excavation subgrade where groundwater level: has been lowered to at least 2 feet below lowest level of excavation; is stable with no ponded water, mud, or muck; is able to

support construction equipment without rutting or disturbance; and is suitable for placement and compaction of fill material, pipe, or concrete foundations.

- G. **Objectionable Material:** Includes topsoil, organic matter, contaminated soil, construction debris, perishable materials, snow, ice, frozen earth, and rocks or lumps of cemented soils over 6 inches in maximum dimension.
- H. **Optimum Moisture Content:** Moisture content (percent by dry weight) corresponding to maximum dry density of the same material as determined by ASTM Test Method D1557.
- I. **Overexcavation:** Removal of unsuitable soil or objectionable material at or below the normal grade of excavation or subgrade as indicated on Drawings.
- J. **Percent Compaction:** Required in-place dry density of the material, expressed as a percentage of the maximum dry density of the same material, as determined in the laboratory by ASTM Test Method D1557.
- K. **Structures:** Buildings, wet wells, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, manholes and vaults, or other man-made stationary features constructed above or below the ground surface.
- L. **Subgrade:** Required surface of subsoil, borrow fill, or compacted fill that is immediately beneath site improvements, especially dimensioned fill, paving, or other surfacing material.
- M. **Unsuitable Soil:** Includes existing fill materials, organic soils, weak native soils, or clays with a plasticity index of greater than 30, and any materials that cannot be properly placed and compacted as specified.
- N. **Utilities:** On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.
- O. **Zone of Influence:** A line extending at least 2 feet beyond foundation or pipeline edge, then outward and downward at a slope of 1 horizontal to 1 vertical. Do no excavation below foundation of existing structures or pipeline.
- P. **Professional Engineer:** Registered Professional Engineer registered in the State of New York meeting project qualifications and who is hired by Contractor.
- Q. **The Engineer:** The Engineer or designated representative hired by Owner.
 - 1. Approval given by the Engineer shall not relieve Contractor of its responsibilities for performing the work in accordance with Contract Document requirements.

1.4 ACTION SUBMITTALS

- A. Coordinate various submittal types required by this Section with requirements of dewatering, support of excavation, rock removal, and soils and aggregates for earthwork submittals specified in other Sections.

- B. Prepare excavation support system designs by a licensed Professional Engineer, registered in the State of New York and having a minimum of 5 years of professional experience in design and construction of excavation support systems.
 - 1. Submit an original and three copies of licensed Professional Engineer's certification, on PE form specified in Section 013300 "Submittal Procedures," stating excavation support systems designs have been prepared by Professional Engineer who is responsible for their execution.

1.5 INFORMATIONAL SUBMITTALS

- A. Construction and Operations Plan: Submit proposed methods of construction, including earthwork operations, excavation limits, slopes, fill material moisture conditioning and handling, compaction equipment, excavation support systems designs, backfilling and filling and compaction, and material sources.
 - 1. Include additional submittal requirements related to schedule, work sequence, and on-site and off-site storage when necessary, based on project conditions.
 - 2. Submit excavation support system plan as prepared by registered Professional Engineer complying with requirements stated in previous Article.
- B. Submit copies of field daily reports by soil technician at the end of each work-day that earthwork and grading operations occur.
- C. Upon completion of earthwork and grading operations, submit an as-graded map showing density test numbers and locations, a table of density test results and depths, and a certification of compliance by geotechnical engineer in charge.
- D. Qualification Data: For qualified testing agency to conduct geotechnical observation, testing and documentation. include qualifications of firm, resumes of soil technicians assigned to the project, and licensed geotechnical engineer in charge.
 - 1. Firm Qualifications: Meet ASTM D3740.
 - 2. Soil Technicians: Have minimum three years demonstrated experience in earthwork and grading operations and satisfy certification requirements of agency having local jurisdiction.
 - a. The Engineer reserves right to request substitution of soil technicians assigned to field work. Do not substitute assigned soil technicians without prior approval of the Engineer.
- E. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earthwork operations. Submit before earthwork begins.

1.6 QUALITY ASSURANCE

- A. Excavation, trenching, sheeting, bracing, and similar work shall comply with requirements of OSHA excavation safety standards, 29 CFR Part 1926 Subpart P and State and local authorities

having jurisdiction. Apply most stringent requirements where conflict between OSHA, State and local regulations exist.

- B. At least three working days prior to starting any excavation, notify the appropriate regional notification center for underground utilities and underground utility owners who are not members of notification center. To obtain area specific information for project site, refer to [www.call 811.com](http://www.call811.com).
- C. Quality Control Testing for Off-site Borrow Materials:
 - 1. Chemical testing will not be required where site characterization of off-site borrow sources indicates that soils are acceptable for use. If site characterization data or materials are suspected of being contaminated, perform chemical testing as directed by The Engineer with no additional compensation.
 - 2. Chemical Test Data: Test each material source requiring testing by a person experienced in sample collection who is a registered Professional Engineer or geologist, or certified groundwater or environmental professional registered in the State of New York. Submit samples of each proposed material to a chemical analytical laboratory, certified by the governing agency, for following analyses:
 - a. Volatile Organic Compounds: EPA 8240 plus Hazardous Substance List (HSL) Parameters.
 - b. Acid and Base Neutral Extractable Organic Compounds: EPA 8270.
 - c. Pesticides and PCBs: EPA 8080.
 - d. Total Petroleum Hydrocarbons: Infrared Method, EPA 9071/418.1.
 - e. Thirteen Priority Pollutant Metals: EPA 7000 Series.
 - f. Total Cyanide: EPA 9012.
 - 3. Obtain and test off-site borrow samples in accordance with criteria established by the Engineer. Submit results for review and approval prior to use on site.

1.7 FIELD CONDITIONS

- A. Be responsible for construction layout and reference staking necessary for proper control and satisfactory completion of structures, cutting, filling, grading, drainage, fencing, embankment improvements, curbing, and other appurtenances.
- B. Perform construction layout and staking by a Professional Surveyor or Professional Engineer registered in the State of New York, experienced and skilled in construction layout and staking requirements.
- C. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earthwork operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

- D. Utility Locator Service: Notify Dig Safely New York for area where Project is located before beginning earthwork operations.
- E. Do not commence earthwork operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 015000 "Temporary Facilities and Controls" and Section 311000 "Site Clearing" are in place.
- F. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Foot traffic.
 - 4. Erection of sheds or structures.
 - 5. Impoundment of water.
 - 6. Excavation or other digging unless otherwise indicated.
 - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- G. Do not direct vehicle or equipment exhaust towards protection zones.
- H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Fill materials designated for use in this Section are specified in Section 310515 "Soils and Aggregates for Earthwork."
- B. On-Site Fill Material: Earth and rock material obtained at project site during excavation, following clearing and stripping, from which any Unsuitable Soil or Objectionable Material has been removed.
- C. General: Provide imported fill materials when sufficient satisfactory soil materials are not available from excavations.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, tanks, utilities, sidewalks, pavements, fencing, landscaping, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
 - 1. If necessary, remove and restore or replace curbing, driveway aprons, and fencing after performing backfilling work.
 - 2. Replace existing facilities damaged by construction with new material fully equal to existing without additional compensation.

- B. Prior to and During Earthwork Operations:
 - 1. Protect and maintain erosion and sedimentation controls; coordinate with Section 312500 “Erosion and Sedimentation Controls.”
 - 2. Provide, monitor, and maintain excavation support; coordinate with Section 315000 “Excavation Support and Protection.”
 - a. Use excavation support system for excavations within the zone of influence for existing structures or utilities.
 - b. Do not permit excavations below base level of adjacent foundations or retaining walls, unless excavation design and bracing includes an analysis of structure’s stability supported by the foundation. When necessary due to project conditions, incorporate required bracing and foundation underpinning.
 - 3. Provide, monitor, and maintain dewatering and drainage systems; coordinate with Section 312319 “Dewatering.”
- C. Test Pits:
 - 1. Perform exploratory excavation work, test pits, for purpose of verifying the location of underground utilities and structures and to check for unknown utilities and structures, prior to commencing excavation work.
 - 2. As earthwork progresses, perform test pits for the purpose of compaction testing. Pause operations and provide safe access for testing personnel.
 - 3. Backfill and compact test pits as soon as desired information has been obtained. Stabilize backfilled surfaces in accordance with approved erosion and sedimentation control plans.
- D. Clearing and Stripping. Initially clear and strip ground surfaces beneath planned structures and in areas requiring excavation or filling of organic material and debris. Do not use those materials as On-Site Fill Material; remove from the site and properly disposed or reused as topsoil in landscape areas.
- E. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.
- F. Saw cut existing pavement with a saw, wheel, or pneumatic chisel along straight lines before excavating.

3.2 DEWATERING AND DRAINAGE

- A. Provide dewatering and drainage in accordance with Section 312319 “Dewatering”. This Article supplements those requirements.
- B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff and groundwater seepage away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
- D. Prior to excavation, verify groundwater will be at required level indicated on approved dewatering and drainage submittal.
- E. Accomplish dewatering by methods that preserve undisturbed state of subgrade soils. Dewater in a manner to prevent boiling, detrimental under-seepage, or disturbance at excavation base.

3.3 SUPPORT OF EXCAVATION

- A. Provide excavation support in accordance with Section 315000 “Excavation Support”. This Article supplements those requirements.
- B. Install excavation support in accordance with reviewed Shop Drawings prior to beginning excavation work. Maintain excavation supports that are required to remain in place, if applicable, as indicated on Drawings or as required by approved Shop Drawings.
- C. Owner or Engineer may direct that certain excavation supports remain in place or be cut off at any specific elevation. Supports directed by Owner or Engineer to be left in place and not so designated on Contract Documents will be paid for according to Contract provisions for changes in the Work.
- D. The right of Owner or Engineer to direct that certain excavation supports remain in place shall not be construed as creating any obligation on Owner or Engineer to give such direction, nor shall failure to give such direction relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place sufficient excavation supports to prevent any movement of the ground or damage to adjacent structures.
- E. Construct temporary excavation slopes in accordance with the requirements of OSHA excavation safety standards and approved Shop Drawings.
- F. Where allowed, carefully remove excavation supports in a manner without endangering the Work or other adjacent structures, utilities, or property. Immediately fill voids left or caused by withdrawal of supports with sand and compact.

3.4 EXCAVATION

- A. Include material of every description and of whatever substance encountered as an unclassified excavation.
- B. General: Excavate on-site soils using standard earthmoving equipment. Excavation in dense soil or rock may require special equipment. Do not plough, scrape, or dig earth with machinery so near to finished subgrade to result in excavation of or disturbance of below grade material.

- C. Make excavations to grades indicated on Drawings and in widths sufficient for laying of pipe, construction of the structure, installing bracing, excavation supports, dewatering and drainage facilities, and working clearances.
- D. Perform excavation in-the-dry and accomplished by methods which preserve the natural undisturbed condition of subgrade soils.
- E. Moisture Sensitive Soils: Use a smooth-edge bucket to excavate last one foot of depth when excavation is to end in such soils.
- F. If excavation bottom is removed below the limits shown on Drawings, specified, or directed by the Engineer, refill with structural fill, screened gravel enveloped with filter fabric or other material satisfactory to the Engineer without additional compensation.
- G. When excavation has reached prescribed depths, notify the Engineer who will observe the conditions. If materials and conditions are not satisfactory, the Engineer will issue instructions for corrective procedures. The Engineer will be the sole judge as to whether the work has been accomplished satisfactorily.
- H. Subgrade soils that have become soft, loose, quick, or otherwise unsatisfactory due to inadequate excavation, dewatering, or other construction methods in the opinion of the Engineer, remove existing soil and replaced with structural fill or screened gravel enveloped with filter fabric as acceptable to the Engineer at Contractor's expense.
- I. Exposed subgrades for foundations shall be proof rolled with at least two overlapping coverages of a vibratory drum roller with a minimum static drum weight of 10 tons. Conduct proof-rolling in presence of the Engineer. The Engineer will waive this requirement, if in its opinion the subgrade will be rendered unsuitable by such proof-rolling.
 - 1. Confined Areas: Proof-roll with hand operated vibratory equipment that is approved by the Engineer.
- J. Perform overexcavation at the Engineer's request to remove unsuitable soil, objectionable material, or other materials as determined by the Engineer and to such depth and width as directed. Replace with suitable material as directed by the Engineer.
 - 1. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- K. Perform excavation for pipelines beneath structures and excavation for footings with excavating equipment operating from the subgrade for the structure, while in-the-dry and in a manner preserving the undisturbed state of subgrade soils.
- L. When excavations have reached the required subgrade, including any allowances for working mats or base materials and prior to their placement, notify soils testing laboratory to verify suitability of existing subgrade soils for anticipated foundation and structural loadings.
 - 1. If existing subgrade soils are determined to be unsuitable, follow direction provided by the Engineer regarding removal and replacement with suitable materials.
 - 2. Notify the Engineer if the revised work scope would modify Contractor's cost and thereby entitle a change to the Contract Sum. Authorized additional excavation and

replacement material will be paid for according to Contract provisions for changes in the Work.

- M. Replace overexcavation beyond the limits and depths required by Contract Documents using structural fill, screened gravel enveloped with filter fabric, or other material satisfactory to the Engineer without additional compensation.

3.5 SUBGRADE PREPARATION

- A. Notify Engineer when excavations have reached required subgrade.
- B. Maintain excavated subgrade in-the-dry condition.
- C. Prior to fill placement, remove objectionable material which includes, but not be limited to, pavement, topsoil, organic matter, contaminated soil, construction debris, perishable materials, snow, ice, frozen earth, and rocks or lumps of cemented soils over 6 inches in maximum dimension.
- D. For subgrades consisting of granular soils, proof roll the final subgrade using at least four coverages of a vibrator plate compactor.
- E. Where existing subgrade contains a significant amount of clay or cohesive soils, over-excavate sufficiently below the bottom of structure for placement of a lean concrete working mat. Remove loose or soft material from the subgrade immediately prior to placing lean concrete working mat.
- F. Remove and replace soft subgrades or unusable material with structural fill, screened gravel enveloped with filter fabric, or other material satisfactory to the Engineer.
- G. During wet or freezing weather, or in areas where exposed subgrade consists of moisture-sensitive soils, take measures to protect foundation excavations once they have been approved by the Engineer. Protective measures include, but are not limited to, placing insulation blankets, placing a layer of fill, pea gravel, crushed rock, or lean concrete on the exposed subgrade, or covering the exposed subgrade with a plastic tent.
 - 1. If additional over excavation is required due to the subgrade not being protected against wet or freezing weather, perform additional work without additional compensation.
- H. Notify the Engineer to observe conditions following subgrade preparation and prior to fill placement. If existing subgrade soils are determined to be unsuitable, follow direction provided by the Engineer regarding removal and replacement with suitable materials.
 - 1. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

3.6 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust. Protect from precipitation.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.7 FILL PLACEMENT AND COMPACTION PROCEDURES

- A. Fill and Backfill: Place materials in lifts to suit specified compaction requirements to required lines and grades, making allowances for settlement and placement of cover materials, such as topsoil or sod. Correct soft spots or uncompacted areas.
- B. Do not place or compact fill and backfill when materials are too wet to properly compact.
 1. In-place Soil Moisture Content: Maximum of three percentage points above optimum moisture content of soil, as determined by laboratory test of moisture-density relation appropriate to specified level of compaction.
- C. Structural Fill and Embankment Fill: Construct to required lines and grades, making allowances for settlement and placement of cover materials, such as topsoil and sod. Correct soft spots or uncompacted areas.
- D. Fill material shall be free of snow, ice, frost, and frozen earth. Do not place fill materials on frozen surfaces or surfaces covered by snow, ice, or frost.
- E. Complete structure water-tightness tests and installation of damp-proofing or waterproofing systems, if required, prior to placing various types of fill or backfill around structures.
- F. If subgrade slopes more than 10 percent, step subgrade to produce a stable, horizontal surface for placement of fill materials. Scarify existing subgrade slope to a depth of at least 6 inches.
- G. Compact filled slopes by slope rolling and trimming or overfill and trim back to plan grade to expose a firm, smooth surface free of loose material.
- H. Do not allow fill lifts to contain stones with a dimension larger than $\frac{2}{3}$ the specified loose measure lift thickness.
- I. Perform compaction in open areas using compaction equipment by any of the following methods:
 1. Heavy vibratory rollers.
- J. Confined Compaction: Perform compaction in confined areas, including areas within a 45-degree angle extending upward and outward from the base of a wall, and in areas where the use of large equipment is impractical, using hand-operated vibratory equipment or mechanical tampers.
 1. Do not exceed lift thickness of 6 inches, measured before compaction, when using hand operated equipment.
- K. Moisture condition on-site fill material prior to placement, unless Contractor demonstrates to the Engineer in-place moisture conditioning methods can achieve the required moisture content.

- L. Conduct compaction of each specified lift of fill materials by a minimum of four complete coverages with acceptable compaction equipment to a specified density as a percentage of maximum dry density as determined by ASTM D1557, unless otherwise specified.
- M. Use structural fill required beneath foundations or slabs on grade, except sidewalks. Place and compact structural fill in even lifts having a maximum thickness of 8 inches, measured before compaction.
- N. Use select fill and backfill material placed within 10 feet of all structures. Uniformly place and compact select fill around the structure in even lifts having a maximum thickness of 8 inches, measured before compaction.
- O. Use common fill in areas beyond those designated for structural fill or select fill, unless shown or otherwise specified. Place in even lifts having a maximum thickness of 12 inches, measured before compaction.

3.8 COMPACTION REQUIREMENTS

- A. Perform in-place testing of compacted fill lifts to measure in-place density and water content.
- B. Beneath Foundations and Slabs-on-Grade, except sidewalks: Compact top 12 inches of existing subgrade and each layer of fill, if applicable to:
 - 1. Maximum Dry Density: Minimum of 95 percent for ASTM D1557.
 - 2. Moisture Content: At or near its optimum moisture content of minus 2 percent to plus 3 percent.
- C. Area Around Structures: Within 10 feet compact each fill or backfill layer to: Maximum Dry
 - 1. Density: Minimum of 92 percent for ASTM D1557.
 - 2. Moisture Content: At or near its optimum moisture content of minus 2 percent to plus 3 percent.
- D. Embankments, Lawn, or Unimproved Areas: Does not include embankments under roadways and earth dam structures. Compact each fill or backfill layer to:
 - 1. Maximum Dry Density: Minimum of 90 percent for ASTM D1557.
 - 2. Moisture Content: At or near its optimum moisture content of minus 1 percent to plus 4 percent.
- E. Sidewalks: Compact each fill layer to:
 - 1. Maximum Dry Density: Minimum of 92 percent for ASTM D1557.
 - 2. Moisture Content: At or near its optimum moisture content of minus 2 percent to plus 3 percent.
- F. Roads, Paved Areas, and Roadway Embankments: Compact each layer of fill or backfill to:
 - 1. Maximum Dry Density: Minimum of 95 percent for ASTM D1557.
 - 2. Moisture Content: At or near its optimum moisture content of minus 2 percent to plus 3 percent.

3.9 DISPOSAL OF UNSUITABLE, WASTE, AND SURPLUS EXCAVATED MATERIALS

- A. Unsuitable soil, objectionable material, waste, and surplus excavated material shall be removed and disposed of off-site. Materials may be temporarily stockpiled in an area within the limits of construction that does not disrupt construction activities, create any nuisances or safety hazards, or otherwise restricts access to work site.
- B. Topsoil or loam excavated under this Section may be salvaged for use as specified under Section 329200 "Turf and Grasses", as approved by the Engineer.

3.10 GRADING

- A. Perform grading to lines and grades shown on Drawings. Remove objectionable materials encountered within the limits indicated and disposed of off-site. Completely and continuously drained and dewatered subgrades throughout the grading process. Install temporary drains and drainage ditches to intercept or divert surface water that may affect the execution or condition of grading work.
- B. If it is not possible at the time of grading to place material in its proper section of the Work, stockpile it in approved areas for later use. No additional compensation will be made for stockpiling or double handling of excavated materials.
- C. In cut areas, remove loose or protruding rocks in slopes to line or finished grade of the slope. Uniformly dress, cut, and fill slopes to slope cross-section and alignment shown on Drawings, unless otherwise directed by the Engineer.

3.11 FIELD QUALITY CONTROL

- A. Test and observe materials as described in this Article. Cooperate by allowing free access to work for selection of test materials and observations.
- B. General Testing Requirements:
 - 1. At Structures: Prior to placement of bedding material, concrete work mats, structural fill or structural concrete, coordinate with the Geotechnical Engineer to verify suitability of existing subgrade soil.
 - 2. Backfill and Fill: Prior to and during the placement of backfill and fill coordinate with the Geotechnical Engineer or Soils Testing Laboratory to perform in-place soil density tests to verify that backfill and fill material has been placed and compacted in accordance with specified compaction requirements.
 - a. Provide minimum 48 hours' notice prior to placement of backfill and fill.
 - 3. Subgrade: Do not cover with fill without observation, testing, and approval by the Geotechnical Engineer.
 - a. Earthwork activities performed without properly scheduled inspection are subject to removal and replacement or additional testing as directed by the Engineer without additional compensation.

- C. Test materials by a certified independent laboratory, engaged by Contractor and acceptable to the Engineer, demonstrating conformance with project requirements. Deliver test reports and material certifications to the Engineer before using any material in the work.
 - 1. Owner will make payment for laboratory and in place density testing.
- D. If field test results are not in conformance with project requirements, costs involved in correcting deficiencies in compacted materials to satisfaction of the Engineer are without additional compensation.
- E. Earthwork activities performed without properly scheduled inspection are subject to removal and replacement or additional testing as directed by the Engineer without additional compensation.
- F. Testing methods shall comply with latest ASTM or equivalent AASHTO Standards applicable during bidding.
- G. During placement of bedding, backfill, and fill, perform in-place soil density testing to confirm that fill material has been compacted in accordance with project requirements. The Engineer may designate areas to be tested. Notify the Engineer at least 72 hours in advance of scheduled compaction testing. In place soil density tests on backfill and fill material shall be as required by authorities having jurisdiction, project geotechnical report,, but in no instance, shall less than those listed:
 - 1. Structures and Embankments: At least one density and moisture content test for each 2,500 square feet of surface area for each lift of fill at embankment, structure, and manhole locations.
 - 2. Trench Excavations: At least one nuclear density and one moisture content test at a maximum of 50 feet intervals for each lift of fill placed or as directed by the Engineer.
 - 3. The Engineer may designate supplemental areas to be tested at additional compensation.
- H. Materials which have been previously tested may be subjected to further testing from time to time and may be rejected if it is determined that results do not conform to project requirements. Immediately remove rejected materials when directed by the Engineer, notwithstanding results of previous testing.
- I. The Engineer or Owner may conduct additional soil testing. Cooperate fully in allowing additional test to be made, including free access to the work.
- J. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.

3.12 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by the Engineer; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION 312000

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SECTION 312316 - ROCK REMOVAL

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. Excavating, removing, and disposing of identified and discovered rock and boulders during excavation.
2. Tools to assist rock removal.
3. Backfill in place of the excavated rock.

- B. Related Requirements:

1. Section 310515 “Soils and Aggregates for Earthwork” for backfilling material.
2. Section 310900 “Geotechnical Instrumentation and Monitoring” for geotechnical measurements.
3. Section 312000 “Earthwork” for excavation, backfilling, and filling operations.
4. Section 312333 “Trenching and Backfilling” for trenching and backfilling for utilities.
5. Section 312500 “Erosion and Sedimentation Controls.”
6. Section 315000 “Excavation Support and Protection.”

1.3 DEFINITIONS

- A. Rock: Intact mass of stone, bedrock, or ledgerrock.
- B. Boulder: Rock fragments exceeding 1 cubic yard in volume.
- C. Rock Excavation: Removal of intact rock, which in The Engineer’s opinion cannot be removed by conventional mechanical excavation equipment and requires continuous, systematic drilling, blasting, wedging, sledging, cutting, barring, jack hammering, hoe ramming or expansive chemical splitting.
- D. Boulder Excavation: Removal of non-intact boulders that can be removed by conventional mechanical excavation equipment.
- E. Conventional Mechanical Excavation Equipment: Bulldozer or tractor, drawing a single tooth hydraulic ripper with a minimum drawbar pull of 18,300 pounds.
- F. Soil Excavation:

1. Rock fragments less than 1 cubic yard in volume that can be removed by conventional mechanical excavation.
 2. Removal of earth, weathered rock, and rock fragment that can be removed by conventional mechanical excavation.
 3. Soil excavation includes excavation of earth materials that are not considered as rock excavation or boulder excavation.
- G. Loose or disintegrated rock, rotted shale, nested stones, hardpan, and like materials are not considered as rock or boulder.
- H. Abutter: Owner of an adjoining property.
- I. The Engineer: Engineer hired by Owner.

1.4 ACTION SUBMITTALS

- A. Submit means and methods description at least two weeks prior to commencing rock and boulder excavation.
1. Identify techniques including size and energy of impact equipment and chemical properties of agents to be used for chemical splitting.
 2. Name and qualifications of persons responsible for monitoring and reporting rock excavation vibrations.
- B. Review by The Engineer of Contractor's submittals does not relieve Contractor of responsibility for accuracy, adequacy, and safety of rock and boulder excavation, exercising proper supervision and field judgment, and producing results specified in this Section.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Uncover rock when encountered, but do not excavate until measurements are made by The Engineer.

3.2 ROCK REMOVAL

- A. Perform rock excavation by drilling, wedging, sledging, cutting, barring, jack hammering, hoe ramming, expansive chemical splitting, or other similar process in a manner, which does not cause damage to existing structures, new construction, or affecting Owner operations.
- B. Blasting is not allowed.

- C. Perform rock excavation operations to comply with project, state, and local noise and dust regulations.
- D. When below grade excavation methods shatter rock and is unfit for subgrade, as determined by The Engineer, remove rock and refill excavation with thoroughly compacted screened gravel, structural fill, or lean concrete without additional compensation.

3.3 BOULDER EXCAVATION

- A. Boulder and rock fragments up to 1 cubic yard in volume may be reduced in size by rock excavation methods to simplify its removal.

3.4 DISPOSAL OF ROCK AND BOULDERS

- A. Fragmented rock with dimensions not exceeding 6 inches in any direction may be mixed with common fill and used as common fill in accordance with Section 310515 “Soils and Aggregates for Earthwork.”
- B. Crushed and screened rock and boulders may be for reused in the work, provided resultant materials meet requirements for gravel, crushed stone, or structural fill as specified in Section 310515 “Soils and Aggregates for Earthwork.”
- C. Stockpile excavated material without excessive surcharge on excavation or obstructing free access to hydrants and gate valves. Avoid inconvenience to traffic and abutters as much as possible.
- D. Should conditions make it impracticable or unsafe to stack material adjacent to excavations, haul and store material at provided location. When required, re-handle and use it for trench backfilling without additional compensation.
- E. Replace rock and boulder material disposed of by wasting using available surplus suitable soils. Where there is a deficiency of surplus backfill material, provide common fill without additional compensation.
- F. Remove and dispose off-site unused rock and boulders.

END OF SECTION 312316

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SECTION 312319 - DEWATERING

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 temporary construction dewatering and surface water control, and incorporates the design, equipment, materials, installation, operation, protection, monitoring and removal of dewatering and drainage system. Provide a dewatering system sufficient to lower groundwater and collect surface water, regardless of groundwater level or rainfall at any time during the work.
 - 1. Provide, operate, and maintain dewatering equipment and systems, as required during the Contract.
 - 2. Provide standby equipment and power supply for maintaining uninterrupted construction dewatering.
 - 3. Install groundwater monitoring wells/piezometers and measure, record and report the levels/hydraulic head of groundwater as required during the project. The Contractor is responsible for confirming site groundwater conditions prior to completing design of the dewatering system and conducting site excavation work.
 - 4. Obtain and comply with necessary permits from State and local agencies required for operation of the dewatering system, monitoring groundwater, and disposal of dewatering effluent.
 - 5. Collect samples of the dewatering effluent as required by the applicable State and local permits and provide the services of a laboratory certified under the New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) for the analyses of the samples collected to determine the quality of dewatering effluent prior to disposal.
- B. Related Requirements:
 - 1. Section 013233 "Photographic Documentation" for recording preexisting conditions and dewatering system progress.
 - 2. Section 310515 "Soils and Aggregates for Earthwork" for filter sand.
 - 3. Section 310519 "Geotextiles for Earthwork" for filter fabric materials.
 - 4. Section 310900 "Geotechnical Instrumentation and Monitoring" for monitoring.
 - 5. Section 312000 "Earthwork" for excavating, backfilling.
 - 6. Section 312316 "Rock Removal" for removal of rock and boulders.
 - 7. Section 312333 "Trenching and Backfilling" for trenching, backfilling, and compaction.
 - 8. Section 312500 "Erosion and Sedimentation Controls" for controlling surface-water runoff and ponding.
 - 9. Section 315000 "Excavation Support and Protection" for support of excavations.

10. Division 32 "Site Improvements" for various Sections relating to civil and landscape related work.

1.3 DEFINITIONS

- A. Construction Dewatering: Controlling groundwater levels, hydrostatic pressures, and surface water, such that excavations required on the Contract Drawings can be performed to required depths in substantially dry and stable conditions.
- B. Dewatering System: System of wells, well points, sumps, ejectors, pumps, piping, power supply, effluent treatment equipment and other equipment designed by the Contractor, submitted to and approved by the Engineer prior to dewatering, that will effectively dewater the site as required herein. Adequate monitoring wells/piezometers shall be included in the dewatering system to verify drawdown levels inside the excavation area and monitor groundwater levels outside the limits of the excavation near adjacent structures.
- C. In-the-Dry: An excavation subgrade where all of the following are met:
 1. Groundwater level has been lowered to at least 2 feet below lowest excavation level.
 2. Subgrade is stable with no ponded water, mud, or muck.
 3. Subgrade is able to support construction equipment without rutting or disturbance.
 4. Subgrade is suitable for placement and compaction of fill material, pipe, or concrete foundations.
- D. Contractor's Engineered Design: Design prepared on behalf of Contractor by a registered Professional Engineer.
- E. Professional Engineer: Professional Engineer registered in the State of Massachusetts meeting project qualifications and who is hired by Contractor.
- F. The Engineer: Engineer hired by Owner.
 1. Approvals given by The Engineer shall not relieve Contractor of its responsibilities for performing the work in accordance with Contract Document requirements.

1.4 ACTION SUBMITTALS

- A. Dewatering submittals shall be coordinated with excavation and support of excavation submittals.
- B. Pre-Construction Submittals: A Dewatering Plan shall be submitted to the Engineer for approval, at least 30 calendar days prior to the scheduled date for commencement of the dewatering Work. Approval of the Dewatering Plan by the Engineer or City shall not in any way relieve the Contractor from full responsibility for the complete and adequate design and performance of the dewatering system to provide the necessary construction dewatering. At a minimum, the Dewatering Plan shall include the following:

1. Design calculations confirming the adequacy of the proposed dewatering system, including depths to groundwater within the excavation limits. The Contractor is responsible for confirming the depth to site groundwater prior to conducting site work.
 2. Calculations and requisite technical data on well screens and filter materials and gradations to demonstrate the adequacy of proposed systems to prevent the pumping of fines.
 3. Sequence of well and well-point placement coordinated with support of excavation system installation and control procedures to be adopted if dewatering problems arise.
 4. Identification of anticipated area influenced by dewatering system and address impacts to adjacent existing and proposed structures.
 - a. Include detailed plans for pre-construction surveys of existing structures in vicinity of dewatering system, settlement monitoring of existing structures during construction, and provisions to address settlement of existing structures resulting from dewatering activities.
 5. Shop drawings showing the proposed types and planned locations of surface water control and the dewatering system to be used.
 6. Shop drawings shall include plans, elevations, sections and details; the arrangements, locations and depths of the dewatering system, a complete description of equipment and materials to be used, and the procedures to be followed in installation, operation and maintenance in relation to the proposed sequence of excavation, foundation construction, and backfilling.
 7. Include pump capacity and anticipated discharge rate.
 8. Show areas and depths of excavation to be dewatered and adjacent structures or facilities within the anticipated area influence.
 9. The standby equipment and standby power supply details.
 10. The proposed locations and sizes of effluent treatment equipment, effluent flow equalization tanks and discharge of water.
 11. Location and size of sumps, ditches, and water discharge lines, including their relation to water disposal points.
 12. Submittals shall also include discharge details, metering, and monitoring schedules and the details of the settling tank and oil/water separator.
 13. Methods and equipment to be used for drilling, construction, and development of wells and piezometers.
 14. Protocols to be followed for the sampling and analysis of dewatering effluent, and the name and qualifications of the laboratory that will be testing the quality of dewatering effluent prior to disposal.
 15. Protocols to be followed for treatment of effluent in conformance with the requirements of the applicable permits.
- C. Record Submittals: Prior to the start of construction dewatering, submit as-built conditions of the dewatering system. As-built data are to include but are not limited to:
1. Plans and sections showing as-built locations, and surveyed elevations of the dewatering system and its components.
 2. Drawings to indicate changes made to the original shop drawings to accommodate field conditions and to comply with design standards.
 3. Details of installation including dimensions and materials used, description and drawings of all installations, all procedures, soil strata encountered and logs with descriptions of soil samples and stratification.

4. Details of each sump, well, well point, observation well, and piezometer installed, including, but not limited to, the diameters of the borehole and the components, screen type, screen opening size, screen top and bottom elevations, details of filter, seal and grout, pump type, and capacity if installed within. These details should be provided to the Engineer within a week of installation of each entity. The details shall be re-submitted if any part of the entity changes during construction.
5. Details of abandoning each sump, well, well point, observation well, and piezometer after its use has been completed.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, land surveyor, and Professional Engineer.
- B. Field quality-control reports.
- C. Existing Conditions: Using photographs or video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by dewatering operations. Submit at least 15 calendar days before Work begins.
- D. Record Drawings: Identify locations and depths of capped wells and well points and other abandoned-in-place dewatering equipment.
- E. Discharge sampling log, testing results of effluent samples and flow rate record.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer having a minimum of 5 years' experience that specializes in the installation and operation of dewatering systems and dewatering work in similar subsurface conditions..
- B. Professional Engineer Qualifications: Licensed Professional Engineer registered in the State of New York; having a minimum of 5 years' experience in design and construction of dewatering and drainage systems; and having completed not less than 5 successful dewatering and drainage projects of equal type, size, and complexity to that required for the work.
- C. Well drillers shall be licensed in the State of New York.
- D. Comply with authorities having jurisdiction for the following:
 1. Drilling and abandoning of wells used for dewatering systems.
 2. Water discharge and disposal from dewatering operations.
- E. Obtain permit from EPA under National Pollutant Discharge Elimination System (NPDES), for storm water discharge from construction sites.

1.7 FIELD CONDITIONS

- A. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. Owner is not responsible for interpretations or conclusions drawn from this report.
1. Make additional test borings and conduct other exploratory operations necessary for dewatering according to the performance requirements.
 2. Groundwater levels may vary during the work and should not be assumed to be accurately represented by groundwater level readings reported in the geotechnical report.
 3. The geotechnical report is included elsewhere in Project Manual.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

- A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of surface and ground water and permit excavation and construction to proceed in-the-dry in accordance with the requirements herein and elsewhere.
1. Design dewatering system, including comprehensive engineering analysis by the Contractor's Design Engineer.
 2. Continuously monitor and maintain dewatering operations to ensure required groundwater lowering, erosion control, stability of excavations, excavation support, and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.
 3. Control and remove seepage and surface water from entering excavations.
 4. Allow subsequent work to be safely performed without damaging existing buildings, structures, and site improvements adjacent to excavation.
 5. Remove dewatering system when no longer required for construction.
- B. Primary Purpose of Work: Preserve natural undisturbed condition of subgrade soils in areas of proposed excavations.
1. Prior to excavation, lower and maintain groundwater to at least 2 feet below lowest excavation subgrade elevation.
 2. Additional groundwater lowering may be necessary beyond 2 feet requirement, depending on construction methods, equipment used, and prevailing groundwater and soil conditions. Lower groundwater as necessary to complete construction in accordance with Contract Documents without additional compensation.
 3. Maintain stable slopes and subgrade.
- C. Design deep wells, well points and sumps, and other groundwater control system components to prevent loss of fines from surrounding soils. Use sand filters with dewatering installations, unless screens are properly sized by Contractor's design engineer to prevent passage of fines from surrounding soils.
- D. Maintain standby pumping systems and sources of standby power at various sites.

- E. Design dewatering system to prevent damage to adjacent properties, buildings, structures, utilities, and facilities from dewatering operations. Be responsible for damage to properties, buildings or structures, sewers and other utility installations, pavements, and work that may result from dewatering or surface water control operations.
- F. The method of dewatering and control of water both inside and outside the excavation shall be selected by the Contractor who shall be solely responsible for the location, arrangement and depth of any system(s) selected to accomplish the Work. The Contractor shall construct protective works as necessary to dewater, cut off porous zones of fill, and direct the flow of water from whatever source away from the excavations and adjacent areas. Protective works shall include slurry methods, grouting, clay seepage plugs, toe drains with appropriate filters, deep wells, well points, sumps, dikes, ditches and all supporting features as required, but not specifically shown on the Contract Drawings.
 - 1. The dewatering system shall be designed and implemented so as to maintain a minimum factor of safety against the uplift groundwater pressures in any soil strata. The factor of safety shall be calculated by considering the stabilizing pressure to consist of overburden soil weight alone. The dewatering system shall be maintained operational until the dead weight of the overburden soil plus any completed portion of the structure is able to provide the required factor of safety at static (normal) groundwater level / pressure.
- G. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with water- and debris-disposal regulations of authorities having jurisdiction.

2.2 MATERIALS

- A. Materials and equipment used in the dewatering system shall adhere to accepted industry standards and be in good operating condition and able to perform satisfactorily over the required duration of construction dewatering.
- B. Back up equipment for the dewatering system shall be identical to the primary equipment and shall be available in operating condition at all times.
- C. Pipes and well screens shall consist of Schedule 40 PVC or stronger.
- D. Sand shall consist of clean, single-size filter sand of adequate gradation.
- E. Grout shall consist of cement-bentonite grout of adequate mix proportion and consistency. Seals shall consist of bentonite pellets.
- F. Pumps, meters, hoses, and controls shall be suitable for the intended purpose and application.
- G. Power supply and effluent discharge are included in this Work.

PART 3 - EXECUTION

3.1 GENERAL

- A. Control surface water and groundwater such that:
 - 1. Excavation to final grade is made in-the-dry.
 - 2. Natural undisturbed conditions of subgrade soils are maintained.
 - 3. Softening, instability, or disturbance due to presence or seepage of water does not occur.
 - 4. Construction and backfilling proceeds in-the-dry.
 - 5. Floation of completed portions of work shall be prohibited.
- B. Methods of groundwater control may include but are not limited to perimeter trenches and sump pumping, perimeter groundwater cutoff, well points, ejectors, deep wells, or any combination.
- C. Where groundwater levels are above proposed bottom of excavation level, provide a pumped dewatering system for pre-drainage of soils prior to excavation and for maintaining lowered groundwater level until construction has been completed such that structure, pipeline, or fill will not be floated or otherwise damaged.
- D. Vary type of system, spacing of dewatering units, and other details of the work depending on soil and water conditions at each location.
- E. Do work in a manner to protect adjacent structures and utilities without causing loss of ground or disturbance to pipe bearing soils or soils supporting overlying or adjacent structures.
- F. Install, monitor, and report data from observation wells. Evaluate collected data relative to groundwater control system performance and modify systems necessary to dewater site.
- G. Locate groundwater control system components where they will not interfere with construction activities adjacent to the work area or interfere with installation and monitoring of geotechnical instrumentation including observation wells. Do not make excavations for sumps or drainage ditches within or below 1H:1V slopes extending downward and out from edges of existing or proposed foundation elements or from downward vertical footprint of pipe without approval by the Engineer.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
 - 1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
 - 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways, if required by authorities having jurisdiction.
- C. Provide temporary grading to facilitate dewatering and control of surface water.
- D. Protect and maintain temporary erosion and sedimentation controls, which are specified in Section 015000 "Temporary Facilities and Controls," Section 311000 "Site Clearing," during dewatering operations.

3.3 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
 1. Space well points or wells at intervals required to provide sufficient dewatering.
 2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
- B. Place dewatering system into operation to lower water to specified levels before excavating below ground-water level.
- C. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- D. Provide standby equipment on-site, installed, and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

3.4 SURFACE WATER CONTROL

- A. Construct surface water control measures, including dikes, ditches, sumps, and other methods to prevent flow of surface water into excavations and to allow construction to proceed without delay.
- B. Grade excavation to divert surface water and seepage water within excavation areas into sumps and dewatering wells.

3.5 EXCAVATION DEWATERING

- A. Provide and maintain equipment and facilities to promptly remove and properly dispose of water entering excavations. Maintain excavations in-the-dry.
- B. Excavation dewatering shall maintain the subgrade in a natural undisturbed condition and be in operation until the fill, structure or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations.

- C. Do not place pipe, masonry, and concrete in water or submerge within 24 hours after being installed. Prevent water from flow over new masonry or concrete within four days after placement.
- D. Prevent water from rising to cause unbalanced pressure on structures until concrete or mortar has set at least 24 hours. Prevent pipe flotation by promptly placing backfill.
- E. Conduct dewatering to preserve natural undisturbed condition of subgrade soils at bottom of excavation.
- F. If trench subgrade or excavation bottom becomes disturbed due to inadequate dewatering or drainage, excavate below normal grade as directed by the Engineer and refill with structural fill, screened gravel, or other material as approved by the Engineer without additional compensation.
- G. It is expected that initial dewatering plan may be modified to suit variable soil and water conditions encountered. Dewater and excavate in a manner without causing loss of ground or disturbance to pipe bearing soil or soil that supports overlying or adjacent structures or instability of excavation or tunnel face conditions.
- H. If methods do not properly dewater excavation, install additional groundwater observation wells as directed by the Engineer. Do not place pipe or structure until readings obtained from observation wells indicate that groundwater has been lowered to specified minimum of below bottom of final excavation.
- I. Surround dewatering units with suitable filter sand with no fines being removed by pumping. Pump continuously from dewatering system until pipe or structure is adequately backfilled. Provide stand-by pumps.
- J. Collect water entering excavations from precipitation or surface runoff in shallow ditches around excavation perimeter, drained to a sump, and pump from excavation to maintain a bottom free from standing water.

3.6 WELL-POINT SYSTEMS

- A. Where necessary, install a vacuum well-point system around excavation for dewatering purposes. Surround each well-point and riser pipe by a sand or gravel filter. Use sand of gradation that after initial development of well-points, quantity and size of soil particles discharged shall be negligible. Provide well-point systems capable of operating continuously under highest possible vacuum. Include sufficient valves and gauges to accurately monitor and control the system. Develop and redevelop well-points to provide reliable performance throughout the duration of the work.
- B. Install well point systems in the Engineer's presence according with approved submittal.

3.7 REMOVAL OF SYSTEMS

- A. At completion of excavation and backfilling work and when approved by the Engineer, remove from site various pipe, deep wells, well-points, pumps, generators, observation wells, other equipment, and accessories used for groundwater and surface water control systems.
 - 1. Removed materials and equipment become property of Contractor.
- B. Restore areas disturbed by installation and removal of groundwater control systems and observation wells to their original condition.
- C. Leave in place deep wells casings, well-points, and observation wells located:
 - 1. Within plan limits of structures or pipelines.
 - 2. Within zone below 1H:1V planes extending downward and out from edges of foundation elements or from downward vertical footprint of pipe.
 - 3. Where removal would result in ground movements causing adverse settlement to adjacent ground surface, utilities, or existing structures.
- D. Fill pulled casings holes with sand. Where left in place, fill casings with cement grout and cut off a minimum of 3 feet below finished ground level or 1 foot below foundation level to prevent interference with finished structures or pipelines.
- E. When directed by the Engineer, leave observation wells in place for continued monitoring. Cut casings flush with final ground level when directed and provide protective lockable boxes with locking devices. Provide protective boxes suitable for traffic and other conditions to which observation wells will be exposed.

END OF SECTION 312319

SECTION 312333 - TRENCHING AND BACKFILLING

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 trench excavation, backfilling, and compaction.
- B. Related Requirements:
 - 1. Section 310515 “Soils and Aggregates for Earthwork” for materials used as backfill.
 - 2. Section 310519 “Geotextiles for Earthwork” for subsurface drainage geotextiles.
 - 3. Section 312000 “Earthwork” for related earthwork activities.
 - 4. Section 312316 “Rock Removal” for rock and boulder excavation.
 - 5. Section 312319 "Dewatering" for dewatering and drainage.
 - 6. Section 312500 “Erosion and Sedimentation Controls” to prevent erosion, sedimentation, and contamination of adjacent properties.
 - 7. Section 333113 “Public Sanitary Sewerage Piping”: Sanitary sewer piping and bedding from building to utility service.
 - 8. Section 334113 “Public Storm Utility Drainage Piping”: Storm sewer piping and bedding from building to utility service.

1.3 DEFINITIONS

- A. Percent Compaction: Means at least the stated percentage of maximum density as determined by ASTM D1557, Method C.

1.4 ACTION SUBMITTALS

- A. Submit proposed method of backfilling and compaction prior to start of Work.
- B. Submit method of excavation and trench support, where necessary, including design of sheeting and bracing with calculations signed and sealed by qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Material Test Reports: For material excavated from trench for re-use as backfill, by a qualified testing agency.

1.6 QUALITY ASSURANCE

- A. Comply with following regulations:
 - 1. Occupational Safety and Health Administration (OSHA): 29 CFR Part 1926 Subpart P.
- B. Provide excavation, trenching, related sheeting, bracing, and related materials to comply with requirements of OSHA excavation safety standards (29 CFR Part 1926 Subpart P) and State of New York requirements. Where conflict exists between OSHA and State regulations, more stringent requirements apply.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store excavated materials according to Section 312500 “Erosion and Sedimentation Control” to prevent erosion of soil materials and contamination of adjacent water sources.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine that erosion and sedimentation controls are in place and comply with project requirements and authorities having jurisdiction.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Where excavation activities occur across active vehicular or pedestrian circulation paths, use temporary controls specified in Division 01 to maintain circulation during operations required by this Section. Maintain temporary controls for each day circulation paths are restricted.
- B. Coordinate work of this Section with materials specified in other Sections of Division 31.
- C. Identify required lines, levels, contours, and datum locations.
- D. Protect features to remain-in-place including benchmarks, existing structures, fences, sidewalks, paving, curbs, etc. from excavating equipment and vehicular traffic.
- E. Maintain and protect above and below grade utilities indicated to remain.

3.3 TRENCH EXCAVATION

- A. Trench excavation includes material of every description and substance encountered, except rock and boulders. Refer to Section 312316 “Rock Removal” for excavation of those materials.

- B. Cut rigid and flexible pavement with a saw, wheel, or pneumatic chisel along straight lines before excavating.
- C. Strip and stockpile topsoil from grassed areas crossed by trenches.
 - 1. At Contractor's option when required, topsoil may be disposed of and replaced with approved topsoil of equal quality.
- D. While excavating and backfilling is in progress, maintain traffic and protect utilities and other property.
- E. Excavate trenches to indicated depths and in widths sufficient and of practical minimum for pipe laying, bracing, and pumping and drainage facilities.
- F. Accomplish excavation and dewatering by methods preserving undisturbed state of subgrade soils. Excavate trench by machinery to or just below designated subgrade, if material remaining in trench bottom is no more than slightly disturbed.
 - 1. Remove subgrade soils that become soft, loose, quick, or otherwise unsatisfactory due to inadequate excavation, dewatering, or other construction methods and replace with screened gravel fill acceptable to the Engineer at Contractor's expense.
- G. Use care when working in clay and organic silt soils, which are particularly susceptible to disturbance due to construction operations. When excavation is to end in such soils, use a smooth-edge bucket to excavate the last 12 inches of depth.
- H. Where pipe is to be laid in screened gravel bedding, excavate trench by machinery to normal depth of pipe, provided material remaining in trench bottom is no more than slightly disturbed.
- I. Where pipe is to be laid directly on trench bottom, manually perform final excavation, providing a flat-bottom, true to grade upon undisturbed material. Make bell holes required by project conditions.

3.4 DISPOSAL OF MATERIALS

- A. Stack excavated material without excessive surcharge on trench bank or obstructing free access to hydrants and gate valves. Avoid inconvenience to traffic and abutters. Segregated excavated material for use in backfilling as specified below.
- B. Do not remove excavated material from work site, except as directed by the Engineer. When removal of surplus materials is approved by the Engineer, dispose of such surplus material in approved designated areas.
- C. Should conditions make it impracticable or unsafe to stack material adjacent to trench, haul and store material at a location provided. When required, re-handled and use it in backfilling trench.

3.5 SHEETING AND BRACING

- A. Provide and maintain sheeting and bracing required by Federal, State, or local safety requirements to support sides of excavation and prevent loss of ground which could endanger personnel, damage, adjacent structures, or delay the work.
 - 1. Engineer may order additional supports placed at Contractor's expense if it is determined that at any point sufficient or proper supports have not been provided. Compliance with such order shall not relieve Contractor from their responsibility for sufficiency of such supports. Take care to prevent voids outside of sheeting; if voids are formed, immediately fill and ram them.
- B. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support trench sides, take care in placing and moving the boxes or supporting bracing to prevent pipe movement, disturbance of pipe bedding, or screened gravel backfill.
 - 1. Rigid Pipe Installation (such as R.C., V.C., A.C.): Raise that portion of box extending below mid-diameter above this point prior to moving box ahead to install next pipe. Perform to prevent separation of installed pipe joints due to box movement.
 - 2. Flexible Pipe Installation (such as PVC): Do not allow trench boxes, moveable sheeting, shoring, or plates to extend below mid-diameter of pipe. As trench boxes, moveable sheeting, shoring, or plates are moved, place screened gravel to fill voids created. Re-compact screened gravel and backfill to provide uniform side support for pipe.
- C. Engineer may give permission to use steel sheeting in lieu of wood sheeting for entire job wherever sheeting use is necessary. Include cost for use of sheeting in bid items for pipe, including full compensation for driving, bracing, and later removal of sheeting.
- D. Carefully remove sheeting and bracing in manner to not endanger construction of other structures, utilities, or property, whether public or private. Immediately refill voids left after withdrawal of sheeting using sand by ramming with tools especially adapted to that purpose and watering or otherwise directed by the Engineer.
- E. No payment will be given for sheeting, bracing, or other support during progress of the work. No payment will be given for sheeting left in trench for Contractor's convenience.
- F. No sheeting shall be left in place without written approval by the Engineer.
- G. Leave sheeting driven below mid-diameter of pipe in place from driven elevation to at least 12 inches above top of pipe.

3.6 TEST PITS

- A. Excavation of test pits may be required for purpose of locating underground utilities or structures as an aid in establishing the precise location of new work.
- B. Backfill test pits as soon as desired information has been obtained. Maintain backfilled surface appropriate for travel until resurfaced.

3.7 EXCAVATION BELOW GRADE AND REFILL

- A. Drain trench completely and effectively be in-the-dry, whatever the nature of unstable material encountered or groundwater conditions.
- B. If Contractor excavates below grade through error or for their own convenience, through failure to properly dewater the trench, or disturbs subgrade before dewatering is sufficiently complete, the Engineer may direct Contractor to excavate below grade as set forth in following Paragraph, where work shall be performed at its own expense.
- C. If material at trench bottom consists of fine sand, sand and silt or soft earth which may work into the screened gravel, even with effective drainage, remove subgrade material to extent directed. Refill excavation with a 6-inch-thick layer of coarse sand or a mixture graded from coarse sand to fine pea stone to form a filter layer preserving voids in pipe gravel bed. Composition and gradation of gravel shall be approved by the Engineer prior to placement. Place screened gravel in 6-inch-thick layers thoroughly compacted up to normal grade of pipe. If directed by the Engineer, use bank-run gravel for refill of excavation below grade.
- D. Subsurface Drainage Geotextile: Non-woven filter fabric as specified in Section 310519 "Geotextiles for Earthwork" may be substituted for filter layer, if approved by the Engineer.

3.8 BACKFILLING

- A. Begin backfilling as soon as practicable after laying and jointing pipe and continue expeditiously. Place bedding gravel of specified type for pipe installed up to 12 inches over the pipe.
- B. Construct an impervious dam or bulkhead cutoff of clay or other impervious material in the trench, as directed by the Engineer, to interrupt unnatural flow of groundwater after construction is completed. Key dam into trench bottom and sidewalls. Provide at least one clay or other impervious material dam in pipe bedding between each manhole where directed or every 300 feet, whichever is less.
- C. Where pipes are laid cross-country, fill remainder of trench with common fill material in layers not to exceed 12 inches and mounded 6 inches above existing grade or as directed by the Engineer. Where a loam or gravel surface exists prior to cross-country excavations, remove, conserve and replace it to full original depth as part of the work under pipe items. Where necessary, remove excess material during clean-up process, so that ground may be restored to its original level and condition.
- D. Where pipes are laid in streets, backfill remainder of trench up to a depth of 12 inches below bottom of specified permanent paving with select common fill material in layers not to exceed 12 inches and thoroughly compacted. Use material as shown on the drawings for subbase layer of paving and compact in 6-inch-thick layers.
- E. To prevent longitudinal pipe movement, do not dump backfill material into trench and then spread, until selected material or screened gravel has been placed and compacted to a level at least 12 inches over the pipe.

- F. Bring backfill up evenly on all sides. Thoroughly compact each layer of backfill material by rolling, tamping, or vibrating with mechanical compacting equipment or hand tamping to 95 percent compaction according to ASTM D1557 or 98 percent according to ASTM D698. If rolling, use a suitable roller or tractor being careful to compact fill throughout full width of trench.
- G. Do not compact by puddling or water jetting.
- H. Use hand or pneumatic ramming with tools weighing at least 20 pounds for compacting in confined areas. Spread and compact material in layers not exceeding 6 inches thick, an uncompacted loose measurement.
- I. Use granular fill material as backfill around structures. Spread and compact specified backfill under and over pipes connected to structures.
- J. Do not place bituminous paving in backfill. Do not use frozen material under any circumstances.
- K. Broom and hose-clean road surfaces immediately after backfilling. Employ dust control measures throughout construction period.

3.9 RESTORING TRENCH SURFACE

- A. Where trench occurs adjacent to paved streets, in shoulders, sidewalks, or in cross-country areas, thoroughly consolidate backfill and maintain surface as the work progresses. If settlement takes place, immediately deposit additional fill to restore ground level.
- B. In and adjacent to streets, 12 inches of trench backfill below specified initial pavement shall consist of compacted bank-run gravel. If Contractor wants to use material excavated from trench as gravel subbase for pavement replacement, take samples at intervals not to exceed 500 feet of material and test by an independent testing laboratory at Contractor's expense. Use only materials approved by the Engineer.
- C. Restore surface of driveways or other areas which are disturbed by trench excavation to a condition at least equal to that existing before work began.
- D. In areas where pipeline passes through grassed areas, remove and replace sod or loam and seed surface at Contractor's own expense.

END OF SECTION 312333

SECTION 312500 - EROSION AND SEDIMENTATION CONTROLS

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. Sediment Fences.

- B. Related Sections:

- 1. Section 031000 "Concrete Forming and Accessories."
 - 2. Section 032000 "Concrete Reinforcing."
 - 3. Section 033000 "Cast-In-Place Concrete."
 - 4. Section 310515 "Soils and Aggregates for Earthwork."
 - 5. Section 311000 "Site Clearing."
 - 6. Section 312316 "Excavation."

1.3 REFERENCE STANDARD

- A. EPA document titled: "Stormwater Management for Construction Activities – Developing Pollution Prevention Plans and Best Management Practices" document number EPA 832-R-92-005, dated 1992, or most recent edition. State or appropriate Conservation Commission standards can be substituted for the EPA standard if the State or Conservation Commission standard is equal to, or more detailed than, the EPA standard.

1.4 ACTION SUBMITTALS

- A. Submit, within 10 days after award of Contract, technical product literature for all commercial products.
- B. Product Data: Product Data: Submit data on filter fabric.
- C. Test Reports: Indicate certified tests results for precast concrete at manufacturing facility, cast-in-place concrete in field, and granular backfill.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- E. Certificate: Certified statement as specified in "Erosion Control Blanket" Article.

1.5 INFORMATIONAL SUBMITTALS

- A. Stormwater Pollution Prevention Plan (SWPPP) as specified in “Quality Assurance” article.
- B. Copy of EPA NPDES Notice of Intent to Discharge submitted to the EPA as specified in “Quality Assurance” article.

1.6 QUALITY ASSURANCE

- A. Prepare and submit a Stormwater Pollution Prevention Plan (SWPPP) in accordance with the U.S. Environmental Protection Agency (EPA) National Pollution Discharge Elimination System (NPDES) General Permit applicable to this work) document number EPA 832-R-92-005, dated 1992, or most recent edition.
- B. Prepare and submit the EPA NPDES Notice of Intent to Discharge to the applicable EPA office in accordance with EPA regulations.
- C. Sedimentation and erosion control measures shall conform to the requirements outlined in the New York Standards and Specifications for Urban Erosion and Sediment Control.

1.7 PRE-INSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing work of this section.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not place grout when air temperature is below freezing.
- B. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2 - PRODUCTS

2.1 SILT FENCE

- A. Silt fence filter fabric shall be a woven, polypropylene, ultraviolet resistant material meeting minimum requirements below:

Fabric Properties	Minimum Acceptable Value	Test Method
Grab Tensile Strength (lbs)	110	ASTM D 4632/ D 4632M
Elongation at Failure (%)	20	ASTM D 4632/ D 4632M
Mullen Burst Strength	300 psi	ASTM D 3786/ D 3796M
Puncture Strength (lbs)	60	ASTM D 4833/ D 4833M

Fabric Properties	Minimum Acceptable Value	Test Method
Minimum Trapezoidal Tear Strength (lbs)	50	ASTM D 4533/ D 4533M
Flow through Rate (gal/min/sf)	25	ASTM D 4491/ D 4491M
Equivalent Opening Size	40 – 80	US Std Sieve ASTM D 4751
Minimum UV Residual (%)	70	ASTM D 4355/ D 4355M

B. Products: Provide one of the following or equal:

1. “Mirafi 140N,” by TenCate Geosynthetics.
2. Or equal.

PART 3 -

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify compacted subgrade, granular base, stabilized soil is acceptable and ready to support devices and imposed loads.
- C. Verify gradients and elevations of base or foundation for other work are correct.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SILT FENCE

- A. Position sediment fences as indicated on the Drawings and to prevent off site movement of sediment produced by construction activities as directed by the Engineer. Areas beyond limits of silt fence shall be undisturbed or stabilized.
- B. Dig trench approximately 6 inches wide and 6 inches deep along proposed fence lines.
- C. Drive stakes, 10 feet on center (maximum) at back edge of trenches. Drive stakes 2 feet (minimum) into ground.
- D. Hang filter fabric on posts carrying to bottom of trench with about 4 inches of fabric laid across bottom of trench. Stretch fabric fairly taut along fence length and maintain secure both ways.
- E. Backfill trench with excavated material and tamp.
- F. Install pre-fabricated silt fence according to manufacturer's instructions.

3.3 SITE STABILIZATION

- A. Incorporate erosion control devices indicated on the Drawings into the Project at the earliest practicable time.
- B. Construct, stabilize and activate erosion controls before site disturbance within tributary areas of those controls.
- C. Stockpile and waste pile heights shall not exceed 35 feet. Slope stockpile sides at 2 : 1 or flatter.
- D. Stabilize any disturbed area of affected erosion control devices on which activity has ceased and which will remain exposed for more than 20 days.
 - 1. During non-germinating periods, apply mulch at recommended rates.
- E. Stabilize diversion channels, sediment traps, and stockpiles immediately.

3.4 FIELD QUALITY CONTROL

- A. Inspect erosion control devices on a weekly basis and after each runoff event. Make necessary repairs to ensure erosion and sediment controls are in good working order.
- B. Field test concrete in accordance with Section 033000.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

3.5 CLEANING

- A. When sediment accumulation in sedimentation structures has reached a point one-third depth of sediment structure or device, remove and dispose of sediment.
- B. Do not damage structure or device during cleaning operations.
- C. Do not permit sediment to erode into construction or site areas or natural waterways.
- D. Clean channels when depth of sediment reaches approximately one-half channel depth.

3.6 PROTECTION

- A. Immediately after placement, protect paving from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Protect paving from elements, flowing water, or other disturbance until curing is completed.

END OF SECTION 312500

SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

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 temporary excavation and trench support and protection systems.
- B. Related Requirements:
 - 1. Section 013233 "Photographic Documentation" for recording preexisting conditions and excavation support and protection system progress.
 - 2. Section 014000 "Quality Requirements" for testing and laboratory services.
 - 3. Section 310900 "Geotechnical Instrumentation and Monitoring" for monitoring equipment.
 - 4. Section 312000 "Earthwork" for excavating and backfilling.
 - 5. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
 - 6. Section 312316 "Rock Removal" for excavation of rock and boulders.
 - 7. Section 312319 "Dewatering" for lowering and disposing of ground water during construction and dewatering excavations.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: For excavation support and protection system prepared by or under the supervision of a qualified professional engineer.
 - 1. Include overall system plan, indicating clearances, dimensions, material properties, member sizes, locations, spacing and member penetrations depths, and locations of various types of lateral supports.
 - 2. Show details, layout, arrangement, equipment requirements, and method of construction of proposed excavation support system.
 - 3. Indicate existing and proposed utilities, structures, or other obstructions.
 - 4. Show wall elevations and locations of bracing.
Show overall installation sequence and removal of bracing. Indicate work levels to be performed before bracing is installed or removed.
 - 5. Method of preloading bracing, if required, including preload for each member, and method of locking-off the preload. Submit detailed drawings of connections, jacking supports, and method of shimming.
 - 6. Include procedures for resolving difficulties arising from misalignment of members exposed during excavation and criteria for implementing those procedures.

- B. Design Calculations: For excavation support and protection system. Include analysis data prepared, signed, and sealed by professional engineer responsible for their preparation.
 - 1. Include loads on excavation support system for all stages of excavation, bracing removal, and concrete placement, including material and equipment loads on adjacent ground during construction.
 - 2. Include design of wall and bracing members including details for all construction stages.
 - 3. Include theoretical deflections of excavation support system and deformation of structures, pipelines, and other improvements located within areas influencing excavations.

1.4 INFORMATIONAL SUBMITTALS

- A. Submit quality control measures to ensure that performance of excavation support system complies with project requirements.
- B. Submit welder qualifications and weld procedures in accordance with AWS D1.1.
- C. Qualification Data: For land surveyor.
- D. Maintain at least one copy of design at job site during excavation that includes a plan indicating sizes, types, and configurations of the materials to be used in protective system. Identify Contractor's registered design engineer who stamped the design.
- E. Do not proceed with excavation support or protection activities until submittals have been approved by the Engineer.
- F. Submit inspection documentation:
 - 1. On-site inspections of excavation support system as the systems are constructed.
 - 2. Review of quality control measures and performance data.
 - 3. Certification that excavation support system is constructed per applicable design following completion of each support system and following Contractor modifications during construction.

1.5 QUALITY ASSURANCE

- A. Contractor Qualifications: Minimum 5 years' experience compatible to indicated Work, and who employs labor and supervisory personnel similarly experienced in Work of this Section.
- B. Contractor's Design Engineer: Registered Professional Engineer in the State of New York with at least 5 years' professional experience in design and construction of support of excavation systems and having completed a minimum of 5 successful excavation support projects of equal type, size, and complexity to specified work.
- C. Existing Conditions: Using photographs or video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by inadequate performance of excavation support and protection systems. Submit before Work begins.

- D. Regulatory Requirements: Comply with authorities having jurisdiction, including OSHA requirements.
- E. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

1.6 FIELD CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
 - 1. Contact utility companies and other responsible authorities to locate and mark underground utilities.
 - 2. Notify the Engineer at least two days in advance of proposed interruption of utility.
 - 3. Do not proceed with interruption of utility without the Engineer's written permission.
- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent soil borings and tests, conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data. The Contractor is responsible for their own interpretation and conclusions based on review of the data.
 - 1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection according to the performance requirements.
 - 2. The geotechnical report is included elsewhere in Project Manual.
- C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide, design, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting earth and hydrostatic pressures and superimposed and construction loads within specified movement criteria conforming to Section 310900 "Geotechnical Instrumentation and Monitoring."
 - 1. Contractor Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 3. Install excavation support and protection systems to minimize horizontal and vertical movements without damaging existing buildings, structures, and site improvements adjacent to excavation.

4. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.
- B. Do not permit excavations below the level of the base of adjacent existing foundations or retaining walls, unless excavation design and bracing includes an analysis of stability of structure supported by foundation and if necessary, incorporates required bracing or underpinning of foundation.
- C. For support systems in which bracing is installed between opposite sides of the excavation, design excavation support of both sides to be nearly the same as feasible.
- D. Where necessary to resist point loads, fill pipe piles used as soldier piles with concrete. Neglect concrete strength in design of pipe pile for bending stress.
- E. Design, install, operate, and maintain ground water control system to control ground water inflows, prevent piping or loss of ground, and maintain stability of the excavation. Refer to the requirements of Section 312319 “Dewatering.”
- F. Design review and field monitoring activities by Owner or the Engineer does not relieve Contractor of its work responsibilities.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that instrumentation required under Section 310900 “Geotechnical Instrumentation and Monitoring” is installed and initialized prior to start of work required by this Section.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Obtain permits from local authority having jurisdiction prior to initiating excavation work.
- B. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
 1. Shore, support, and protect utilities encountered.
- C. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

2. Install fencing, gates, lights, and signs around excavations and staging areas to provide for public safety.
- D. Locate excavation support and protection systems clear of permanent construction so that construction and finishing of other work is not impeded.

3.3 GENERAL

- A. Install excavation support systems in accordance with the shop drawings and applicable permits.
- B. Fill voids between excavation support system and earth with materials acceptable to the Engineer.
- C. If unstable material is encountered during excavation, take immediately measures to contain it in place and prevent ground displacement.
- D. If settlement or deflections of supports indicate that support system requires modification to prevent excessive movements, redesign and resubmit revised shop drawings and calculations to the Engineer without additional compensation.
- E. Maintain sufficient quantity of material on site for protection of work and for use in case of accident or emergency.

3.4 PORTABLE TRENCH BOXES

- A. Use portable trench boxes or sliding trench shields only for worker protection
- B. Additional excavation, backfilling, and surface restoration required as result of trench box use shall be provided without additional compensation.
- C. Design, construct, and maintain trench boxes or shields to meet acceptable engineering and industry standards.
- D. Install shields in a manner to restrict lateral or other hazardous movement of the shield in the event of sudden lateral loads.
- E. Maintain a written copy of trench box manufacturer's specifications, recommendations, and limitations at job site during excavation work.

3.5 SOLDIER PILES AND LAGGING

- A. Install steel soldier piles before starting excavation.
 1. Install using impact hammer or vibratory hammer in predrilled holes.
 2. Soldier Piles in Predrilled Holes:
 - a. Provide casing or other methods of support to prevent caving of holes and loss of ground.

- b. Backfill with concrete from elevation of bottom excavation to pile tip elevation. Backfill remainder of predrilled hole with flowable fill or clean sand.
 - c. Predrill hole of sufficient diameter allowing for proper alignment and concrete backfilling of pile.
 3. Install driven piles with driving shoes where hard driving is anticipated.
 4. Advance driven soldier piles without aid of a water jet.
- B. Extend soldier piles below excavation grade level to depths shown on reviewed Shop Drawings. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- C. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging.
 1. Install lagging so ground loss does not occur between adjacent or below lowest board. As excavation proceeds, do not maximum height of 4 feet for unlagged face of excavation.
 2. Do not exceed unlagged face of 2 feet, if water seeps or flows from excavation face or excavation face becomes unstable.
- D. As installation progresses, pack voids between excavation face and lagging with materials such as hay, burlap, or geotextile filter fabric to allow drainage of ground water without loss of ground.
- E. Install wales at locations indicated on Drawings and secure to soldier piles.

3.6 STEEL SHEET PILING

- A. Thoroughly clean and inspect sheet piles for defects and proper interlock dimensions prior to installation. Provide a tool for checking interlock dimensions.
- B. Before starting excavation, drive one-piece sheet piling lengths in plumb position and tightly interlock vertical edges for its entire length to form a continuous barrier. Form a continuous diaphragm throughout length of each run of wall, bearing tightly against original ground.
 1. Exercise care in driving so interlocking members can be extracted without damaging adjacent structures or utilities.
 2. Use driving, cutting, and splicing methods conforming to approved Shop Drawings.
 3. Use templates or other temporary alignment facilities to maintain piling line.
- C. Accurately place piling, using templates and guide frames unless otherwise recommended in writing by sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 5 feet. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- D. Install each sheet pile having sufficient clearance in interlocks to slide under its own weight into interlock of previously placed sheet pile.
- E. Do not excavate in advance of steel sheet piling installation.

- F. Where obstructions are anticipated, pre-excavate or pre-drill along sheet pile wall alignment without additional compensation. Do not extend pre-excavation and pre-drilling below lowest excavation level or into bearing soils for existing or future structures.
- G. Remove obstructions encountered before the specified embedment for piles. Where obstructions cannot be removed, re-evaluate sheet pile system by Contractor's design Engineer show reduced embedment and additional toe stability measures to be implemented for sheet pile wall realignment. Submittal proposed design measures to the Engineer for review.
- H. Withdraw damaged or faulty aligned pilings with provide new piling, driven properly in its place without additional compensation.
- I. Cut tops of sheet piling to uniform elevation at top of excavation.

3.7 INTERNAL BRACING

- A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
 - 1. Do not place bracing where it will be cast into or included in permanent concrete work, unless otherwise approved by the Engineer.
 - 2. Install internal bracing if required to prevent spreading or distortion of braced frames.
 - 3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.
- B. Provide internal bracing to carry maximum design load without distortion or buckling.
- C. Include web stiffeners, plates, or angles required to prevent rotation, crippling, or buckling of connections and points of bearing between structural steel members. Allow for eccentricities caused by field fabrication and assembly.
- D. Install and maintain bracing support members in tight contact with each other and with the surface being supported. Do not use wood shims.
- E. Coordinate excavation work with installation of bracing. Extend excavation no more than 2 feet below any brace level prior to installation of the bracing.
- F. Use procedures that produce uniform loading of bracing member without eccentricities, overstressing, or distortion of system members.

3.8 FIELD QUALITY CONTROL

- A. Survey-Work Benchmarks: Resurvey benchmarks daily during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Engineer if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.
- B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.

- C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

3.9 REMOVAL

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.
- B. Retain first subparagraph below if required. Some jurisdictions require removing excavation support and protection systems within 48 inches (1200 mm) of finish grade.
- C. Do not remove vertical support members that were installed within zone of influence of new or existing structures. Cut off support members installed within this zone at 5 feet below finished grade and abandon in place.
- D. Do not remove internal bracing or transfer loads to permanent structure without prior acceptance of the Engineer.
- E. Begin removal at excavation bottom and progress upward. Slowly release members noting indication of possible failure of remaining members or possible cave-in of excavation sides.
- F. Progress backfilling together with removal of support systems from excavations.
- G. Remove all portions of excavation support, unless otherwise indicated by approved Shop Drawings.
 - 1. Zone of Influence Definition: Zone extending down and away from outer edge of the structure at 1 horizontal to 1 vertical.
- H. Do not leave untreated wood as part of abandoned portion of the work.
- I. When removing excavation support system, do not disturb or damage adjacent buildings, structures, waterproofing material, or utilities. Fill voids immediately with lean concrete or well-graded cohesionless sand or as directed by the Engineer.
- J. Immediately remove excavation support system material from site.

END OF SECTION 315000

SECTION 321216 - ASPHALT PAVING

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. Asphalt materials.
2. Aggregate materials.
3. Aggregate subbase.
4. Asphalt paving base course, binder course, and wearing course.
5. Asphalt paving overlay for existing paving.
6. Surface slurry.

1.3 ACTION SUBMITTALS

- A. Section 013300 "Submittal Procedures": Requirements for submittals.
- B. Product Data:
 1. Submit product information for asphalt and aggregate materials.
 2. Submit mix design with laboratory test results supporting design.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Mixing Plant: Conform to requirements of the New York State Department of Transportation (NYSDOT), Standard Specifications.

1.5 QUALIFICATIONS

- A. Installer: Company specializing in performing work of this section with minimum five years documented experience.

1.6 AMBIENT CONDITIONS

- A. Comply with Ambient conditions control facilities for product storage and installation.

- B. Do not place asphalt mixture between November 1 and March 1.
- C. Do not place asphalt mixture when ambient air or base surface temperature is less than 40 degrees F (4 degrees C), or surface is wet or frozen.
- D. Place asphalt mixture when temperature is not more than 15 degrees F (8 degrees C) less than initial mixing temperature.

PART 2 - PRODUCTS

2.1 ASPHALT PAVING

- A. Performance / Design Criteria:
 - 1. Paving: Design for movement of trucks up to 60,000 lbs..
- B. Asphalt Materials:
 - 1. Asphalt Binder: In accordance with State of New York Department of Transportation standards.
 - 2. Primer: In accordance with State of New York Department of Transportation standards.
 - 3. Tack Coat: ASTM D977; diluted emulsified asphalt, or ASTM D2397, diluted cationic emulsified asphalt, slow setting type.
 - 4. Reclaimed Asphalt Pavement (RAP): Processed material obtained by milling or full depth removal of existing asphalt paving.
- C. Aggregate Materials:
 - 1. Fine and Coarse Aggregate: in accordance with New York State Department of Transportation standards.
- D. Aggregate Subbase:
 - 1. In accordance with NYSDOT Standard Specifications, Section 304-Subbase Course, Gradation Type 4.
- E. MIXES
- F. Use dry material to avoid foaming. Mix uniformly.
- G. Asphalt Paving Mixtures: Designed in accordance with New York State Department of Transportation standards.
 - 1. Base Course: Type 37.5 F9 Base Course HMA, 60 Series Compaction; NYS DOT Item 402.378902.
 - 2. Binder Course: Type 19 F9 Binder Course HMA, 60 Series Compaction; NYS DOT Item 402.128903.
 - 3. Wearing Course: 12.5 F2 Top Course HMA, 60 Series Compaction; NYS Item 402.128203.

2.2 ACCESSORIES

- A. Geotextile Fabric: AASHTO M288; non-woven, polypropylene.
- B. Sealant: ASTM D6690, Type IV; hot applied type.

2.3 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Submit proposed mix design of each class of mix for review prior to beginning of Work.
- C. Test samples in accordance with New York State Department of Transportation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 017300 “Execution”: Requirements for installation examination.
- B. Verify utilities indicated under paving are installed with excavations and trenches backfilled and compacted.
- C. Verify compacted subbase is dry and ready to support paving and imposed loads.
- D. Verify gradients and elevations of base are correct.
- E. Verify valve boxes are installed in correct position and elevation.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare subbase in accordance with New York State Department of Transportation.

3.3 DEMOLITION

- A. Saw cut and notch existing paving as indicated on Drawings.
- B. Clean existing paving to remove foreign material, excess joint sealant and crack filler from paving surface.
- C. Repair surface defects in existing paving to provide uniform surface to receive new paving.

3.4 INSTALLATION

A. Subbase:

1. Prepare subbase in accordance with New York State Department of Transportation.

B. Primer:

1. Apply primer in accordance with New York State Department of Transportation.
2. Use clean sand to blot excess primer.

C. Tack Coat:

1. Apply tack coat in accordance with New York State Department of Transportation.
2. Apply tack coat to contact surfaces of curbs and concrete pads.
3. Coat surfaces of valve boxes with oil to prevent bond with asphalt paving. Do not tack coat these surfaces.

D. Double Course Asphalt Paving:

1. Place asphalt binder course within 24 hours of applying primer or tack coat.
2. Place binder course to thickness indicated on Drawings.
3. Place wearing course within 24 hours of placing and compacting binder course. When binder course is placed more than 24 hours before placing wearing course, clean surface and apply tack coat before placing wearing course.
4. Place wearing course to thickness indicated on Drawings.
5. Compact each course by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
6. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.5 TOLERANCES

- #### A. Flatness: Maximum variation of 1/4 inch measured with 10 foot (3 m) straight edge.

- #### B. Scheduled Compacted Thickness: Within 1/4 inch.

- #### C. Variation from Indicated Elevation: Within 1/2 inch.

3.6 FIELD QUALITY CONTROL

- #### A. Take samples and perform tests in accordance with New York State Department of Transportation.

- #### B. Asphalt Paving Mix Temperature: Measure temperature at time of placement.

- #### C. Asphalt Paving Thickness: ASTM D3549; test one core sample from every 1000 square yards compacted paving.

- D. Asphalt Paving Density: ASTM D2950 nuclear method; test one location for every 1000 square yards compacted paving.

3.7 PROTECTION

- A. Immediately after placement, protect paving from mechanical injury for 24 hours or until surface temperature is less than 140 degrees F.

END OF SECTION 321216

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SECTION 321623 - SIDEWALKS

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: Concrete paving for sidewalks.
- B. Related Requirements:
 - 1. Section 031000 “Concrete Forming and Accessories” for form materials, waterstops, and accessories.
 - 2. Section 032000 “Concrete Reinforcing” for reinforcing steel and supports for cast-in-place concrete.
 - 3. Section 033000 “Cast-in-Place Concrete” for cast-in-place or in-situ concrete for structural building frames, slabs on fill or grade, and other concrete components.

1.3 PREINSTALLATION MEETINGS

- A. Section 013100 “Project Management and Coordination”: Requirements for preinstallation meeting.
- B. Convene minimum one week prior to commencing Work of this Section.

1.4 ACTION SUBMITTALS

- A. Section 013300 “Submittal Procedures”: Requirements for submittals.
- B. Product Data:
 - 1. Submit required information regarding concrete materials, joint filler, admixtures, and curing compounds.
 - 2. Mix Design:
 - a. Submit concrete mix design for each concrete strength prior to commencement of Work.
 - b. Submit separate mix designs if admixtures are required for hot- and cold-weather concrete Work.
 - c. Identify mix ingredients and proportions, including admixtures.

3. Identify chloride content of admixtures and whether or not chloride was added during manufacture.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- B. Source Quality-Control Submittals: Indicate results of shop tests and inspections.
- C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- D. Qualifications Statement:
 1. Submit qualifications for manufacturer and installer.

1.6 QUALITY ASSURANCE

- A. Perform Work according to Sections 031000 "Concrete Forming and Accessories", 032000 "Concrete Reinforcing", and 033000 "Cast-in-Place Concrete"
- B. Obtain cementitious materials from same source throughout.
- C. Perform Work according to New York State Department of Transportation standards.
- D. Maintain a copy of each standard affecting Work of this Section on Site.
- E. Qualifications
 1. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
 2. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience.

1.7 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. Provide additional protection according to manufacturer instructions.

1.8 AMBIENT CONDITIONS

- A. Minimum Conditions: Do not place concrete if base surface temperature is less than 40 deg. F (5 deg. C), or if surface is wet or frozen.
- B. Subsequent Conditions: Maintain minimum 50 deg. F (10 deg. C), for not less than 72 hours after placing, and at a temperature above freezing for remainder of curing period.

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 AGGREGATE SUBGRADE

- A. As specified in Section 321216 “Asphalt Paving”.

2.2 MATERIALS

- A. Forms:
 - 1. Description: As specified in Section 031000 “Concrete Forming and Accessories”.
 - 2. Height: Equal to full depth of finished sidewalk.
- B. Reinforcement:
 - 1. Reinforcing Steel and Wire Fabric: As specified in Section 032000 “Concrete Reinforcing”.
- C. Concrete:
 - 1. Concrete Materials:
 - a. As specified in Section 033000 “Cast-in-Place Concrete”.

2.3 FABRICATION

- A. Reinforcing:
 - 1. Comply with New York State Department of Transportation standards.

2.4 MIXES

A. Concrete:

1. Comply with ASTM C94/C94M, Option A.

2.5 FINISHES

A. Reinforcement:

1. Galvanized Finish for Steel Bars:
 - a. Comply with ASTM A767/A767M.
 - b. Class: I.
 - c. Hot-dip galvanized after fabrication.
2. Epoxy-Coated Finish for Steel Bars: Comply with ASTM A775/A775M.
3. Epoxy-Coated Finish for Steel Wire:
 - a. Comply with ASTM A884/A884M.
 - b. Class A, using ASTM A775/A775M.

2.6 ACCESSORIES

A. Curing Compound:

1. Comply with ASTM C309.
2. Type: 1 1D 2.
3. Class: B.

B. Joint Sealers:

1. Hot Applied:
 - a. Comply with ASTM D6690.
 - b. Type: IV.

2.7 SOURCE QUALITY CONTROL

- A. Testing: Comply with ASTM C94/C94M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 017300 "Execution": Requirements for installation examination.

- B. Verify that compacted subgrade is dry and ready to support paving and imposed loads.
- C. Verify that gradients and elevations of subgrade are as indicated on Drawings.
- D. Verify reinforcing placement for proper size, spacing, location, and support.

3.2 PREPARATION

- A. Section 017300 “Execution”: Requirements for installation preparation.
- B. Moisten substrate to minimize absorption of water from fresh concrete.
- C. Notify Engineer minimum 24 hours prior to commencement of concreting operations.

3.3 INSTALLATION

A. Subgrade:

- 1. Comply with New York State Department of Transportation standards.

B. Forms:

- 1. Place and secure forms and screeds to correct location, dimension, profile, and gradient.
- 2. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- 3. Wood Forms: Thoroughly wet with water before concrete is placed.

C. Reinforcement:

- 1. Place reinforcing as indicated on Drawings.
- 2. Interrupt reinforcing at expansion joints.
- 3. Place reinforcing to achieve indicated paving alignment.
- 4. Repair damaged epoxy coating to match shop finish.

D. Placing Concrete:

- 1. As specified in Section 033000 “Cast-in-Place Concrete”.

E. Joints:

- 1. Place continuous transverse contraction joints at 5-foot intervals or width of sidewalk, whichever is less.
- 2. Filler:
 - a. Place joint filler between paving components and building or other appurtenances.
 - b. Recess top of filler 1/4 inch for sealant installation.
- 3. Provide scored joints at 3-foot intervals between sidewalks and curbs.
- 4. Saw-cut contraction joints 3/16 inch wide at optimum time after finishing, cutting one-third into depth of slab.
- 5. Seal joints as indicated on Drawings.

F. Exposed Aggregate:

1. Apply surface retarder where exposed aggregate finish is required.
2. Wash exposed aggregate surface with clean water and scrub with stiff bristle brush, exposing aggregate.

G. Finishing:

1. Light broom and trowel edges of joints.
2. Texture Direction: Parallel to paving direction.
3. Ramps: Broom perpendicular to slope.
4. Place curing compound on exposed concrete surfaces immediately after finishing.
5. Edges and Joints:
 - a. Edger Radius: 1/8 inch .
 - b. Spalled Corners and Edges: Clean and fill with mortar mixture and finish.

H. Curing:

1. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
2. Mats:
 - a. Cover exposed surface with two or more layers of wetted burlap, overlapping each other minimum 6 inches.
 - b. Maintain burlap continuously saturated and in contact with concrete for minimum seven days.

I. Backfilling: After curing, backfill, grade, and compact adjacent disturbed area as indicated.

3.4 TOLERANCES

- A. Maximum Variation of Surface Flatness: 1/2 inch in 10 feet.
- B. Maximum Variation from True Position: 1/2 inch.
- C. Line and Grade for Forms: 1/8 inch in any 10-foot long section.

3.5 FIELD QUALITY CONTROL

- A. Section 017300 "Execution": Requirements for testing, adjusting, and balancing.
- B. Inspection and Testing:
 1. Comply with New York State Department of Transportation standards.
 2. Samples:
 - a. Sampling Procedures: Comply with ASTM C172/C172M.
 - b. Cylinder Molding and Curing Procedures: Comply with ASTM C31/C31M, standard cured.

- c. Sample concrete and make one set of three cylinders for every 75 cu. yd. (or less of each class of concrete placed each day, and for every 5,000 sq. ft. of surface area paving.
 - d. Make one additional cylinder during cold-weather concreting, and field cure.
3. Cylinder Compressive Strength:
 - a. Comply with ASTM C39/C39M.
 - b. Acceptance:
 - 1) Average Compressive Strength of Three Consecutive Tests: Maximum 500 psi less than specified compressive strength.
 - c. Test one cylinder at seven days, and two cylinders at 28 days.
 - d. Retain one cylinder for 14 days for testing when requested by Engineer.
 - e. Dispose of remaining cylinders if testing is not required.
4. Slump, Temperature, and Air Content:
 - a. Measure for each compressive-strength concrete sample.
 - b. Slump: Comply with ASTM C143/C143M.
 - c. Air Content: Comply with ASTM C173/C173M or C231/C231M.
 - d. Temperature: Comply with ASTM C1064/C1064M.
5. Records:
 - a. Maintain records of placed concrete items.
 - b. Record date, location of pour, quantity, air temperature, number of test samples taken.

3.6 PROTECTION

- A. Section 017300 “Execution”: Requirements for protecting finished Work.
- B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, rain and flowing water, and mechanical injury.
- C. Do not permit traffic over paving until ninety percent design strength of concrete has been achieved.
- D. Damaged Concrete:
 1. Remove and reconstruct concrete that has been damaged for entire length between scheduled joints.
 2. Refinishing damaged portion is not acceptable.
 3. Dispose of damaged portions.

END OF SECTION 321623

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SECTION 329200 - TURF AND GRASSES

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. Seeding.
 - 2. Erosion-control material(s).

1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging:

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.
- B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Accompany each delivery of bulk materials with appropriate certificates.

1.6 FIELD CONDITIONS

- A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion:
 - 1. Spring Planting: April.
 - 2. Fall Planting: September.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with Association of Official Seed Analysts (AOSA's) "Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Species:
 - 1. Quality: State-certified seed of grass species as listed below for solar exposure.
 - 2. Quality: Seed of grass species as listed below for solar exposure, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:
 - 3. Full Sun: Bermudagrass (*Cynodon dactylon*).
 - 4. Full Sun: Kentucky bluegrass (*Poa pratensis*), a minimum of three cultivars.
 - 5. Sun and Partial Shade: Proportioned by weight as follows:
 - a. 50 percent Kentucky bluegrass (*Poa pratensis*).
 - b. 30 percent chewings red fescue (*Festuca rubra* variety).
 - c. 10 percent perennial ryegrass (*Lolium perenne*).

- d. 10 percent redtop (*Agrostis alba*).
- 6. Shade: Proportioned by weight as follows:
 - a. 50 percent chewings red fescue (*Festuca rubra* variety).
 - b. 35 percent rough bluegrass (*Poa trivialis*).
 - c. 15 percent redtop (*Agrostis alba*).

2.2 EROSION-CONTROL MATERIALS

- A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long.
- B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd., with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches long.
- C. Erosion-Control Mats: Cellular, nonbiodegradable slope-stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface, of 3-inch nominal mat thickness. Include manufacturer's recommended anchorage system for slope conditions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work:
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 3. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

- A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations:

1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
 2. Protect grade stakes set by others until directed to remove them.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 PREPARATION FOR EROSION-CONTROL MATERIALS

- A. Prepare area as specified in "Turf Area Preparation" Article in Part 3.
- B. For erosion-control mats, install planting soil in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.
- C. Fill cells of erosion-control mat with planting soil and compact before planting.
- D. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.
- E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.4 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph:
1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 2. Do not use wet seed or seed that is moldy or otherwise damaged.
 3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a total rate of 2 lb/1000 sq. ft..
- C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets and 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.
- E. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.
- F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment:
1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.

2. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal./1000 sq. ft.. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.
- G. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch, and roll surface smooth.

3.5 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.
- C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- D. Remove nondegradable erosion-control measures after grass establishment period.

3.6 MAINTENANCE SERVICE

- A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:
 1. Seeded Turf: 60 days from date of planting completion:
 - a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.
- B. Meadow Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Meadow Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable meadow is established, but for not less than maintenance period below:
 1. Maintenance Period: 40 days from date of planting completion.

END OF SECTION 329200

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SECTION 330513 - MANHOLES AND STRUCTURES

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. Monolithic concrete manholes and structures with concrete transition to cover frame, covers, anchorage, and accessories.
2. Modular precast concrete manhole and structures with tongue-and-groove joints with concrete transition to cover frame, covers, anchorage, and accessories.
3. Bedding and cover materials.

- B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for forming and installation of reinforcing steel.
2. Section 310515 "Soils and Aggregates for Earthwork" for soil and aggregates for backfill in trenches.
3. Section 312000 "Earthwork" for excavating for manholes and structures.

1.3 ACTION SUBMITTALS

- A. Product Data: Submit cover and frame construction, features, configuration, dimensions.
- B. Shop Drawings: Indicate manhole and structure locations, elevations, piping, conduit, sizes and elevations of penetrations.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Products meet or exceed specified requirements.
- B. Manufacturer Instructions: Detailed instructions on installation requirements, including storage and handling procedures.
- C. Field Quality-Control Submittals: Results of Contractor-furnished tests and inspections.
- D. Qualifications Statements: Qualifications for manufacturer.

1.5 QUALITY ASSURANCE

- A. Perform Work according to State of New York Department of Transportation standards.
- B. Maintain a 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 three years' documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Unload, store, and handle precast manholes and structures according to manufacturer instructions.
- B. Storage: Store precast concrete manholes and structures as to prevent damage to Owner's property or other public or private property.
 - 1. Repair property damaged from materials storage.

1.8 AMBIENT CONDITIONS

- A. Cold Weather Requirements: According to ACI 530/530.1.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Equivalent strength: Based on structural design of reinforced concrete as outlined in ACI 318 .
- B. Design of Lifting Devices for Precast Components: According to ASTM C913.
- C. Design of Joints for Precast Components:
 - 1. According to ASTM C913.
 - 2. Maximum Leakage: 0.025 gal. per hour per foot of joint at 3 feet of head.
- D. Shape: Rectangular.
- E. Clear Inside Dimensions: As indicated on Drawings.
- F. Design Depth: As indicated on Drawings.
- G. Clear Cover Opening: As indicated on Drawings.

- H. Pipe and Conduit Entry: Furnish openings as indicated on Drawings.

2.2 MANHOLES AND STRUCTURES

- 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. Fort Miller Co., Schuylerville, NY
 - 2. Oldcastle Infrastructure Inc, Littleton, CO
- B. Manhole and Structure Sections: Reinforced precast concrete according to ASTM C478
Pipe Connection Gaskets: According to ASTM C923.
 - 2. Joint Sealant: Preformed flexible joint sealant conforming to ASTM C990
- C. Reinforcement: ASTM A615 Grade 60.

2.3 FRAMES,COVERS, AND GRATES

- 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. Neenah Foundry.
 - 2. Campbell Foundry.
- B. Components and Fabrication:
 - 1. Construction: ASTM A48 , Class 30B cast iron.
 - 2. Surface: Machined flat bearing.
 - 3. Lid: Removable
 - 4. Cover Design: Closed.
 - 5. Live Load Rating: H-20 Wheel Loads.
 - 6. Basis-of-Design:
 - a. Manhole Frame and Cover: Neenah 1740-D or approved equal.
 - b. Inlet Frame and Grate: Neenah R-3561 or approved equal.

2.4 FINISHES

- A. Steel Galvanizing: ASTM A123. Hot dip galvanize after fabrication.

2.5 ACCESSORIES

- A. Manhole and Structure Steps:
 - 1. Formed Steel Reinforced Polypropylene rungs.
 - 2. Formed integral with manhole and structure sections.
 - 3. Diameter: 3/4 inch.
 - 4. Width: 12 inch.

5. Spacing: 16 inch o.c. vertically, set into manhole and structure wall.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that items provided by other Sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location and ready for roughing into Work.
- C. Verify correct size of manhole and structure excavation.

3.2 PREPARATION

- A. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers as indicated on Drawings to indicate its intended use.
- B. Coordinate placement of inlet and outlet pipe or duct sleeves required by other Sections.
- C. Do not install structures where Site conditions induce loads exceeding structural capacity of structures.
- D. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage; remove and replace damaged units.

3.3 INSTALLATION

- A. Excavation and Backfill:
 1. Excavate manholes and structures as specified in Section 312000 "Earthwork" in location and to indicated depth.
 2. Provide clearance around sidewalls of structure for construction operations.
 3. When groundwater is encountered, prevent accumulation of water in excavations; place manholes and structures in dry trench.
 4. Where possibility exists of watertight structure becoming buoyant in flooded excavation, anchor structure to avoid flotation as approved by Engineer.
- B. Place manhole and structure sections plumb and level, trim to correct elevations, and anchor to base pad.
- C. Backfill excavations for manholes and structures as specified in Section 312000 "Earthwork."
- D. Form and place manhole and structures cylinder plumb and level and to correct dimensions and elevations.
- E. Cut and fit for pipe and sleeves.

- F. Set cover frames and covers level without tipping and to correct elevations.
- G. Coordinate with other Sections of Work to provide correct size, shape, and location.
- H. Precast Concrete Manholes and Structures:
 - 1. Lift precast components at lifting points designated by manufacturer.
 - 2. When lowering manholes and structures into excavations and joining pipe to units, take precautions to ensure that interior of pipeline and structure remains clean.
 - 3. Set precast structures bearing firmly and fully on crushed stone bedding, compacted as specified in Section 312000 "Earthwork" or on other support system as indicated on Drawings.
 - 4. Assemble multi-section structures by lowering each section into excavation; set level and firmly position base section before placing additional sections.
 - 5. Remove foreign materials from joint surfaces and verify sealing materials are placed properly.
 - 6. Maintain alignment between sections by using guide devices affixed to lower section.
 - 7. Joint sealing materials may be installed on Site or at manufacturer's plant.
 - 8. Verify that installed manholes and structures meet required alignment and grade.
 - 9. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe; fill annular spaces with mortar.
 - 10. Cut pipe flush with interior of structure.

3.4 FIELD QUALITY CONTROL

- A. Test concrete manhole and structure sections according to ASTM C497.
- B. Leakage Tests:
 - 1. Performed on every manhole with Engineer observing.
 - 2. Preparation:
 - a. Prior to placing the shelf and invert, and pointing the horizontal joints, fill all lifting holes within 6 feet of ground surface with approved non-shrinking mortar.
 - b. Lower groundwater table as required.
 - c. Plug all pipes and other openings into manhole.
 - 3. Test:
 - a. Fill water to top of cone section.
 - b. Observe for visible water in the excavated area.
 - c. If area around structure is backfilled or the test is unsatisfactory, repeat the test allowing for suitable time for absorption of water in the excavated area.
 - d. At the end of the absorption period, refill manhole and wait 8 hours.
 - e. Refill the cone at the end of 8 hours, measuring the amount required to refill.
 - f. Extrapolate to determine 24-rate of leakage. Do not allow leakage to exceed 1 gallon per vertical foot in a 24-hour period.
 - g. Engineer will perform visual inspection along with the Contractor.
 - 4. Repair:

- a. If leakage is less than 3 gallons per vertical foot per 24 hours, make approved repairs to the structure and retest, if it is determined the leakage is due to defects in the joints or sections.
 - b. If leakage is 3 gallons or more, then replace the entire structure, including all joints and sections without additional compensation. Retest the new structure as described above.
- C. A vacuum test may be substituted for a leakage test as follows:
1. The filling and pointing of exterior joints are not required where the excavation has not been backfilled.
 2. Inflate to affect a seal between the vacuum base and the top of the manhole.
 3. Connect the vacuum pump to the outlet port with the valve open and a vacuum of 10" Hg (20" of Hg absolute) drawn.
 4. Close the valve.
 5. The following test criteria shall apply to 4-ft and 5-ft diameter manholes:
 - a. Allowable drops in pressure:
 - 1) Manholes 0 – 10 ft. deep:
 - a) Drop of 1" Hg over 2 minutes.
 - 2) Manholes 10 -15 ft. deep:
 - a) Drop of 1" Hg over 2-1/2 minutes.
 - 3) Manholes 15 - 30 feet:
 - a) Drop of 1" Hg over 3 minutes.
 6. If the pressure drop exceeds the acceptable limits, make necessary repairs as approved by the Engineer, and:
 - a. Re-test the structure.
 - b. If the structure fails to meet the minimum requirements of the vacuum test retest using the leakage test.
 7. Upon completion of a successful vacuum test, the interior and exterior joints shall be filled and pointed.

3.5 CLEANING

- A. Clean all new manholes to be free of silt, debris and foreign matter of any kind, prior to final inspection.

END OF SECTION 330513

SECTION 330516.13 - PRECAST CONCRETE UTILITY STRUCTURES

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. Precast concrete utility structures.
2. Valve chambers.
3. Access hatches.

B. Related Requirements:

1. Section 031000 - Concrete Forming and Accessories: Erection and bracing of forms.
2. Section 032000 - Concrete Reinforcing: Execution requirements for reinforcing steel as required by this Section.
3. Section 033000 - Cast-in-Place Concrete: Concrete type for manhole and structure foundation slab construction.
4. Section 312000 - Earthwork: Excavating for structures and foundation slabs.
5. Section 312333 - Fill: Backfilling after structure installation.

1.3 ACTION SUBMITTALS

A. Design Data:

1. Precast concrete manholes and structures:
 - a. Sectional plans and elevations showing dimensions and reinforcing steel placement.
 - b. Structural calculations including assumptions.
 - c. Concrete design mix.

B. Product Data:

1. Pipe connections to structure.
2. Structure frame and cover, access hatch, rungs and or ladders with notarized certificate indicating compliance with the specified ASTM standard and Class designation.
3. Sewer brick with notarized certificate indicating compliance with ASTM C 32, Grade SS.

1.4 DELEGATED DESIGN SUBMITTALS

- A. Shop Drawings:
 - 1. Base sections, riser sections, eccentric and concentric conical top sections, flat slab tops, grade rings with notarized certificate indicating compliance with ASTM C 478.
 - 2. Cut sheets indicating location, orientation size and elevation of finished inverts for all penetrations for each structure.
- B. Submit concrete mix design for each different mix.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate:
 - 1. Precast Concrete Structures:
 - a. Concrete test cylinder reports from an approved testing laboratory certifying conformance with this Section.
- B. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
 - 1. Method of repair for minor damage to precast concrete sections.
- C. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- E. Qualifications Statements:
 - 1. Submit qualifications for manufacturer, installer, and licensed professional.
 - 2. Submit manufacturer's approval of installer.

1.6 QUALITY ASSURANCE

- A. Obtain precast concrete utility structures from single source.
- B. Perform structural design according to ACI 318.
- C. Perform Work according to NPCA Quality Control Manual for Precast and Prestressed Concrete Plants.
- D. Conform to following material and fabrication requirements:
 - 1. Three Sided Structures: ASTM C1504.
 - 2. Other Structures: ASTM C913.

- E. Perform welding according to following:
 - 1. Structural Steel: AWS D1.1.
 - 2. Reinforcing Steel: AWS D1.4.
- F. The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the Engineer, or other representative of the Owner. Such inspection may be made at the place of manufacture, or on the work after delivery, or at both places and the materials shall be subject to rejection at any time on account of failure to meet any of the requirements specified herein; even though samples may have been accepted as satisfactory at the place of manufacture. Material rejected after delivery to the job shall be marked for identification and shall be removed from the job at once. All materials which have been damaged after delivery will be rejected, and if already installed, shall be acceptably repaired, if permitted, or removed and replaced, entirely at the Contractor's expense.
- G. At the time of inspection, the materials will be examined for compliance with the ASTM standard specified below and this Section and with the approved manufacturer's drawings. All sections shall be inspected for general appearance, dimension, "scratch-strength", blisters, cracks, roughness, soundness, etc. The surface shall be dense and close-textured.
- H. Imperfections in sections may be repaired, subject to the approval of the Engineer, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Cement mortar used for repairs shall have a minimum compressive strength of 4000 psi at 7 days and 5000 psi at 28 days, when tested in 3 by 6 inch cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the approval of the Engineer.
- I. Perform Work according to New York State Department of Transportation standards.

1.7 QUALIFICATIONS

- A. Manufacturer: Certified by NPCA Plant Certification Program prior to and during Work of this Section.
- B. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
- C. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience.
- D. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of New York.
- E. Welders and Welding Procedures: AWS qualified within previous 12 months for employed weld types.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver products until concrete has cured 5 days or has attained minimum 75 percent of specified 28-day compressive strength.
- B. Inspection: Accept precast structures on Site in manufacturer's original packaging and inspect for damage.
- C. Comply with precast concrete manufacturer instructions for unloading, storing, and moving precast structures.
- D. Lift structures from designated lifting points.
- E. Storage:
 - 1. Store precast concrete structures to prevent damage to Owner's property or other public or private property.
 - 2. Repair property damaged from materials storage.

1.9 AMBIENT CONDITIONS

- A. Subsequent Conditions: Maintain materials and surrounding air temperature at minimum 50 degrees F prior to, during, and 48 hours after completion of masonry Work.
- B. Cold Weather Requirements: According to ACI 530/530.1.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

- A. Design structures for minimum loads conforming to ASTM C857 and ASTM C890.
- B. Roof Live Load: Comply with following loading conditions, including impact load:
 - 1. Light Traffic:
 - a. ASTM C857, A-8 AASHTO HB-17, HS10.
 - b. Maximum 8,000 lb. each wheel.

2.2 PRECAST CONCRETE UTILITY STRUCTURES

- A. Fabricator List:
 - 1. Precast reinforced concrete manholes and catch basins shall be manufactured by Concrete Systems Inc, Rotondo Precast, Fort Miller or approved equal. Refer to Drawings for inside dimensions, headroom requirements and minimum thickness of concrete.

- B. Precast concrete base sections, riser sections, transition top sections, flat slab tops and grade rings shall conform to ASTM C478 and meet the following requirements:
 - 1. Design precast concrete base and flat slab top for their own weight, weight of soil at 130 pcf, and a live load equal to AASHTO H-20 truck loading applied at finished grade.
 - 2. Bottom slab thickness shall be no less than the riser wall thickness or flat top slab thickness, whichever is greater.
 - 3. Construct precast concrete bases as shown on the Drawings.
 - 4. Base, riser and transition top sections shall have tongue and groove joints.
 - 5. Top section shall be eccentric cone where cover over pipe exceeds 4-ft. Top section shall be a flat slab where cover over top of pipe is 4-ft or less.
 - 6. Section shall be cured by an approved method.
 - 7. Construct and install precast concrete base as shown on the Drawings.
- C. Precast Concrete Utility Structures: Reinforced precast concrete.
- D. Foundation Slab:
 - 1. Top Surface: Leveled.

2.3 ACCESS HATCHES

- A. Manufacturers:
 - 1. Heavy Duty H-20 rated hatches will be CHS1 SAFE Hatch by EJ Group, Inc.
 - 2. Pedestrian rated hatches will be TLN2 SAFE Hatch by EJ Group, Inc.
 - 3. Furnish materials according to New York State Department of Transportation standards.
- B. Access Hatch – RAS Valve Structure:
 - 1. Construction: Aluminum, welded. Pedestrian rated.
 - 2. Attachment: Cast in place
 - 3. Size: 48" x 48".
 - 4. Door: Single.
 - 5. Cover: Diamond plate, reinforced with structural stiffeners to support required loads.
 - 6. Frame:
 - a. Angle type, with integral seat to support cover stiffeners.
 - b. Anchor flange around frame perimeter.
 - 7. Hinges: Stainless steel.
 - 8. Lift Handle: Flush drop handle, non-removable type mounted in cover.
 - 9. Lifting Mechanism:
 - a. Stainless steel compression springs with automatic hold-open and dead stop to retain cover in open position.
 - b. Cover springs to prevent contact by personnel entering utility structure.

10. Latch Mechanism: Stainless steel lock with external handle and permanent internal release mechanism.
11. Hardware: Stainless steel.
12. Finishes: Exterior of frame which comes in contact with concrete shall have one coat black paint.

C. Access Hatch – Filtrate Pump Station:

1. Construction: Aluminum, welded. Pedestrian rated.
2. Attachment: Surface mounted.
3. Size: 55" x 34" to match existing opening.
4. Door: Single.
5. Cover: Diamond plate, reinforced with structural stiffeners to support required loads.
6. Frame:
 - a. Angle type, with integral seat to support cover stiffeners.
 - b. Anchor flange around frame perimeter.
7. Hinges: Stainless steel.
8. Lift Handle: Flush drop handle, non-removable type mounted in cover.
9. Lifting Mechanism:
 - a. Stainless steel compression springs with automatic hold-open and dead stop to retain cover in open position.
 - b. Cover springs to prevent contact by personnel entering utility structure.
10. Latch Mechanism: Stainless steel lock with external handle and permanent internal release mechanism.
11. Hardware: Stainless steel.
12. Finishes: Exterior of frame which comes in contact with concrete shall have one coat black paint.

D. Access Hatch – Pressure/Level Indicator Vault

1. Construction: Aluminum, welded. Pedestrian rated.
2. Attachment: Cast in place
3. Size: 36"x36" .
4. Door: Single.
5. Cover: Diamond plate, reinforced with structural stiffeners to support required loads.
6. Frame:
 - a. Gutter type, with integral seat to support cover stiffeners.
 - b. Anchor flange around frame perimeter.
7. Hinges: Stainless steel.
8. Lift Handle: Flush drop handle, non-removable type mounted in cover.
9. Lifting Mechanism:

- a. Stainless steel compression springs with automatic hold-open and dead stop to retain cover in open position.
 - b. Cover springs to prevent contact by personnel entering utility structure.
10. Latch Mechanism: Stainless steel lock with external handle and permanent internal release mechanism.
 11. Hardware: Stainless steel.
 12. Finishes: Exterior of frame which comes in contact with concrete shall have one coat black paint.

2.4 MATERIALS

A. Concrete:

1. Cement:
 - a. ASTM C150.
 - b. Type II - Moderate.
 - c. Type: Portland.
2. Fine and Coarse Aggregates: ASTM C33, except gradation requirements do not apply.
3. Lightweight Aggregate: ASTM C330, except gradation requirements do not apply.
4. Water: Clean and not detrimental to concrete.

B. Admixtures:

1. Air Entrainment: Comply with ASTM C260.
2. Chemical Admixtures:
 - a. Comply with ASTM C494.

C. Concrete Reinforcement:

1. Reinforcing Steel:
 - a. Comply with ASTM A615.
 - b. Yield Grade: 60 ksi.
 - c. Billet Bars: Deformed.
 - d. Finish: Uncoated.
2. Reinforcing Wire:
 - a. Plain Wire:
 - 1) Comply with ASTM A82.
 - 2) Finish: Unfinished.
 - b. Deformed Wire:

- 1) Comply with ASTM A496.
 - 2) Finish: Unfinished.
3. Welded Steel Wire Fabric:
- a. Plain Wire:
 - 1) Comply with ASTM A185.
 - 2) Finish: Unfinished.
 - b. Deformed Wire:
 - 1) Comply with ASTM A497.
 - 2) Finish: Unfinished.

2.5 FABRICATION

- A. Fabricate precast concrete utility structures conforming to ACI 318 and NPCA Quality Control Manual for Precast and Prestressed Concrete Plants.
- B. Fabricate precast concrete utility structures and openings to size and configuration as indicated on Drawings.
- C. Construct forms to provide uniform precast concrete units with consistent dimensions.
- D. Clean forms after each use.
- E. Reinforcing:
 1. Install reinforcement by tying or welding to form rigid assemblies.
 2. Position reinforcement to maintain minimum 3/4 inch cover.
 3. Secure reinforcement to prevent displacement while placing concrete.
- F. Position and secure embedded items to prevent displacement while placing concrete.
- G. Deposit concrete in forms and consolidate concrete without segregating aggregate.
- H. Provide initial curing by retaining moisture using one of following methods:
 1. Cover with polyethylene sheets.
 2. Cover with burlap or other absorptive material and keep continually moist.
 3. Apply curing compound according to manufacturer instructions.
- I. Provide final curing according to manufacturer's standard.
- J. Remove forms without damaging concrete.

2.6 MIXES

A. Concrete:

1. Select proportions for normal weight concrete according to ACI 318 and ACI 211.1.
2. Concrete Criteria:
 - a. Compressive Strength: 4,000 psi at 28 days.
 - b. Water-Cement Ratio:
 - 1) Concrete Exposed to Freezing and Thawing: Maximum 0.45 percent by mass.
 - 2) Watertight Concrete Not Exposed to Freezing and Thawing: Maximum 0.45 percent by mass.
 - 3) Concrete Exposed to Corrosive Conditions: 0.40 percent by mass.

c. Air Content:

MAXIMUM AGGREGATE SIZE, INCHES	AIR CONTENT, PERCENT	
	SEVERE EXPOSURE	MODERATE EXPOSURE
3/8 inches	6.0 to 9.0	4.5 to 7.5
1/2 inches	5.5 to 8.5	4.7 to 7.0
3/4 inches	4.5 to 7.5	3.5 to 6.5
1 inches	4.5 to 7.5	3.0 to 6.0
1-1/2 inches	4.5 to 7.0	3.0 to 6.0

3. Admixtures:

- a. Include admixture types and quantities indicated in concrete mix designs approved through submittal process.
- b. Do not use calcium chloride.

2.7 FINISHES

A. Reinforcing Steel:

1. Galvanized Finish: Comply with ASTM A767, Class II.
2. Epoxy Coating Finish: Comply with ASTM A775.

B. Wire and Wire Fabric:

1. Epoxy Coated Finish: Comply with ASTM A884, Class A.

C. Concrete:

1. Formed Surfaces Not Exposed to View: As formed.
2. Unformed Surfaces:

- a. Finish with vibrating screed or hand float.
- b. Permitted: Color variations, minor indentations, chips, and spalls.
- c. Not Permitted: Major imperfections, honeycomb, or other defects.

D. Steel:

1. Galvanizing:

- a. Comply with ASTM A123.
- b. Hot dip galvanize after fabrication.

2.8 ACCESSORIES

A. Membrane Curing Compound: ASTM C309, Type I.

B. Steps:

1. Formed steel-reinforced polypropylene rungs.
2. Diameter: 3/4 inch.
3. Width: 12 inches.
4. Spacing: 16 inches o.c. vertically.

C. Inserted and Embedded Items:

1. Structural Steel Sections:

- a. Comply with ASTM A36.
- b. Finish: Galvanized.

D. Joint Sealants and Joint Gaskets:

1. Gasket Joints:

- a. ASTM C443.
- b. Gaskets: Standard rubber.

2. Preformed Joint Sealants: Comply with ASTM C990.

E. Pipe Entry Connectors: Comply with ASTM C923.

F. Grout:

1. Cement Grout: Portland cement, sand, and water mixture with stiff consistency to suit intended purpose.
2. Non-Shrink Grout:
 - a. Description: Premixed compound consisting of non-metallic aggregate, cement, and water-reducing and plasticizing agents.

- b. Conform to ASTM C1107.
- c. Minimum Compressive Strength: 2,400 psi in 48 hours, and 7,000 psi in 28 days.

G. Bituminous Coating:

1. Brushed dampproofing shall be an asphalt emulsion reinforced with fibers conforming to ASTM D1227, Type II, Class 1. The dampproofing shall be Hydrocide 700B by Sonneborn Building Products, Division of ChemRex Inc., Minneapolis, MN; Karnak 220 Asphalt Emulsion by Karnak Corporation, Clark, NJ or equal.

H. Touch-Up Primer for Galvanized Surfaces:

1. SSPC Paint 20, Type II Organic.
2. Comply with ASTM A780.

2.9 SOURCE QUALITY CONTROL

A. Testing:

1. Perform following tests for each 150 cu. yd. of concrete placed with minimum one set of tests each week:
 - a. Slump: Comply with ASTM C143.
 - b. Compressive Strength: ASTM C192 and ASTM C39.
 - c. Air Content: Comply with ASTM C231.
 - d. Unit Weight: Comply with ASTM C138.
2. Make test results available to Engineer upon request.

B. Inspection:

1. Visually inspect completed precast structures for defects.
2. Repair defects on surfaces exposed to view to achieve uniform appearance.
3. Repair honeycomb by removing loose material and applying grout to produce smooth surface flush with adjacent surface.
4. Repair major defects only if permitted by Engineer.

C. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that items provided by other Sections of Work are properly sized and located.
- B. Verify correct size and elevation of excavation.
- C. Verify that subgrade and bedding are properly prepared, compacted, and ready to receive Work of this Section.

3.2 PREPARATION

- A. Mark each precast structure by indentation or using waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Drawings to indicate its intended use.
- B. Coordinate placement of inlet and outlet pipe or duct sleeves required by other Sections.
- C. Do not install structures if Site conditions induce loads exceeding weight capacity of structures.
- D. Inspect precast concrete structures immediately prior to placement in excavation to verify that they are internally clean and free from damage; remove and replace damaged units.

3.3 INSTALLATION

- A. Install underground precast utility structures according to ASTM C891.
- B. Lift precast concrete structures at lifting points designated by manufacturer.
- C. When lowering structures into excavations and joining pipe to units, take precautions to ensure that interior of pipeline and structure remains clean.
- D. Install precast concrete utility structures to elevation and alignment as indicated on Drawings.
- E. Assembly of Multi-Section Structures:
 - 1. Lower each section into excavation.
 - 2. Clean joint surfaces.
 - 3. Install watertight joint seals according to manufacturer instructions using gasket joints, or preformed joint sealants,.
- F. Remove knockouts or cut structure to receive piping without creating openings larger than required to fit pipe; fill annular space with grout.
- G. Pipe Connections:

1. Connect pipe to structure and seal watertight.

H. Foundation slab:

1. Grout to achieve slope to drain.
2. Trowel smooth.
3. Contour as indicated on Drawings.

I. Paint interior with two coats of bituminous interior coating at rate of 120 sq. ft. per gal. for each coat.

J. Frame and Cover and Access Hatch:

1. Set level, without tipping, to elevations as indicated on Drawings.
2. Set cover and access hatch 2 inches above finished grade for structures located within unpaved areas to allow area to be graded away from cover beginning 1 inch below top surface of frame.
3. Connect drain from access hatch frame to storm drainage system or as shown on the Drawings.

K. Touch up damaged galvanized coatings.

L. Backfill excavations for structures as specified in Section 312000 - Earthwork.

3.4 FIELD QUALITY CONTROL

A. Perform following tests and inspections for structures indicated to be watertight:

1. Vacuum Test: Comply with ASTM C1244.
2. Hydrostatic Exfiltration Test: According to manufacturer instructions.

END OF SECTION 330516.13

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SECTION 333113 - PUBLIC SANITARY UTILITY SEWERAGE 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. Sanitary sewerage gravity pipe and fittings.
2. Pipe markers.
3. Connection to manholes.
4. Wye branches and tees.
5. Bedding and cover materials.

- B. Related Requirements:

1. Section 032000, "Concrete Reinforcing" for requirements for concrete reinforcement.
2. Section 033000, "Cast-In-Place Concrete" for concrete type for manhole base pad construction.
3. Section 310515 "Soils and Aggregates for Earthwork" for soils and aggregate for backfill in trenches.
4. Section 312316, "Rock Removal" for product and execution requirements for excavation and backfill required by this Section.
5. Section 312333, "Trenching and Backfilling" for execution requirements for trenching required by this Section.
6. Section 400531, "Thermoplastic Process Pipe" for requirements for piping.
7. Section 460553, "Identification for Water and Wastewater Equipment" for pipe markers.

1.3 COORDINATION

- A. Coordinate Work of this Section with municipal sewerage authority having jurisdiction.
- B. Notify affected utility companies at least 72 hours prior to construction.

1.4 PREINSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing Work of this Section. At the pre-installation meeting, discuss at a minimum, construction schedule, coordination with others, known deviations

from the specifications, communication protocols and quality control / testing procedures and system start-up procedures.

- B. Attendance Roster: Include affected utility companies and appropriate county officials.

1.5 ACTION SUBMITTALS

- A. Section 013300, “Submittal Procedures” for submittals requirements.
- B. Product Data: Submit manufacturer catalog cuts and other information indicating proposed materials to be used, accessories, details,, and construction information.
- C. Shop Drawings:
 - 1. Drawings showing layout and details of pipe, reinforcement, joints, gaskets, special fittings and the name of the pipe manufacturer.
- D. Permits: Submit one copy of State construction permit,.

1.6 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Products meet or exceed specified requirements.
- B. Test and Evaluation Reports: Documenting field tests made and results obtained.
- C. Manufacturer Instructions: Procedures required to install specified products.
- D. Field Quality-Control Submittals: Results of Contractor-furnished tests and inspections.
- E. Qualifications Statements:
 - 1. Qualifications for manufacturer and installer.
 - 2. Manufacturer's approval of installer.

1.7 CLOSEOUT SUBMITTALS

- A. Section 017700 “Closeout Procedures” for submittals requirements.
- B. Project Record Documents: Record invert elevations and actual locations of pipe runs, connections, manholes, and cleanouts.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.8 QUALITY ASSURANCE

- A. Perform Work according to State of New York Department of Transportation standards.
- B. Maintain a copy] of each standard affecting Work of this Section on Site.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000, "Product Requirements" for transporting, handling, storing, and protecting products requirements. Refer to specific pipe material specifications for additional information.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Storage: Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Block individual and stockpiled pipe lengths to prevent moving.
 - 3. Provide additional protection according to manufacturer instructions.
 - 4. Protect materials from weather and UV exposure.

1.11 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Field verify fit-up to existing infrastructure prior to fabrication.
 - 3. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 SANITARY SEWERAGE PIPE AND FITTINGS

- A. Ductile-Iron Pipe: Per AWWA C151.
 - 1. Minimum Pressure Class: 150.
 - 2. Minimum Special Thickness Class: 53.
 - 3. End Connections: Bell and spigot.
 - 4. Outside Coating Type: Asphaltic coating, minimum 1 mil uniform thickness. Per AWWA C151.
 - 5. Lining: ASTM C150 Type 2 X Thickness cement mortar lining and asphaltic seal coat in accordance with AWWA C104.
 - 6. Fittings: Ductile iron, Class 53 or greater. Per AWWA C153 or AWWA C110.

- B. Plastic Pipe: Polyvinyl chloride (PVC), Schedule 80 per ASTM D1785.
 - 1. Inside Nominal Diameter: As noted on drawings.
 - 2. End Connections: Bell and spigot style, with solvent-sealed ends.
 - 3. Fittings: PVC per ASTM D2466.
 - 4. Joints: Solvent welded with solvent cement per ASTM D2564. Comply with ASTM D2855.

- C. Thermoplastic Pipe: High-density polyethylene (HDPE)
 - 1. Inside Nominal Diameter: As noted on drawings.
 - 2. End Connections: Bell and spigot style, with solvent-sealed ends.
 - 3. Fittings: HDPE in compliance with AWWA C901 and ASTM D3261 or fabricated to comply with ASTM F2206.
 - 4. Joints: Butt fusion.

2.2 FLEXIBLE COUPLINGS

- A. Manufacturers:
 - 1. Substitutions: Section 016000, "Product Requirements."
 - 2. Furnish materials according to State of New York Department of Transportation standards.

- B. Description: Resilient chemical-resistant elastomeric polyvinyl chloride (PVC) coupling.
 - 1. Attachment: Two Series 300 stainless-steel clamps, screws, and housings.

2.3 FLEXIBLE PIPE BOOT FOR MANHOLE PIPE ENTRANCES

- A. Manufacturers:
 - 1. Substitutions: Section 016000, "Product Requirements."
 - 2. Furnish materials according to State of New York Department of Transportation standards.

- B. Description: Ethylene propylene rubber (EPDM) per ASTM C923.
 - 1. Attachment: Series 300 stainless-steel clamp and hardware.

2.4 MATERIALS

- A. Bedding and Cover:
 - 1. Bedding: Coarse aggregate – screened gravel as specified in Section 310515 "Soils and Aggregates for Earthwork"
 - 2. Cover: Coarse aggregate – screened gravel as specified in Section 310515 "Soils and Aggregates for Earthwork"
 - 3. Soil Backfill from Above Pipe to Finish Grade:
 - a. Select common fill as specified in Section 310515 "Soils and Aggregates for Earthwork".

- b. Subsoil with no rocks over 6 inches in diameter, frozen earth, or foreign matter.

2.5 FINISHES

- A. Galvanizing: Hot-dip galvanize after fabrication per ASTM A123.

2.6 ACCESSORIES

- A. Pipe Supports: Metal for pipe support brackets: Galvanized structural steel, thoroughly coated with bituminous paint.
- B. Pipe Markers: As specified in Section 460553, "Identification for Water and Wastewater Equipment."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 017300 "Execution" for installation examination requirements.
- B. Verify that trench cut is ready to receive Work.
- C. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

- A. Section 017300 "Execution" for installation preparation requirements.
- B. Correct over-excavation with coarse aggregate.
- C. Remove large stones or other hard materials that could damage pipe or impede consistent backfilling or compaction.
- D. Protect and support existing sewer lines, utilities, and appurtenances.
- E. Utilities:
 - 1. Maintain profiles of utilities.
 - 2. Coordinate with other utilities to eliminate interference.
 - 3. Notify Engineer if crossing conflicts occur.

3.3 INSTALLATION

- A. Bedding:
 - 1. Excavate pipe trench as specified in Section 312000, "Earthwork."

2. Excavate to lines and grades as indicated on as required to accommodate installation.
 3. Dewater excavations to maintain dry conditions and to preserve final grades at bottom of excavation.
 4. Provide sheeting and shoring as specified in Section 312000, "Earthwork."
 5. Placement: Place bedding material at trench bottom.
 - a. Level materials in continuous layer not exceeding 6 inches compacted depth.
 - b. Compact to 95 percent of maximum density.
- B. Piping:
1. Install pipe, fittings, and accessories according to ASTM D2321, and seal joints watertight.
 2. Lay pipe to slope gradients as indicated on Drawings.
 3. Maximum Variation from Indicated Slope: 1/8 inch in 10 feet.
 4. Begin at downstream end and progress upstream.
 5. Assemble and handle pipe according to manufacturer's instructions, except as may be modified on Drawings or by Engineer.
 6. Keep pipe and fittings clean until Work has been completed and accepted by Engineer.
 7. Cap open ends during periods of Work stoppage.
 8. Lay bell and spigot pipe with bells upstream.
 9. Backfill and compact as specified in Section 310515, "Soils and Aggregates for Earthwork."
 10. Do not displace or damage pipe when compacting.
 11. Connect pipe to existing sewer system or at existing manhole.
 12. Pipe Markers: As specified in Section 460553, "Identification for Water and Wastewater Equipment."
- C. Connection to Existing Manholes:
1. Drilling: Core drill existing manhole to clean opening.
 - a. Use of pneumatic hammers, chipping guns, and sledge hammers are not permitted.
 2. Install watertight neoprene gasket and seal with non-shrink concrete grout.
 3. Encasement: Concrete encase new sewer pipe minimum of 24 inch to nearest pipe joint. Use epoxy binder between new and existing concrete.
 4. Prevent construction debris from entering existing sewer line when making connection.
- D. Wye Branches and Tees:
1. Concurrent with pipe-laying operations, install wye branches and pipe tees at locations indicated on Drawings.
 2. Use standard fittings of same material and joint type as sewer main.
 3. Maintain minimum 5 feet separation distance between wye connection and manhole.
 4. Use saddle wye or tee with stainless-steel clamps for taps into existing piping.
 5. Mount saddles with solvent cement or gasket and secure with metal bands.
 6. Lay out holes with template and cut holes with mechanical cutter.
- E. Backfilling: Maintain optimum moisture content of bedding material as required to attain specified compaction density
1. Backfill around sides and to top of pipe as specified in Section 310515, "Soils and Aggregates for Earthwork."

3.4 FIELD QUALITY CONTROL

- A. Section 014000, “Quality Requirements” for inspecting and testing requirements.
- B. Request inspection by Engineer prior to and immediately after placing bedding.
- C. Testing of Gravity Sewer Piping:
 - 1. Low Pressure Air Testing:
 - a. Test each reach of gravity sewer piping between manholes.
 - b. Introduce air pressure slowly to approximately 4 psig.
 - 1) Determine ground water elevation above spring line of piping.
 - 2) For every foot of ground water above spring line of piping, increase starting air test pressure by 0.43 psi.
 - 3) Do not increase pressure above 10 psig.
 - c. Allow pressure to stabilize for at least five minutes.
 - d. Adjust pressure to 3.5 psig or to increased test pressure as determined above when ground water is present.
 - e. Testing: Determine test duration for reach of sewer with single pipe size from following table; do not make allowance for laterals.

NOMINAL PIPE SIZE, INCHES	MINIMUM TESTING TIME, MINUTES/ 100 FEET
3	0.2
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8
33	5.4
36	6.0

- 1) Record drop in pressure during testing period.
- 2) Test Acceptance: If 1.0 psi air pressure drop has not occurred during testing period, piping is acceptable; discontinue testing.
- 3) Test Failure: If air pressure drops more than 1.0 psi during testing period, piping has failed.

- a) If piping fails, test reach of piping in incremental stages until leaks are isolated, repair leaks, and retest entire reach between manholes.
2. Exfiltration Testing of Pipes Larger than 36 inches in Diameter:
 - a. Maximum Allowable Exfiltration: 100 gal/inch of pipe diameter for each mile per day for each reach of piping undergoing testing.
 - b. Perform testing with minimum positive head of 2 feet.
 3. Infiltration Testing:
 - a. Maximum Allowable Infiltration: 100 gal/in of pipe diameter for each mile per day for reach of piping undergoing testing.
 - b. Include allowances for leakage from manholes.
 - c. Perform testing with minimum positive head of 2 feet.
 4. Deflection Testing of Plastic Sewer Piping:
 - a. Vertical Ring Deflection Testing: On PVC and acrylonitrile butadiene styrene sewer piping after backfilling has been in place for 30 days but not longer than 12 months.
 - b. Allowable Maximum Deflection: For installed plastic sewer pipe; not greater than 5 percent of original vertical internal diameter.
 - c. Deflection Testing: Using properly sized rigid ball or "go, no go" mandrel.
 - 1) Furnish rigid ball or mandrel with diameter not less than 95 percent of base or average inside diameter of pipe, as determined by ASTM standard to which pipe is manufactured.
 - 2) Measure pipe diameter in compliance with ASTM D2122.
 - d. Perform testing without mechanical pulling devices.
 - e. Locate, excavate, replace, and retest piping that exceeds allowable deflection.
 5. Compaction Testing:
 - a. Comply with ASTM D1557.
 - b. Testing Frequency: Every 50 linear feet test each lift.

3.5 PROTECTION

- A. Section 017300 "Execution" for protecting finished Work requirements.
- B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION 333113

SECTION 334113 - PUBLIC STORM UTILITY DRAINAGE 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. Drain piping.
- 2. Piping accessories.
- 3. Bedding and cover materials.

- B. Related Requirements:

- 1. Section 310515 “Soils and Aggregates for Earthwork” for soils and aggregate for backfill in trenches.
- 2. Section 312000 “Earthwork” for product and execution requirements for excavation and backfill required by this Section.
- 3. Section 312333 “Trenching and Backfilling” for execution requirements for trenching and backfilling required by this Section.
- 4. Section 330513 “Manholes and Structures” for concrete manholes, frames and grates for storm drainage.

1.3 COORDINATION

- A. Coordinate Work of this Section with termination of storm sewer, trenching, connections.

1.4 PREINSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing Work of this Section.

1.5 ACTION SUBMITTALS

- A. Product Data: Submit data indicating pipe, pipe accessories.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

- D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- E. Qualifications Statements:
 - 1. Submit qualifications for manufacturer and installer.
 - 2. Submit manufacturer's approval of installer.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of pipe runs, connections, cleanouts, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Storage:
 - 1. Store materials according to manufacturer instructions.
 - 2. Block individual and stockpiled pipe lengths to prevent moving.
 - 3. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.
 - 4. Do not place pipe flat on ground; cradle to prevent point stress.
- C. Protection:
 - 1. Keep UV-sensitive materials out of direct sunlight.
 - 2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 DRAINAGE PIPING

- A. Pressure Plastic Piping:
 - 1. Pipe and Fittings:

- a. Comply with ASTM D1785, Class 12454.
- b. Schedule: 80
- c. Fittings: ASTM D2467, Schedule 80, socket; ASTM D2464, Schedule 80 threaded.

B. Gravity Plastic Piping:

1. Pipe:
 - a. Material: PVC.
 - b. Comply with ASTM D3034, SDR 35.
 - c. Inside Nominal Diameter: 6 inches
 - d. Style: Bell and spigot with rubber-ring sealed gasket joint.
2. Fittings: PVC.
3. Joints:
 - a. Comply with ASTM F477.
 - b. Gaskets: Elastomeric.

2.2 MATERIALS

A. Bedding and Cover:

1. Bedding: Fill Type Screened Gravel, as specified in Section 310515 "Soils and Aggregates for Earthwork".
2. Soil Backfill from above Pipe to Finish Grade: Common Fill, as specified in Section 310515 - Soils and Aggregates for Earthwork.
3. Subsoil: No rocks more than 8 inches (150 mm) in diameter, frozen earth, or foreign matter.

2.3 FINISHES

A. Steel:

1. Galvanizing:
 - a. Comply with ASTM A123 (A123M).
 - b. Hot-dip galvanized after fabrication.
2. Galvanizing for Nuts, Bolts, and Washers: Comply with ASTM A153 (A153M).

2.4 ACCESSORIES

A. Pipe Support Brackets: Galvanized structural steel coated with bituminous paint.

B. Geotextile Filter Fabric:

1. Comply with AASHTO M288 for subsurface drainage.

2. Class 2, non-biodegradable.
 3. Non-woven.
 4. 140NS, as manufactured by Mirafi or approved equal.
- C. Pipe Markers: As specified in Section 330526 “Utility Identification.”
- D. Drainage Structures:
1. Catch Basins, Inlets, Manholes: As specified in Section 330513 “Manholes and Structures.”

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that trench cut is ready to receive Work.
- B. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

- A. Correct over-excavation with screened gravel.
- B. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.

3.3 INSTALLATION

- A. Excavation and Bedding:
 1. Excavate pipe trench as specified in Section 312333 “Trenching and Backfilling”.
 2. Hand trim excavation for accurate placement of piping to indicated elevations.
 3. Dewater excavations to maintain dry conditions to preserve final grades at bottom of excavation.
 4. Provide sheeting and shoring as specified in Section 312333 “Trenching and Backfilling”.
 5. Consider including following Subparagraph for pile-supported installations.
 6. Install pile support systems as specified in Section and as indicated on Drawings.
 7. Level materials in continuous layers not exceeding compacted depth of 6 inches (150 mm).
 8. Maintain optimum moisture content of bedding material to attain required compaction density.
 9. Install pipe on compacted subgrade meeting bedding requirements.
 10. Cradle bottom 20 percent of diameter to avoid point load.
 11. Compact to 95 percent maximum density.
 12. Place geotextile fabric over backfill as indicated on Drawings.
- B. Piping:

1. Install pipe, fittings, and accessories according to ASTM D2321.
2. Seal joints watertight.
3. Place pipe on minimum 8-inch -deep bed of screened gravel aggregate, or on compacted subgrade meeting bedding requirements.
4. Verify that drainage system is as indicated on Drawings. Drawing details should describe location of coarse and fine aggregate in relation to pipe and pipe bedding, dimensions of cut trench width, and details of connections to other Work.
5. Lay pipe to slope gradients as indicated on Drawings.
6. Connect piping to drainage structures.
7. Install aggregate at sides and over top of pipe.
8. Install top cover to minimum compacted thickness of 12 inches (300 mm), and compact to 95 percent maximum density.

C. Backfilling and Compaction:

1. As specified in Section 312333 “Trenching and BackFilling”.
2. Do not displace or damage pipe while compacting.

D. Pipe Markers: As specified in Section 330526 “Utility Identification.”

E. Installation Standards: Install Work according to New York State Department of Transportation standards.

F. Drainage Structures:

1. Catch Basins, Inlets, Manholes: As specified in Section 330513 “Manholes and Structures.”

3.4 TOLERANCES

- A. Maximum Variation from Indicated Pipe Slope: 1/8 inch (3 mm) in 10 feet (3 m).

3.5 FIELD QUALITY CONTROL

- A. Request inspection by Engineer prior to and immediately after placing aggregate cover over pipe.

B. Testing:

1. If tests indicate that Work does not meet specified requirements, remove Work, replace, and retest.

C. Compaction Tests:

1. Comply with ASTM D1557.
2. Testing Frequency: 100 LF of pipe.

D. Deflection Test:

1. Comply with ASTM C1103 (C1103M).

3.6 PROTECTION

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION 334113

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. Pipe penetrations
2. Restrained joints
3. Flexible connections
4. Expansion joints
5. Expansion loops
6. Sleeve-type couplings.

- B. Related Requirements:

1. Section 055000 "Metal Fabrications": Miscellaneous metalwork and fasteners as required by this Section
2. Section 400507 "Hangers and Supports for Process Piping: Hangers, anchors, sleeves, and sealing of piping to adjacent structures
3. Section 400519 "Ductile Iron Process Pipe": Ductile-iron piping materials and appurtenances
4. Section 400531 "Thermoplastic Process Pipe": Plastic piping materials and appurtenances
5. Section 400551 "Common Requirements for Process Valves": Common product requirements for valves for placement by this Section

1.3 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): The sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire-rated construction.
- B. FM: Factory Mutual Insurance Company; FM Global is the communicative name of the company.
- C. WH: Warnock Hersey; indicates compliance to relevant building codes, association criteria, and product safety and performance standards.

1.4 COORDINATION

- A. Section 013100 “Project Management and Coordination”: Requirements for coordination.
- B. Coordinate Work of this Section with installation of piping, valves and equipment connections specified in other Sections and indicated on Drawings.

1.5 PREINSTALLATION MEETINGS

- A. Section 013100 “Project Management and Coordination”: Requirements for preinstallation meeting.

1.6 ACTION SUBMITTALS

- A. Section 013300 “Submittal Procedures”: Requirements for submittals.
- B. Product Data:
 - 1. Submit manufacturer catalog information for each specified product, including installation instructions.
 - 2. Firestopping: Submit data on product characteristics, performance, and limitation criteria.
 - 3. 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.
 - 4. Expansion Joints: Indicate maximum temperature, pressure rating, and expansion compensation.
- C. 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.
- D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings for maintenance of fire-resistance rating of adjacent assembly.

1.7 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.
4. Firestopping Engineering Judgments: For conditions not covered by UL- or WH-listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction to accept as meeting fire-protection code requirements.

1.8 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 ASME 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.

1.9 CLOSEOUT SUBMITTALS

- A. Section 017700 "Closeout Procedures": Requirements for submittals.
- B. Project Record Documents: Record actual locations of piping appurtenances.
- C. Identify and describe unexpected variations to pipe routing or discovery of uncharted utilities.

1.10 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 ASME BPVC-IX for welding materials and procedures.
- C. Perform Work according to ASME B31.9 for installation of piping systems.
- D. Through-Penetration Firestopping of Fire-Rated Assemblies:
 1. Comply with UL 1479 or ASTM E814.
 2. Minimum Positive Pressure Differential: 0.1-inch wg (24.9 Pa) to achieve fire F-ratings and temperature T-ratings as indicated on Drawings, but not less than one hour.
 3. Wall Penetrations: Fire F-ratings as indicated on Drawings, but not less than one hour.

- E. Through-Penetration Firestopping of Non-fire-rated Floor Assemblies:
 - 1. Materials to resist free passage of flame and products of combustion.
 - 2. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 3. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- F. Fire-Resistive Joints in Fire-Rated Floor, Roof, and Wall Assemblies:
 - 1. Comply with ASTM E1966 or UL 2079.
 - 2. Rating: As indicated on Drawings for assembly in which joint is installed..
- G. Surface-Burning Characteristics: Maximum 25/450 flame-spread/smoke-developed index when tested according to ASTM E84.
- H. Perform Work according to City of Rome, New York standards or New York State Building Code Standards.
- I. Maintain a copy of each standard affecting Work of this Section on Site.

1.11 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: ASME 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 New York.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 "Product Requirements": Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. 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.

1.13 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.14 WARRANTY

A. Section 017700 "Closeout Procedures": Requirements for warranties.

B. Furnish five-year manufacturer's warranty.

PART 2 - PRODUCTS

2.1 PIPE SLEEVES

A. All construction except new concrete walls:

1. Material: Schedule 40 galvanized steel conforming to ASTM A53.
2. 2-inch minimum circumference water stop welded to exterior sleeve at midpoint
3. Ends cut and ground to be:
 - a. Flush with ground
 - b. Flush with ceiling
 - c. 2 inches above finished floors
 - d. Sealed with caulking
 - e. Sized as required.

B. New concrete walls with pipes up to 20 inches in diameter:

1. Material: non-metallic High-Density Polyethylene Sleeves (HDPE)
2. Integral hollow molded water stops
 - a. 4 inches larger than the outside diameter of the sleeve.
3. End caps for forming and reinforcing ribs.
4. Domestically manufactured by:
 - a. Century-Line as manufactured by Pipeline Seal & Insulator, Inc., Houston, TX, or equal.

C. New concrete with pipes 20 to 60 inches in diameter:

1. Material: molded HDPE modular interlocking discs to make the width of the wall

- a. Corrugated
- b. Cell-Cast as manufactured by Pipeline Seal & Insulator, Inc., Houston, TX, or equal.

D. External wall penetrations:

1. 36 -in diameter and less may be made by means of a ductile iron sleeve capable of being bolted directly to the formwork:
2. Seal of the annular space between the carrier pipe and the sleeve made by means of a confined rubber gasket and be capable of withstanding 350 psi.:
3. Sleeve to have an integrally cast waterstop of 1/2-in minimum thickness, 2-1/2-in minimum height.
4. Manufacturers: Omni-Sleeve, Malden, MA or equal.

2.2 WALL CASTINGS

- A. Ductile iron conforming to ANSI/AWWA A21.51/C151, thickness Class 53.
- B. Diameter as required.
- C. Flanges and/or mechanical joint bells drilled and tapped for studs where flush with the wall.
- D. Castings provided with a 2-in minimum circumferential flange/waterstop integrally cast with or welded to the casting.
- E. Located as follows:
 1. for castings set flush with walls: located at the center of the overall length of the casting,
 2. for castings which extend through wall: located within the middle third of the wall.

2.3 SEALING MATERIALS

- A. Mechanical seals:
 1. Of rubber links shaped to continuously fill the annular space between the pipe and the wall opening or sleeve.
 2. Link pressure plates molded of glass reinforced nylon:
 - a. colored throughout elastomer,
 - b. permanent identification of the size and manufacturer's name molded into the pressure plate and sealing element.
 3. Hardware:
 - a. Mild steel with a 60,000 psi minimum tensile strength
 - b. 2-part Zinc Dichromate coating per ASTM B-633
 - c. Organic Coating, tested in accordance with ASTM B-117 to pass a 1,500-hour salt spray test.
 - d. Use Type 316 Stainless Steel hardware:

- 1) in chemical areas
 - 2) for submerged service
 - 3) for penetrations in tanks containing sludge or wastewater.
4. Completed sealing system:
- a. Duty pressure rated for 20 psig differential pressure.
 - b. EPDM for all services except fire rated assemblies
 - 1) fire rated seals use silicone link material.
 - c. Manufacturers:
 - 1) PSI-Thunderline/ Link-Seal as manufactured by Pipeline Seal & Insulator, Inc., Houston, TX, or pre-approved equal.
 - 2) Advance Products & Systems, Inc.
 - 3) Fernco Inc.
 - 4) Flexicraft Industries.
 - 5) GPT; an EnPro Industries company.

B. Sealant:

1. A two-part foamed silicone elastomer manufactured by:
 - a. Dow Corning Co., Product No. 3-6548 silicone R.T.V.
 - b. 3M brand fire barrier products caulk C.P. 25 and 3M brand moldable putty MP+;
 - c. Flame-Safe fire stop systems FS-900 by Rectorseal.
2. Sealant bead configuration, depth and width in accordance with manufacturer's recommendations.

2.4 MISCELLANEOUS MATERIALS

A. Bonding compound:

1. Sikadur Hi-Mod epoxy by Sika Corp.;
2. Euco 452 by Euclid Chemical Corp.; Master Builders Company
3. or equal.

B. Non-shrink grout:

1. Masterflow 713 by Master Builders Co.;
2. Euco NS by Euclid Chemical Co.;
3. Five Star Grout by U.S. Grout Corp.
4. or equal.

2.5 FLEXIBLE CONNECTIONS

A. Manufacturers:

1. For pressure pipe applications and applications with steel and copper piping:
2. Flexicraft Industries, Chicago, IL;
3. Hyspan Precision Products, Inc.;
4. Metraflex Company, Chicago, IL; Victaulic Company, Easton, PA or equal.
5. Flex-Weld, Inc.
6. For non-pressurized applications involving plastic, clay, asbestos cement, or cast iron applications: Fernco or equal.

B. Non-Pressurized Piping (Plastic, Clay, Asbestos Cement, Cast Iron utilized under 4.3 psig)

1. Flexible couplings: in accordance with ASTM D 5926, C1173 and CSA B602.
2. Couplings: rubberized PVC and be attached with the use of adjustable stainless steel clamps.

2.6 SLEEVE-TYPE COUPLINGS

A. Manufacturers:

1. GE Oil & Gas (Dresser).
2. ; Xylem (Smith-Blair).
3. Baker Hughes Company.
4. Fernco Inc.
5. US Pipe Fabrication.
6. or equal.
7. Substitutions: As specified in Section 016000 - Product Requirements.

B. Description:

1. Comply with AWWA C213, C219.
2. Middle Ring: Ductile iron.
3. Followers: Ductile iron.
4. Gaskets:
 - a. Material: Compatible with service conditions.
 - b. Comply with ASTM D2000.
5. Bolts: 304 Stainless Steel.

C. Finishes:

1. Factory fusion bonded epoxy coated.

2.7 INSULATION

A. As indicated on pipe schedule.

2.8 FINISHES

- A. Prepare piping appurtenances for field finishes as specified in Section 099676.53 Wastewater Transmission System Coatings.

2.9 SOURCE QUALITY CONTROL

- A. Section 014000 “Quality Requirements”: Requirements for testing, inspection, and analysis.
 - 1. 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. Section 017300 “Execution”: Requirements for installation examination.
- B. Verify that field dimensions are as indicated on Drawings.
- C. Inspect existing flanges for nonstandard bolthole configurations or design and verify that new pipe and flanges mate properly.
- D. Verify that openings are ready to receive sleeves and firestopping.
- E. Verify that pipe plain ends to receive sleeve-type couplings are smooth and round for 12 inches (305 mm) from pipe ends.
- F. Verify that pipe outside diameter conforms to sleeve manufacturer's requirements.

3.2 PREPARATION

- A. Section 017300 “Execution”: Requirements for installation preparation.
- B. Cleaning: Thoroughly clean end connections before installation.
- C. Close pipe and equipment openings with caps or plugs during installation.
- D. Surface Preparation: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

- A. According to ASME B31.9.
- B. Coating: Finish piping appurtenances as specified in Section 099676.53 Wastewater Transmission System Coatings for service conditions.
- C. Pipe Penetrations:
 - 1. Flashing:
 - a. Provide flexible flashing and metal counterflashing where piping penetrates weatherproofed or waterproofed walls, floors, and roofs.
 - b. Flash floor drains with topping over finished areas with lead, 10 inches (250 mm) clear on sides, with minimum 36-by-36-inch (910-by-910-mm) sheet size.
 - c. Fasten flashing to drain clamp device.
 - 2. Sleeves:
 - a. Exterior Watertight Entries: Seal with mechanical sleeve seals.
 - b. Set sleeves in position in forms and provide reinforcement around sleeves.
 - c. Size sleeves large enough to allow for movement due to expansion and contraction and provide for continuous insulation wrapping.
 - d. Extend sleeves through floors 1 inch (25 mm) above finished floor level and calk sleeves.
 - e. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent Work with firestopping insulation and calk airtight.
 - f. Provide close-fitting metal collar or escutcheon covers at both sides of penetration.
 - g. Install stainless-steel escutcheons at finished surfaces.
- D. Restrained Joints: As specified in Section 330519 “- Pressure Piping Tied Joint Restraint System”.
- E. Flexible Connections: Install flexible couplings at connections to equipment and where indicated on Drawings.
- F. Expansion Joints:
 - 1. Install flexible couplings and expansion joints at connections to equipment and where indicated on Drawings.
 - 2. If expansion joint is supplied with internal sleeve, indicate flow direction on outside of joint.
- G. Air Release and Vacuum Breakers: Provide vacuum breakers as indicated on Drawings.
- H. Insulation: As indicated on pipe schedule.

3.4 FIELD QUALITY CONTROL

- A. Section 017300 “Execution”: Requirements for testing, adjusting, and balancing.

- B. After installation, inspect for proper supports and interferences.
- C. Repair damaged coatings with material equal to original coating.

3.5 CLEANING

- A. Sections 017300 “Execution” and 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 031000 “Concrete Forming and Accessories” for placement of sleeves in concrete forms required by this Section.
- 2. Section 033000 “Cast-in-Place Concrete” for placement of concrete housekeeping pads required by this Section.
- 3. Section 400506 “Couplings, Adapters, and Specials for Process Piping”.
- 4. Section 400519 “Ductile Iron Process Pipe”

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 PREINSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing Work of this Section.

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 New York 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 New York.
 - e. All aspects of the analysis and design to comply with the provisions of ANSI B31.9 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 professional.

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 applicable authority for welding hanger and support attachments to building structure.
- B. Perform Work according to City of Rome standards.
- C. Maintain a copy of each standard affecting the Work of this Section on-Site.

1.11 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this Section with minimum three years' documented experience.
- B. Fabricator: Company specializing in fabricating products specified in this Section with minimum three years' documented experience.
- C. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience.
- D. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of New York.
 - 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.

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. Piping schedule is included in the contract drawings.
- D. 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.
- E. Support spacing shall be per ASME 31.9
- F. 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.
- G. 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. Submerged, buried, or within outdoor structures (vaults, etc.): Type 316 stainless steel (SS).
2. Within chemical areas: Vinyl ester fiberglass reinforced plastic (FRP) for pipe size up to 2 inch, epoxy coated steel for 2-1/2 inches size and larger.
3. Other locations: steel with galvanizing where noted, or if not otherwise noted, coating as required in Division 09 Finished Painting.
4. Additional requirements (including dielectric insulation) in ACCESSORIES Article.

B. Non-Metallic Pipe Support:

1. Submerged, buried, or within vaults: Type 316 stainless steel or FRP.
2. Within chemical areas: vinyl ester FRP.
3. Other locations: steel with galvanizing where noted, or if not otherwise noted, coating as required in Division 09 Finished Painting; all with local stress protection shields.
4. Additional requirements (including stress protection shields) in ACCESSORIES Article.

C. Wherever stainless steel is noted, it shall be Type 316 unless noted otherwise.

2.4 INSULATION

- A. See ACCESSORIES Article and Drawings.
- B. Section 404213 “Process Piping Insulation” for process piping insulation requirements.

2.5 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 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.

B. Copper Piping:

1. Supports for copper pipe shall be copper plated or shall have a 1/16-inch plastic coating.
2. Support spacing for copper piping and tubing 2-inch and smaller diameter shall not exceed 5 feet and greater than 2 inch diameter shall not exceed 8 feet.
3. Where pipe supports come in contact with copper piping, provide protection from galvanic corrosion by: wrapping pipe with 1/16 inch thick neoprene sheet material and galvanized protection shield; isolators similar to Cooper B-Line B3195CT; or copper-plated or PVC-coated hangers and supports.

C. 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.

D. Framing Support System:

1. See Part 2 MATERIALS for materials of construction.
2. Beams: Size such that beam stress does not exceed 25,000 psi and maximum deflection does not exceed 1/240 of span.
3. Column Members: Size in accordance with manufacturer's recommended method.
4. Support Loads: Calculate using weight of pipes filled with water.
5. Maximum Spans:
 - a. Steel and ductile iron pipe 3-inch diameter and larger: 10 feetcenters, unless otherwise shown.
 - b. Other pipelines and special situations: Same as noted in previous paragraphs. Supplementary hangers and supports may be required.

- E. All vertical pipes shall be supported at each floor or at intervals of not more than 12 feet by approved pipe collars, clamps, brackets, or wall rests and at all points necessary to ensure rigid construction. All vertical pipes passing through pipe sleeves shall be secured using a pipe collar.

2.6 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.
- E. Unless otherwise noted: use Type 304 stainless steel anchoring parts/bolts and hardware for non-submerged supports, Type 316 stainless steel for 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.

2.7 HANGER RODS

- A. Where use of steel is allowed, hanger rods shall be hot-rolled steel, machine-threaded, and, except for stainless steel, galvanized after fabrication. The strength of the rod shall be based on its root diameter.
- 1. Hanger rods shall be attached to concrete structures using single or continuous concrete inserts by the named support manufacturers above. Where use of steel is allowed, inserts shall be malleable iron or steel with galvanized finish.
 - 2. Beam-clamps, C-clamps, or welded-beam attachments shall be used for attaching hanger rods to structural steel members.
- B. Minimum rod size for metallic rod hangers: (* For pipe diameters less than 14 inch, if using pipe roller, use 2 hanger rods with minimum diameter noted below for pipe's diameter).

	Nominal Pipe / Tube Diameter	Minimum Hanger Rod Diameter
1	Less than 2-1/2 inch	1/4 inch*
2	3 to 8 inches	1/2 inch
3	10 to 14 inches	3/4 inch*
4	16 to 20 inches	2 at 1 inch
5	24 inches	2 at 1-1/4 inch
6	30 inches	2 at 1-1/2 inch

2.8 SINGLE PIPE HANGERS

- A. Unless otherwise indicated, pipe hangers and supports shall be standard catalogued components, conforming to the requirements of MSS-41, 58, or 69 and shall be of the following type:

1. Anvil International.
 2. Equal models by: Carpenter & Patterson, Inc., Wobum, MA.
 3. Cooper B-Line.
 4. Gulf State Manufacturing.
 5. Unistrut Northeast, Cambridge, Massachusetts.
 6. CADDY; nVent.
 7. Carpenter & Paterson, Inc.
 8. Empire Industries, Inc.
 9. Globe Pipe Hanger Products Incorporated.
 10. Haydon Corporation.
 11. Hilti, Inc.
 12. NIBCO INC.
 13. PHD Manufacturing, Inc.
 14. PHS Industries, Inc.
 15. Unitron Product, Inc. / US-Strut.
- B. Single pipes shall be supported by hangers suspended by hanger rods from structural steel members, concrete ceilings, bottom of trapeze hangers, and wall-mounted steel angle brackets.
- C. Where pipes are near walls, beams, columns, etc., and located an excessive distance from ceilings or underside of beams, welded steel wall brackets similar to Carpenter and Patterson, Figure Nos. 68, 79, 84, or 139 shall be used for hanging pipe. Where single pipes rest on top of bracket pipe supports, attachments shall meet requirements as specified under multiple pipe hangers.

2.9 MULTIPLE PIPE HANGERS

- A. Suspended multiple pipes, running parallel in the same horizontal plane that are adjacent to each other, shall be suspended by trapeze type hangers or wall brackets. Where use of steel is allowed, trapeze hangers shall consist of galvanized structural steel channel supported from galvanized threaded rod or attached to concrete walls, columns, or structural steel support members. See previous paragraphs about multiple PVC pipe supports.
- B. Except as otherwise specified herein, pipe anchors used for attaching pipe to trapeze or multiple pipe wall brackets shall be anchor or pipe chairs similar to:
1. Anvil Fig. 175.
 2. Cooper B-Line B3147A or B3147B.
 3. Where use of steel is allowed, material of construction shall be galvanized steel. Chair U bolts shall be tightened to allow freedom of movement for normal expansion and contraction except where pipe must be anchored to control direction of movement or act as a thrust anchor.

2.10 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.
- 2.11 WALL SUPPORTED SINGLE AND MULTIPLE PIPES
- A. Single or multiple pipes located adjacent to walls, columns, or other structural members shall be supported using welded steel wall brackets, where use of steel is allowed, as manufactured by Carpenter and Patterson, Figure No. 69, 84, or 139.
 - B. Where noted, multiple pipes may be supported on C-channel with steel brackets similar to Unistrut pipe clamps; with pipe anchor chairs; or equal.
 - C. Individual pipes, up to 8-in diameter, where noted, may use MSS Type 8 pipe clamps as noted on the Drawings.
 - D. Securely fasten all members to wall, column, etc., using double-expansion shields or other method as approved by the Engineer. Provide additional wall bearing plates as required.

2.12 BASE ANCHOR SUPPORT

- A. Bend Support: Where pipes change direction from horizontal to vertical via a bend, install a welded or cast base bend support to carry the load. Fasten to the floor, pipe stanchion, or concrete pedestal using expansion anchors or other method as approved by the Engineer.
- B. Concrete Supports: Where indicated, securely fasten pipe bends to concrete supports with suitable metal bands as required and approved by the Engineer. Isolate piping from poured concrete with a neoprene insert.

2.13 VERTICAL PIPE SUPPORTS

- A. Where vertical pipes are not supported by a Unistrut type system as specified, they shall be supported in one of the following methods.
 - 1. For pipes 1/4 to 2 inch in diameter:
 - a. Provide extension hanger ring with an extension rod and hanger flange.
 - b. The rod diameter shall be as recommended by the manufacturer for the type of pipe to be supported.
 - c. Where use of steel is allowed, the hanger ring shall be steel- or PVC-clad depending on the supported pipe material of construction. The hanger ring shall be equal to Carpenter & Patterson, Figure Nos. 81.
 - d. Where use of steel is allowed, the anchor flange shall be galvanized malleable iron similar to Carpenter and Patterson, Figure No. 85.
 - 2. For pipes equal to or greater than 2 inch in diameter:
 - a. Extended pipe clamps similar to Carpenter & Patterson, Figure No. 267 may be used.
 - b. Attach hanger to concrete structures using double expansion shields,
 - c. Attach hanger to metal support members using welding lugs similar to Carpenter & Patterson, Figure No. 114.
- B. Pipe supports shall be provided for closely spaced vertical piping systems required to provide a rigid installation. The interval of vertical support spacing shall be as specified, but in no case shall vertical interval exceed 12 feet. The support system shall consist of a framework suitably anchored to floors, ceilings, or roofs.
- C. Unless otherwise specified, shown, or specifically approved by the Engineer, vertical runs exceeding 12 feet shall be supported by base elbows/tees, clamps, brackets, wall rests, and pipe collars, all located as required to ensure a rigid installation.
- D. Pipe riser clamps, per MSS SP58, shall be used to support all vertical pipes extending through floor slabs. Where use of steel is allowed, riser clamps shall be galvanized steel manufactured by:
 - 1. Carpenter & Patterson, Figure No. 128.
 - 2. Anvil, Figure 261.
 - 3. Cooper B-Line, Figure B3373.

4. Or equal.

E. Copper-clad or PVC-coated clamps shall be used on copper pipes. Insulation shall be removed from insulated pipes prior to installing riser clamps. Insulation shall not be damaged by clamp installation.

2.14 SPECIAL SUPPORTS

A. Frame Work Supports:

1. Vertical and horizontal supporting members shall be U-shaped channels similar to Unistrut, Series P1000. Vertical piping shall be secured to the horizontal members by pipe clamps or pipe straps. See pipe clamp and strap requirements.
2. For piping 3 inch and smaller, framework shall be as manufactured by:

- a. Unistrut Corporation.
- b. Power-Strut (or Ackinstruct where fiberglass systems are specified).
- c. Multi-Strut by Carpenter-Paterson.
- d. Or equal.

3. For piping larger than 3 inch, the support frame shall be fabricated from structural stainless steel or steel shapes, depending upon the support location, and secured through the use of drop in, adhesive or expansion anchors.
4. The assemblies shall be furnished complete with all nuts, bolts, and fittings required for a complete assembly including end caps for all Unistrut members.
5. Electrical Conduit Support: Under Division 26.
6. The design of each individual framing system shall be the responsibility of the Contractor. Submit shop drawings, and show all details of the installation, including dimensions and types of supports. In all instances the completed frame shall be adequately braced to provide a complete rigid structure when all the piping has been attached. See also Article SUPPORT AND RESTRAINT.

B. Supports not otherwise described in this Section shall be fabricated or constructed from standard structural stainless steel or steel shapes in accordance with applicable provisions of Section 055000 "Metal Fabrications," or Unistrut-type frame; have anchor hardware similar to items previously specified herein; shall meet the minimum requirements listed below; and be subject to the approval of the Engineer.

C. Additional Pipe Support Situations:

1. Supporting Multiple Chemical and Related Piping:
 - a. Location: indicated on Drawings or otherwise required, especially adjacent to chemical pumps.
 - b. Use: framework support.
 - c. Materials: FRP, with proper local stress protection.

2.15 SHOP FACTORY FINISHING

- A. Prepare and prime metallic (except stainless steel) supports in accordance with Division 09.

2.16 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.
- E. Electrical Isolation: Install 1/4 by 3 inch neoprene rubber wrap between submerged metal pipe and oversized clamps.

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. Install according to: MSS SP 58.
2. Support horizontal piping as indicated on Drawings, depending upon pipe size.
3. Install hangers with minimum 1/2 in space between finished covering and adjacent Work.
4. Place hangers within 12 in of each horizontal elbow.
5. Use hangers with 1-1/2 in minimum vertical adjustment.
6. Support horizontal cast iron pipe adjacent to each hub, with 5 ft maximum spacing between hangers.
7. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
8. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
9. Support riser piping independently of connected horizontal piping.
10. Provide sheet lead packing between hanger or support and piping.
11. Design hangers for pipe movement without disengagement of supported pipe.
12. Support piping independently so that equipment is not stressed by piping weight or expansion in piping system.
13. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
14. Provide welded steel brackets where piping is to be run adjacent to building walls or columns.
15. Use beam clamps where piping is to be suspended from building steel.
16. Insulated Piping: Provide two bolted clamps designed to accommodate insulated piping.
17. Use offset clamps where pipes are indicated as offset from wall surfaces.
18. 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.
19. 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.
20. Repair mounting surfaces to original condition after attachments are made.
21. Brace horizontal pipe movements by both longitudinal and lateral sway bracing.
22. Where supports are required in areas to receive chemical resistant seamless flooring, install supports prior to application of flooring system.

E. Insulation:

1. Provide clearance in hangers and from structure and other equipment for installation of insulation.

F. Equipment Bases and Supports:

1. Provide housekeeping pads of concrete, minimum 3-1/2 in thick and extending 6 in beyond supported equipment. Comply with Section 033000 - 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 formed steel channel. Brace and fasten with flanges bolted to structure.
5. Provide rigid anchors for pipes after vibration isolation components are installed. Comply with Section 400513 - Common Work Results for Process Piping.

G. Prime Coat:

1. Prime coat exposed steel hangers and supports.
2. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

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 New York and shall be subject to the review of the Engineer.

3.4 ATTACHMENT SCHEDULE

A. Pipe Hanger Spacing:

1. Pipe Material: ABS.
 - a. Maximum Hanger Spacing: 4 feet
 - b. 3/8 inch
2. Pipe Material: Aluminum.
 - a. Maximum Hanger Spacing: 10 feet
 - b. 1/2 inch

3. Pipe Material: Cast iron.
 - a. Maximum Hanger Spacing: 5 feet
 - b. 5/8 inch
4. Pipe Material: Cast Iron, with 10-foot length of pipe.
 - a. Maximum Hanger Spacing: 10 feet
 - b. 5/8 inch
5. Pipe Material: CPVC.
 - a. Size: 1 inch and smaller.
 - b. Maximum Hanger Spacing: 3 feet
 - c. 1/2 inch
6. Pipe Material: CPVC.
 - a. Size: 1-1/4 inches and larger.
 - b. Maximum Hanger Spacing: 4 feet
 - c. 1/2 inch
7. Pipe Material: Copper tube.
 - a. Size: 1-1/4 inches and smaller.
 - b. Maximum Hanger Spacing: 6 feet
 - c. 1/2 inch
8. Pipe Material: Copper tube.
 - a. Size: 1-1/2 inches and larger.
 - b. Maximum Hanger Spacing: 10 feet
 - c. 1/2 inch
9. Pipe Material: Fiberglass:
 - a. Maximum Hanger Spacing: 4 feet
 - b. 1/2 inch
10. Pipe Material: Glass.
 - a. Maximum Hanger Spacing: 8 feet
 - b. 1/2 inch
11. Pipe Material: Polybutylene.
 - a. Maximum Hanger Spacing: 2.7 feet
 - b. 3/8 inch

12. Pipe Material: Polypropylene.
 - a. Maximum Hanger Spacing: 4 feet
 - b. 3/8 inch

13. Pipe Material: PVC.
 - a. Maximum Hanger Spacing: 4 feet
 - b. 3/8 inch

14. Pipe Material: Steel.
 - a. Size: 3 inches and smaller.
 - b. Maximum Hanger Spacing: 12 feet
 - c. 1/2 inch

15. Pipe Material: Steel.
 - a. Size: 4 inches and larger.
 - b. Maximum Hanger Spacing: 12 feet
 - c. 5/8 inch

END OF SECTION 400507

SECTION 400519 - DUCTILE IRON 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. Ductile-iron pipe.
2. Ductile-iron, malleable-iron, and cast-iron fittings.
3. Accessories.

- B. Related Requirements:

1. Section 400506 “Couplings, Adapters, and Specials for Process Piping” for piping appurtenances.
2. Section 400507 “Hangers and Supports for Process Piping” for hangers, anchors, sleeves, and sealing of piping to adjacent structures.
3. Section 400551 “Common Requirements for Process Valves” for common product requirements for valves for placement by this Section.

1.3 COORDINATION

- A. Section 013100 “Project Management and Coordination” for requirements for coordination.
- B. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.4 PREINSTALLATION MEETINGS

- A. Section 013100 “Project Management and Coordination” for requirements for preinstallation meeting.

1.5 ACTION SUBMITTALS

- A. Section 013300 “Submittal Procedures” for requirements for submittals.
- B. Product Data: Submit manufacturer information regarding pipe and fittings.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

C. Shop Drawings:

1. Indicate layout of piping systems, including equipment, critical dimensions, sizes, and materials lists.
2. Include plans, elevations, sections, and attachment details.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.6 INFORMATIONAL SUBMITTALS

- A. **Manufacturer's Certificate:** Prior to shipment of pipe, submit a certified affidavit of compliance from the pipe manufacturer stating that the pipe fittings, gaskets, linings and exterior coating for this project have been manufactured and tested in accordance with AWWA and ASTM standards and requirements specified herein.
- B. **Source Quality-Control Submittals:** Indicate results of factory tests and inspections.
- C. **Field Quality-Control Submittals:** Indicate results of Contractor-furnished tests and inspections.
- D. **Qualifications Statements:**
 1. Submit qualifications for manufacturer, installer, and licensed professional.
 2. Submit manufacturer's approval of installer.
- E. **Product Test Reports:** For each test performed by manufacturer .

1.7 CLOSEOUT SUBMITTALS

- A. Section 017700 "Closeout Procedures" for requirements for submittals.
- B. **Project Record Documents:** Record actual locations of piping, valves and other appurtenances, connections, and invert elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
- D. **Operation and Maintenance Data**

1.8 QUALITY ASSURANCE

- A. **Materials (including linings) in Contact with Potable Water:** Certified according to NSF 61 and NSF 372.

- B. Hydrostatically test each length of ductile iron pipe at the point of manufacture to 500 psi for a duration of 10 seconds per AWWA C151. Furnish certified test results in duplicate to the Engineer prior to time of shipment.
- C. Inspect and test by Manufacturer the ductile-iron pipe and fittings at the foundry as required by the AWWA C600, Hydrostatic Testing. Furnish in duplicate to the Engineer sworn certificates of such tests and their results prior to the shipment of the pipe.
- D. Pipe and fittings to be installed under this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory selected by the Owner, at the Owner's expense.
- E. Engineer will inspect the pipe and fittings after delivery. Products are subject to rejection at any time on account of failure to meet any of the specified requirements, even though accepted as satisfactory at the place of manufacture. Immediately mark pipe rejected after delivery and remove from the job site.
- F. Permanently mark pipe and fittings with the following information:
 - 1. Manufacturer name and trademark
 - 2. Manufacturing date.
 - 3. Size, type, class, or wall thickness.
 - 4. Production Standard (AWWA, ASTM, etc.).
- G. Perform Work according to City of Rome, New York standards.
- H. Maintain a copy of each standard affecting Work of this Section on Site.

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. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of New York.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 – Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage. Photograph and provide written documentation of damaged materials.
- C. Store materials according to manufacturer instructions.
- D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Coverall openings to prevent entrance of dirt, water, and debris.
3. Protect piping and appurtenances by storing off ground.
4. Limit stacking height to manufacturers specified maximum.
5. Provide additional protection according to manufacturer instructions.

1.11 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS

A. Piping:

1. Comply with AWWA C115, C150, and C151.
2. Thickness Class 53
3. Ductile Iron pipe as manufactured by U.S. Pipe and Foundry Company, Inc.; American Cast Iron Pipe Company; all divisions of the McWane Company or an approved equal who is a member of the Ductile Iron Pipe Research Association (DIPRA).

B. Fittings:

1. Material: AWWA C153, ductile iron.
2. Class: Same as that of connected piping.
3. Mechanical Joints:
 - a. Comply with AWWA C110 and AWWA C111.
 - b. Glands: Ductile iron with asphaltic coating.
 - c. Push-on Joints: Comply with AWWA C111.
4. Restrained Joints: Comply with AWWA C111.
5. Flanged Fittings: Comply with AWWA C110.
 - a. Assembly bolts: square headed carbon steel machine bolts with hexagon nuts per ANSI B18.2. Threads conform to ANSI B1.1. Bolt length: 1/8" to 5/8" protrusion from nut after torquing.
6. Grooved joints: Comply with AWWA C606
 - a. Rigid couplings: Style 31 couplings as manufactured by Victaulic, Anvil International, or approved equal.

- b. For direct connection of ductile pipe to steel pipe of IPS sizes: Victaulic Style 307 transition coupling with offsetting, angle-pattern, bolt pads.
 - c. Grooved end fittings for AWWA ductile iron pipe: Conform to ANSI A21.10/AWWA C110 for center-to-end dimensions and ANSI A21.10/AWWA C110 or AWWA C153 for wall thickness, with AWWA C606 grooved ends.
 7. Sleeve type couplings: Dresser Style 38 or 138 as manufactured by Dresser Industries, or equivalent products of Smith-Blair, Romac Industries, Ford Meter Box Co or approved equal.
 8. Flanged coupling adaptors: Smith-Blair Type 913, or equivalent products of Klamflex Pipe Couplings (PTY) LTD, Robar Industries LTD or approved equal.
 - C. Cement-Mortar Lining:
 1. Comply with AWWA C104.
 2. Thickness: Standard.
 3. Wastewater applications:
 - a. ASTM C150 Type 2 X Thickness cement mortar lining and asphaltic seal coat in accordance with AWWA C104.
 - D. Special Linings
 1. Glass Lining:
 - a. Glass lining: consists of vitreous and inorganic lining materials applied to the internal surfaces. The internal surface shall be prepared in strict accordance with ASTM B1000, Sections 3 and 4.
 - b. Apply lining in a minimum of two coats, separately applied and separately fired to a maturing temperature of 1350 degree F. Finished dry film thickness: 10 mils minimum.
 - c. Finished glass lining Acceptance Criteria:
 - 1) Free of visible pin holes or holidays, crazing or fish scales.
 - 2) Surface hardness greater than 6 on the MOHS scale.
 - 3) Able to withstand a strain of 0.001 inch/inch of the base metal without damage to the glass.
 - 4) Inspected and tested in accordance with ASTM B1000 - 15, Section 7. Certified inspection and test report to be furnished with each product shipment.
 - d. Applicator Qualifications: minimum of 5 years successful experience in the application of high temperature glass/porcelain coatings to the interior of ductile pipe and fittings. Certify complete compliance with all qualification, final inspection and quality guidelines included in Sections 5 and 6 of ASTM B1000 – 15.
 - E. Exterior Coating:
 1. Exposed Service: As specified in Section 099676 - Wastewater Coatings.

2. If required, coatings "hold-backs" to be provided at pipe and fitting ends for satisfactory installation for joint connections in the field.
3. Provide all necessary coating materials to perform field coating applications at joints compatible with or equal to the shop applied material.
4. Field repair of pipe with damaged coating shall receive prior approval of the Engineer. If, in the opinion of the Engineer coating damage is beyond repair, pipe to be replaced at the expense of the Contractor.
5. All flange bearing surfaces shall be uncoated.
6. Mechanically clean or brush blast all surfaces to have exterior coating applied to ductile iron surfaces. Chemical cleaning or wiping with solvent is not acceptable.

2.2 ACCESSORIES

A. Gaskets:

1. full face type per AWWA C111 to provide positive sealing for the flanged ductile iron joints.
2. Thickness 1/8-in
3. NSF61 certified for potable water applications.

2.3 SOURCE QUALITY CONTROL

- A. Section 014000 - 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 017300 "Execution": Requirements for installation examination.
- B. Verify that field dimensions are as indicated on 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. Thoroughly clean pipe and fittings before installation.
- C. Surface Preparation:
 - 1. Clean surfaces to remove loose rust, mill scale, and other foreign substances by power wire brushing.
 - 2. Touch up shop-primed surfaces with primer as specified in Section 099679 “Atmospheric Protection and Plant Service Areas Coatings.”
 - 3. Solvent-clean surfaces that are not shop primed.

3.3 INSTALLATION

- A. Buried Service Piping: As specified in Section 331116 - Site Water Utility Distribution Piping.
- B. Exposed Service Piping:
 - 1. According to ASME B31.3.
 - 2. In compliance with manufacturer’s instructions.
 - 3. Run piping straight along alignment as indicated on Drawings, with minimum number of joints.
 - 4. Clean each length prior to installation.
 - 5. Support per Section 400507.
 - 6. Do not use equipment flanges for support; support pipe separately.
- C. Fittings:
 - 1. According to manufacturer instructions.
 - 2. Clean gasket seats thoroughly, and 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.
 - 4. Flanged joints to be made using gaskets, bolts, bolt studs with a nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts to conform to the same ANSI Standard as the flanges.
 - 5. Provide required upstream and downstream clearances from devices as indicated on Drawings.
- D. Make taps to ductile iron piping only with service saddle, tapping boss of a fitting or valve body, or equipment casting.
- E. Install piping with sufficient slopes for venting or draining 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 pipe guides as specified in Section 400507 - Hangers and Supports 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. Cutting by abrasive saw only, leaving a smooth cut at right angles to the axis of the pipe. Damage to the lining repaired to the satisfaction of the Engineer. Seal Field cut ends approved epoxy coating in accordance with manufacturer's instructions.
- J. Finish primed surfaces according to Section 099679 "Atmospheric Protection and Plant Service Areas Coatings."
- K. Provide cathodic protection where indicated on Drawings for buried ferrous piping systems..

3.4 TOLERANCES

- A. Section 014000 - Quality Requirements: Requirements for tolerances.
- B. Laying Tolerance: As specified in Section 331116 "Site Water Utility Distribution Piping."
- C. Deflection at joints not to exceed that recommended by the pipe manufacturer.
- D. Supply and install fittings, in addition to those shown on Drawings, in areas where conflict exists with existing facilities.

3.5 FIELD QUALITY CONTROL

- A. Section 014000 "Quality Requirements" for inspecting and testing requirements.
- B. Inspection:
 - 1. Inspect for damage to pipe lining or coating and for other defects that may be detrimental as determined by Engineer.
 - 2. Repair damaged piping or provide new, undamaged pipe at no additional cost to the project.
 - 3. After installation, inspect for proper supports and interferences.
 - 4. Inspect and field test the glass lined piping and fittings to verify the delivered products meeting the criteria specified. Submit field test reports for spark testing and straightness testing showing compliance with the following criteria.
 - a. Perform glass lining inspection and testing of pipe and fitting prior to installation.
 - b. Visually inspect pipe in storage on site for damage and defects.
 - c. The Engineer will select 10% of the pipe and fittings delivered to the site for field testing.
 - d. Perform a spark test on the selected glass lined pipe pieces using testing firm/team acceptable to the manufacturer of the pipe and fittings. Perform the tests in accordance with ASTM B1000.
 - e. The field spark test results not to exceed 15 percent variation in the number of pinholes detected during the factory test. If the field test results show greater than 15 percent variation in the number of pinholes detected when compared to the

factory spark test, perform the field testing on the entire load of the glass lined pipe and fittings delivered to the site.

- f. Perform field test for straightness on 10 percent of 4” to 8” pipes. If the test results reveal deviation exceeds the maximum limits specified in ASTM B1000, perform the test on all the 4” to 8” pipes.
- g. All pieces which fail the field test specified herein or do not meet the maximum allowable pinhole requirement specified in ASTM B1000 to be replaced at no additional cost to the Owner.

C. Pressure Testing:

1. Test Pressure: Not less than 200 psig (1 380 kPa) or 50 psi (345 kPa) 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 (34.4 kPa) 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) $L = SD \times \text{sqrt}(P)/C$.
 - 2) L = testing allowance in gph (L/h).
 - 3) S = length of pipe tested in feet (m).
 - 4) D = nominal diameter of pipe in inches (mm).
 - 5) P = average test pressure during hydrostatic test in psig (kPa).
 - 6) C = 148,000 (794 797).
 - 7) If 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.

3.6 CLEANING

- A. Sections 017300 “Execution” and 017700 “Closeout Procedures” specify requirements for cleaning.

- B. Keep pipe interior clean as installation progresses.
- C. After installation, clean pipe interior of soil, grit, and other debris.

END OF SECTION 400519
(references follow)

EXHIBIT A
Use as a reference

LININGS AVAILABLE FOR DUCTILE PIPE

Description:	Maximum Service Temp. (Degree F): [1]	Common Use:	Thickness:
CEMENT MORTAR	With Sealcoat - 150 Degrees Without Sealcoat - 212 Degrees	Drinking Water Salt Water Non-Septic Gravity Sewers Sanitary Sewer Force Mains	
GLASS		Scum	10 Mil (Min)
PETROLEUM ASPHALT COATING	150 Degrees	Air	1 Mil
PROTECTO 401 (ceramic-filled amine-cured epoxy)	120 to 150 Degrees [2]	Septic Sewer Acids [3] Alkali Waste Pickling Brine	40 Mil (nominal)
EPOXY SUITABLE FOR DRINKING WATER [4]	120 to 150 Degrees [2]	Drinking Water Food Processing	24 Mil (Min)
POLYETHYLENE	120 to 150 Degrees [5]	Septic Sewer Acids [3] Alkali Waste Pickling Brine	40 Mil (nominal)

- [1] Maximum service temperatures listed are intended as general guidelines. For higher service temperatures, consult manufacturer for specific recommendations.
- [2] Maximum service temperature for epoxies depends on service conditions and specific formulation. Consult manufacturer for recommendations for elevated temperature service.
- [3] Consult manufacturer for specific acid service use.
- [4] All epoxies are not suitable for conveying drinking water. Consult manufacturer for recommendations.
- [5] Maximum service temperature for polyethylene for acids and alkali waste depends on the specific acid or alkali waste and service condition(s). Consult manufacturer for recommendations for elevated temperature service.

END OF EXHIBIT A

EXHIBIT B

Use as a reference

GASKET MATERIALS USED FOR DUCTILE IRON PIPE IN WATER AND SEWERAGE SERVICE

Description: Push-on:	Maximum. Service Temperature (Degree F): [1] [2]		Common Uses: [3]
	Mechanical Gaskets:	Joint Gaskets:	
SBR (Styrene Butadiene)	150 Degrees	120 Degrees	Fresh Water Salt Water Sanitary Sewage
EPDM (Ethylene Propylene Diene Monomer)	250 Degrees	225 Degrees	Fresh Water Salt Water Sanitary Sewage Hot Water
Nitrile (NBR) (Acrylonitrile Bu- tadiene)	150 Degrees	120 Degrees	Hydrocarbons Fats Oils Greases Chemicals
Neoprene (R) (CR) (Polychloro- prene)	200 Degrees	200 Degrees	Fresh Water Salt Water Sanitary Sewage
Viton (R); Fluorel (R) (FPM) [4] (Fluorocarbon)	300 Degrees	225 Degrees	Hydrocarbons Acids Petroleum Vegetable Oils

- [1] Maximum service temperatures listed are intended as general guidelines for ductile iron pipe gaskets. For service temperatures greater than those listed, consult manufacturers for specific recommendations.
- [2] Minimum service temperature is not usually a meaningful parameter for piping gaskets; however, low temperatures during pipeline installation may necessitate precautions. Consult manufacturer for pertinent recommendations.
- [3] Water, including sanitary sewage, with low levels of the listed contaminants.
- [4] Consult manufacturer for availability of FPM push-on gaskets.

END OF EXHIBIT B

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. PVC tube.
3. CPVC pipe.
4. Polyvinylidene fluoride (PVDF) pipe and tube.
5. Acrylonitrile-butadiene-styrene (ABS) pipe.
6. Polyethylene (PE) pipe and tube.
7. Fittings.
8. Accessories for plastic piping.

- 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.
3. Section 400551 "Common Requirements for Process Valves": Common product requirements for valves for placement by this Section.

1.3 COORDINATION

- A. Section 013100 "Project Management and Coordination": Requirements for coordination.
- B. Coordinate Work of this Section with piping and equipment connections specified in other Sections and indicated on Drawings.

1.4 PREINSTALLATION MEETINGS

- A. Section 013100 "Project Management and Coordination": Requirements for preinstallation meeting.
- B. Convene minimum one week prior to commencing Work of this Section.

1.5 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 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.

1.6 SUSTAINABLE DESIGN SUBMITTALS

- A. Section 018113 “Sustainable Design Requirements”: Requirements for sustainable design submittals.
- B. Manufacturer's Certificate:
 - 1. Certify that products meet or exceed specified sustainable design requirements.
 - 2. Materials Resources Certificates:
 - a. Certify source and origin for salvaged and reused products.
 - b. Certify recycled material content for recycled content products.
 - c. Certify source for regional materials and distance from Project Site.
- C. Product Cost Data:
 - 1. Submit cost of products to verify compliance with Project sustainable design requirements.

2. Exclude cost of labor and equipment to install products.
3. Provide cost data for following products:
 - a. Salvaged, refurbished, and reused products.
 - b. Products with recycled material content.
 - c. Regional products.

1.7 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 elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.8 QUALITY ASSURANCE

- A. Permanently mark each length of pipe with manufacturer's name or trademark and indicate conformance to standards.
- B. Perform Work according to AWWA standards.
- C. Maintain a copy of each standard affecting Work of this Section on Site.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience.
- C. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of New York.

1.10 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.

1.11 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 (4.4 degrees C) or above 90 degrees F (32.2 degrees C) if pipe is exposed to direct sunlight.
- C. UV Protection: Provide pipe installed above ground or outside with UV protection.

1.12 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 AWWA C900.
 - b. Class 12454-B Schedule 80.
 2. Fittings:
 - a. Material: Molded PVC.
 - b. Type: Push-on, comply with AWWA C907.
 - c. Gaskets: Comply with AWWA C111.

3. Joints:
 - a. Type: Compression gasket ring.
 - b. Comply with ASTM D3139.

4. Materials:
 - a. Comply with ASTM D1784.
 - b. Minimum Cell Classification: 12454-B.

2.3 PE PIPE, TUBE, AND FITTINGS

A. HDPE Pipe and Fittings:

1. Pipe: ASTM F714 / AWWA C906 for sizes 4" and greater
2. SDR: SDR 21.0, rated for a maximum 100 psig working pressure
3. Fittings:
 - a. Comply with AWWA C901.
 - b. Type: Molded to comply with ASTM D3261 or fabricated to comply with ASTM F2206.
 - c. Minimum pressure rating equal to or greater than the pipe to which they are joined.
4. Joints: Butt fusion.
5. Materials:
 - a. PE 4710 high density polyethylene resin.
 - b. Comply with ASTM D3350.
 - c. Minimum Cell Classification: 445574-C-C.

2.4 FINISHES

- A. Coat machined faces of metallic flanges with temporary rust-inhibitive coating.

2.5 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. Primers: Comply with ASTM F656.

B. PE Piping:

1. Insert Fittings: Comply with ASTM D2609.
2. Couplings: Comply with ASTM F1055.
3. Flange Bolting:
 - a. Hex-Head Bolts: Stainless steel; ASTM A193/ (A193M;).
 - b. Hex-Head Nuts: Stainless steel; ASTM A194/ (A194M;).
4. Flange Gaskets:
 - a. Type: Full faced.
 - b. Material: EPDM.
 - c. Comply with ASME B16.21.

2.6 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. Notify Owner at least seven days before inspection is allowed.
- D. Owner Witnessing:
 1. 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 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 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.
- K. Underground Piping: As specified in Section 331116 "Site Water Utility Distribution Piping".

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 (1034 kPa) 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 (34.4 kPa) 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 400551 - COMMON REQUIREMENTS FOR PROCESS 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. Common requirements for valves.
2. Common requirements for valve actuators.
3. Valve tags.
4. Valve Schedule.

- B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for execution requirements for placement of concrete as required by this Section.
2. Section 055000 "Metal Fabrications" for miscellaneous metalwork and fasteners specified by this Section.
3. Section 400507 "Hangers and Supports for Process Piping" for product and execution requirements for valve supports specified by this Section.
4. Section 400557 "Actuators for Process Valves and Gates."
5. Section 400593.23 "Low-Voltage Motor Requirements for Process Equipment" for single- and three-phase motor requirements for equipment specified in this Section.

1.3 COORDINATION

- A. Coordinate Work of this Section with individual process valve specifications.

1.4 PREINSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing Work of this Section.
- B. Section 013100 "Project Management and Coordination": Requirements for preinstallation meeting.

1.5 ACTION SUBMITTALS

- A. Valve Schedule:

1. Submit valve schedule populated with all Division 40 process valves specified for this project. Include all information shown on the Sample Valve Schedule included in this project.
2. Approval of valve schedule submittal to precede all individual valve submittals. All subsequent individual valve submittals to include the approved valve tag number or group on the submittal cover sheet.

B. Valve Tags:

1. Materials, dimensions and thickness of tags, materials and gauge of cable and splicing hardware.
2. Color palate for Owner selection.
3. Full scale drawing of sample with lettering dimensions and scribe depth.
4. Valve tag lettering provided with Valve Schedule above.

C. Power Actuator Data:

1. Sizing calculations
 - a. Provide fluid pressure and velocity sizing basis.
 - b. Provide maximum valve torque based on disc shape and flow direction.
 - c. Clearly indicate safety factors and mechanical ratios of any intermediate gearing.
2. Maximum output torque of actuator and intermediate gearing.
3. Details of actuator mounting, including orientation of actuator and intermediate gearing.
4. Dimensional drawing of actuator assembled on valve.
5. Pneumatic/Hydraulic pressure requirements, electrical power supply, plumbing connection sizes and locations.
6. Wiring diagram, control wiring and protocol.
7. Valve cavitation limits for positioning, modulating and control valves mated to power actuator.

D. Shop Drawings: Valve and actuator model number and size, valve parts list, materials of each part including material standard designation (ASTM or other), position indicators, limit switches, actuator mounting.

E. Provide certified hydrostatic test data, per manufacturer's standard procedure or MSS-SP-61 for all valves.

1.6 DELEGATED DESIGN SUBMITTALS

- A. Submit signed and sealed Shop Drawings with design calculations and assumptions for sizing of control valves.

1.7 INFORMATIONAL SUBMITTALS

- A. Manufacturer Instructions: Submit installation and operation instructions for each component including valve, actuator, gearbox, and any included instrumentation.

- B. Source Quality-Control Submittals: Indicate results of integrators facility tests and manufacturers factory tests and inspections.
- C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- D. Manufacturer Certification of Installation: Certify that equipment has been installed according to manufacturer instructions.
- E. Qualifications Statement:
 - 1. Submit qualifications for manufacturer and licensed professional.

1.8 CLOSEOUT SUBMITTALS

- A. Section 017839 “Project Record Documents” for record actual locations of valves and actuators.

1.9 QUALITY ASSURANCE

- A. Maintain clearances as indicated on Drawings.
- B. Ensure that materials of construction of wetted parts are compatible with process liquid.
- C. Mate valves to actuators at manufacturers or integrator’s facility. Fully test assembled product and certify ready for installation prior to shipment to the job site.
 - 1. Only in special cases for extremely large assemblies where installation requires disassembly, may actuators be mounted to the valves in the field.
- D. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.
- E. Furnish affidavit of compliance with testing and manufacturing standards referred in this specification and the individual valve specifications.
- F. Provide the services of a qualified and factory-trained service representative of the manufacturer to provide installation inspection and check out, and operational and maintenance instruction, for each type of the following equipment for the following durations:

Equipment	Valve Sizes	Installation Inspection	O and M Instruction
480 volt electric actuators	N/A	1 day, 8 hr.	1 day, 8 hr.
Pinch valves	N/A	1 day, 8 hr.	1 day, 8 hr.

- G. Obtain Manufacturer’s Certificate of Compliance for Specified valves and valve assemblies.

1.10 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing valves and actuators with minimum ten years' documented experience.

- B. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of New York.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Deliver factory mated power actuated valves on rigid wooden skids, fully braced and strapped to prevent damage to valve, actuator or coupling system.
- C. Store materials according to manufacturer instructions.
- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.
 - 3. Provide additional protection according to manufacturer instructions.

1.12 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to materials ordering or any fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.13 WARRANTY

- A. Furnish five-year manufacturer's warranty for valves and actuators.

PART 2 - PRODUCTS

2.1 VALVES

- A. Description: Valves, operator, actuator, handwheel, chainwheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and other accessories as required.
- B. Provide all valves of the same type by same manufacturer
- C. Valve Ends: Compatible with adjacent piping system and as indicated on valve schedule.
- D. Operation:
 - 1. Close by turning clockwise.

2. Cast directional arrow on valve or actuator with OPEN and CLOSE cast on valve in appropriate location.

E. Valve Marking and Labeling:

1. Marking: Comply with MSS SP-25.
2. As indicated in valve schedule.
3. Labeling (valve tags):
 - a. Fiberglass reinforced plastic, ASTM D709, 70 mil thick, 2 1/2-inch diameter or 2 1/2-inch by 1 1/4-inch.
 - b. Lettering 1/16-inch thick of silk screening or other permanent embedment of subsurface printed graphics, permanently sealed.
 - c. Colors of lettering and backing as selected by Owner.
 - d. Two, 1/4-inch clear opening 316 stainless steel grommets at each end, center of hole 3/8-inch from tag edge.
 - e. 3/32-inch 316 SS cable and splice hardware.

F. Valve Construction: As Specified in Valve Sections.

- G. Do not use Van Stone flanges 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 VALVE ACTUATORS

- A. Provide actuators in accordance with the valve schedule included on the Drawings.
- B. Provide mechanical position indicators for power actuated and gearbox actuated valves.
- C. Comply with AWWA C541 (Pneumatic and Hydraulic actuators) and C542 (Electric Motor Actuators) as applicable.
- D. Provide chain actuators for shutoff valves mounted greater than 7 feet (2.3 m) above operating floor level.
- E. Gear and Power actuators as specified in Section 400557.00 "Actuators for Process Valves and Gates".

2.3 INSULATION

- A. As indicated in pipe schedule.

2.4 FINISHES

- A. Valve Coating: Comply with AWWA C550.
- B. Factory finishes are included in individual valve sections.

- C. Exposed Valves: As specified in Section 0099676.53 “Wastewater Transmission System Coatings”.
- D. Stainless Body Valves: Do not coat.
- E. Do not coat flange faces of valves unless otherwise specified.

2.5 SOURCE QUALITY CONTROL

- A. Testing: Test valves according to manufacturer's standard testing protocol, including hydrostatic, seal, and performance testing.
- B. Owner Inspection:
 - 1. Notify Owner at least seven days before inspection is allowed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that piping system is ready for valve installation.
- B. Fully examine valves for debris, damage and interior finish blemishes prior to installation. Do not install valves with soiled interior or any visible damage to seats, discs or interior finish.
- C. Identify any piping, plant or equipment clearance issues prior to installation, bring to Engineer's attention via job meetings, submittal process or request for information process.

3.2 INSTALLATION

- A. Install valves, actuators, extensions, valve boxes, and accessories according to manufacturer instructions.
- B. Inspect valve interiors before line closure for the presence of debris. At the option of the Engineer, internal inspection of valve and appurtenances may be required any time that the likelihood of debris is a possibility. Clean connecting pipes prior to installation, testing, disinfection and final acceptance.
- C. Disinfect valves installed in potable water lines with approved pipeline disinfection process.
- D. Rigidly support valves to avoid stresses on piping.
- E. Coat studs, bolts and nuts with anti-seizing lubricant.
- F. Dielectric Fittings: Provide between dissimilar metals.
- G. Clean field welds of slag and splatter to provide a smooth surface.

- H. Mate, adjust and fully test gearboxes, electric, hydraulic and pneumatic actuators to valves at manufacturer's or integrator's facility.
 - 1. Only in special cases for extremely large assemblies where installation requires disassembly may actuators be mounted to the valves in the field. These circumstances require preinstallation meetings.
- I. Do not install stems vertically downward.
- J. Unless otherwise indicated on the Drawings:
 - 1. Install Gate, Globe, Ball valves with stem vertical in the 12 o'clock position.
 - 2. Install Plug valves with stem horizontal and plug opening to the top of the body unless position will not allow proper actuator access, in which case stem may be vertical in the 12 o'clock position.
 - 3. Install Butterfly valves 12 inch and smaller with stem horizontal or vertical in the 12 o'clock position,
 - 4. Install Butterfly valves 14 inch and larger with the stem horizontal unless position will not allow proper actuator access, in which case stem may be vertical in the 12 o'clock position.
 - 5. Install Control valves in horizontal pipelines with top works vertically upward.
- K. Install all brackets, extension rods, guides, the various types of operators and appurtenances as indicated. Before properly setting these items, check all drawings and figures which have a direct bearing on their location.
- L. Inspect all materials for defects in construction and materials. Clean debris and foreign material out of openings, etc. Verify valve flange covers remain in place until connected piping is in place. Verify operability of all operating mechanisms for proper functioning. Check all nuts and bolts for tightness. Repaired or replace valves and other equipment which do not operate easily or are otherwise defective.
- M. Where installation is covered by a referenced standard, install and certify in accordance with that standard, except as herein modified. Also note additional requirements in other parts of this Section.
- N. Unless otherwise noted, provide joints for valves and appurtenances utilizing the same procedures as specified under the applicable type connecting pipe joint. Install valves and other items as recommended by the manufacturer. Verify manufacturers' torqueing requirements for all valves.
- O. Coordinate direction of flow through offset type and shaped butterfly valve discs with the mated actuator torque capacity.
- P. Rotate valve operators and indicators to display toward normal operation locations. Consult with Engineer prior to installing valves with handwheels to confirm final position of handwheel.
- Q. Vertically center floor boxes, valve boxes, extension stems, and low floor stands over the operating nut, with couplings as required.

1. Adjust elevation of the box top to conform to the elevation of the finished floor surface or grade at the completion of the Contract.
 2. Support boxes and stem guides during concrete placement to maintain vertical alignment.
- R. Install brass male adapters on each side of valves in copper-piped system and solder adapters to pipe.
- S. Install 1-inch (24-mm) ball valves with cap for drains at main shutoff valves, low points of piping, bases of vertical risers, and equipment.
- T. Install valves with clearance for installation of insulation and to allow access.
- U. Provide access where valves and fittings are not accessible.
- V. Pipe Hangers and Supports: As specified in Section 400507 “Hangers and Supports for Process Piping”.
- W. Comply with Division 40 - Process Interconnections for piping materials applying to various system types.
- X. Install insulation as indicated on Drawings.

3.3 FIELD QUALITY CONTROL

- A. Valve Field Testing:
1. Test for proper alignment.
 2. If specified by valve Section, field test equipment to demonstrate operation without undue noise, vibration, or overheating.
 3. Engineer will witness field testing.
 4. Functional Test:
 - a. Prior to system startup, inspect valves and actuators for proper alignment, quiet operation, proper connection and satisfactory performance.
 - b. After installation, open and close all manual valves in the presence of the Engineer to show the valve operates smoothly from full open to full close and without leakage.
 - c. Cycle valves equipped with electric, pneumatic or hydraulic actuators 5 times from full open to full closed in the presence of the Engineer to exhibit operation without vibration, jamming, leakage, or overheating.
 - d. Operate pressure control and pressure relief valves in the presence of the Engineer to show they perform their specified function at some time prior to placing the piping system in operation and as agreed during construction coordination meetings.
 5. Field test pipe lines in which the valves and appurtenances are to be installed. During these tests, adjust, remove or replace defective valve or appurtenance, or otherwise make acceptable to the Engineer. Test regulating valves, strainers, or other appurtenances to demonstrate conformance with the specified operational capabilities. Correct deficiencies, replace device or otherwise made acceptable to the Engineer.

END OF SECTION 400551

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SECTION 400553 - IDENTIFICATION 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. Nameplates.
2. Tags.
3. Stencils.
4. Pipe markers.
5. Ceiling tacks.
6. Labels.
7. Lockout devices.

- B. Related Requirements:

1. Section 400551 "Common Requirements for Process Valves": Basic materials and methods for valves.

1.3 PREINSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing Work of this Section.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's catalog literature for each specified product.

- B. Shop Drawings:

1. Indicate list of wording, symbols, letter size, spacing of labels, and color-coding for mechanical identification and valve chart and schedule.
2. Indicate valve tag number, location, function, and valve manufacturer's name and model number.

- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

- D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

E. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Materials: Furnish two containers of spray-on adhesive.
- B. Tools: Furnish special crimpers and other devices required for Owner to reinstall tags.

1.7 QUALITY ASSURANCE

- A. Piping Color Scheme and Lettering Size: Comply with ASME A13.1.
- B. Perform Work according to Municipality of Rome, New York Department of Public Works standards.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three 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. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers:

1. Craftmark Pipe Markers.
2. Kolbi Pipe Marker Co.
3. Pipemarket.com (Brimar Industries, inc.),
4. Seton Identification Products.

B. Description: Laminated three-layer plastic with engraved black letters on light, contrasting background color.

2.2 TAGS

A. Plastic Tags:

1. Manufacturers:

- a. Brady ID.
- b. Craftmark Pipe Markers.
- c. Kolbi Pipe Marker Co.
- d. Marking Services, Inc.
- e. R&R Identification Co.
- f. Seton Identification Products.

2. Description:

- a. Laminated three-layer plastic with engraved black letters on light, contrasting background color.
- b. Minimum Tag Size and Configuration: 2 inches; square.
- c. Provide with brass hooks suitable for attaching the tag to the valve operator.
- d. Stamp or etch tags with the valve number and information on the valve schedule coded in a system provided by the Owner.

2.3 STENCILS

A. Manufacturers:

1. Kolbi Pipe Marker Co.
2. Marking Services, Inc.
3. Pipemarket.com (Brimar Industries, Inc.),
4. R&R Identification Co.
5. Seton Identification Products.

B. Description:

1. Quality: Clean-cut symbols.
2. Letters:

OUTSIDE DIAMETER
OF PIPE

SIZE OF LETTERS

3/4-in to 1-1/4-inch

1/2-inch

1-1/2-in to 2-inch	3/4-inch
2-1/2-in to 6-inch	1-1/2-inch
8-in to 10-inch	2-1/2-inch
Over 10-inch	3-inch

C. Stencil Paint:

1. Description: Manufacturer's standard

2.4 PIPE MARKERS

A. Plastic Pipe Markers:

1. Manufacturers:

- a. Brady ID.
- b. Craftmark Pipe Markers.
- c. Marking Services, Inc.
- d. R&R Identification Co.
- e. Seton Identification Products.

2. Description:

- a. Factory-fabricated, flexible, and semi-rigid plastic.
- b. Preformed to fit around pipe or pipe covering.
- c. Larger sizes may be of maximum sheet size, with spring fastener.
- d. Letter sizes per Paragraph 2.3B.
- e. Color shall be white or black depending on background color.

B. Plastic Tape Pipe Markers:

1. Manufacturers:

- a. Brady ID.
- b. Craftmark Pipe Markers.
- c. Kolbi Pipe Marker Co.
- d. Marking Services, Inc.
- e. Pipemarket.com (Brimar Industries, Inc.).
- f. Seton Identification Products.

2. Description:

- a. Flexible, 3.5 mil vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- b. Letter sizes per Paragraph 2.3B.
- c. Color shall be white or black depending on background color.

C. Plastic Underground Pipe Markers:

1. Manufacturers:

- a. Kolbi Pipe Marker Co.
- b. Marking Services, Inc.
- c. Pipemarket.com (Brimar Industries, Inc.).
- d. Rhino Marking and Protection System.
- e. Seton Identification Products.

2. Description:

- a. Brightly colored, continuously printed plastic ribbon tape.
- b. Minimum Size: 6 inches wide by 4 mils thick.
- c. Manufactured for direct burial service.
- d. Letter sizes per Paragraph 2.3B.

2.5 CEILING TACKS

A. Manufacturers:

1. Marking Services, Inc.
2. R&R Identification Co.
3. Seton Identification Products.

B. Description:

1. Material: Steel.
2. Head:
 - a. Color-coded.
 - b. Diameter: 3/4 inch.

2.6 LABELS

A. Manufacturers:

1. Brady ID.
2. Seton Identification Products.

B. Description:

1. Material: Polyester.
2. Minimum Size: 1.9 by 0.75 inches.
3. Adhesive backed, with printed identification.

2.7 LOCKOUT DEVICES

A. Lockout Hasps:

1. Manufacturers:
 - a. Brady ID.

- b. Master Lock Company, LLC.
- 2. Description:
 - a. Material: Reinforced nylon.
 - b. Furnish hasp with erasable label surface.
 - c. Minimum Size: 7-1/4 by 3 inches.
- B. Valve Lockout Devices:
 - 1. Manufacturers:
 - a. Brady ID.
 - b. Master Lock Company, LLC.
 - 2. Description:
 - a. Material: Plastic.
 - b. Furnish device to restrict access to valve operator and to accept lock shackle.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Stencil Painting: Prepare surfaces as specified in Manufacturer's standard "".

3.2 INSTALLATION

- A. According to manufacturer instructions.
- B. Apply stencil painting as specified in Section Manufacturer's standard ""
- C. Install identifying devices after completion of coverings and painting.
- D. Install plastic nameplates with corrosion-resistant mechanical fasteners or adhesive.
- E. Labels:
 - 1. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer.
 - 2. For unfinished covering, apply paint primer before applying labels.
 - 3. Titles:
 - a. Locate a maximum 26 feet apart.
 - b. Locate directly adjacent to pipeline breaches on each side wall.
 - c. Locate adjacent to each side of the valve regulator, flow meter, strainer, cleanout and all pieces of equipment.

- d. Identify the contents by complete name at least once in each room or space and thereafter may be labeled by generally recognized abbreviations.

F. Tags:

1. Identify valves in main and branch piping with tags.
2. Install tags using corrosion-resistant chain.
3. Number tags consecutively by location.

G. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

H. Piping:

1. Identify piping, concealed or exposed, with plastic tape pipe markers.
2. Identify service, flow direction, and pressure.
3. Install in clear view and align with axis of piping.
4. Locate identification not to exceed 20 feet on straight runs, including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

I. Ceiling Tacks:

1. Provide ceiling tacks to locate valves above T-bar-type panel ceilings.
2. Locate in corner of ceiling panel closest to equipment.

END OF SECTION 400553

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SECTION 400557 - ACTUATORS FOR PROCESS VALVES AND GATES

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: Following types of actuators for linear, multi-turn, and quarter turn valves and gates:
 - 1. Manual actuators.
 - 2. Pneumatic actuators.
 - a. Rotary vane.
 - b. Rack and pinion.
 - c. Pneumatic cylinder.
 - d. Diaphragm.
 - 3. Electric motor actuators.
- B. Related Requirements:
 - 1. Section 055000 "Metal Fabrications" for miscellaneous metalwork and fasteners as required.
 - 2. Section 400507 "Hangers and Supports for Process Piping" for hangers, anchors, sleeves, and sealing of piping to adjacent structures.
 - 3. Section 400551 "Common Requirements for Process Valves" for common product requirements for valves for placement by this Section.

1.3 DEFINITION

- A. Where the term "valve" alone is used in this Section, it applies to both valves and gates as the corresponding text context dictates.

1.4 COORDINATION

- A. Section 400551 "Common Requirements for Process Valves" for valve schedule requirements.
- B. Coordinate Work of this Section with installation of valves, gates, and accessories.

1.5 PREINSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing Work of this Section.

1.6 SUBMITTALS

- A. Product Data: Manufacturer information for actuator with model number and size indicated.
- B. Shop Drawings:
 - 1. Parts list, materials, sizes, position indicators, limit switches, control system, actuator mounting, wiring diagrams, control system schematics with external interfaces on assembly drawings.
 - 2. Actuator Shop Drawings with respective valve submittal.
- C. Manufacturer's Certificate: Products meet or exceed specified requirements.
- D. Manufacturer Instructions: Special procedures and placement requirements.
- E. Source Quality-Control Submittals: Results of factory tests and inspections and provide required certifications.
- F. Field Quality-Control Submittals: Results of Contractor-furnished tests and inspections.
- G. Qualifications Statements:
 - 1. Qualifications for manufacturer and installer.
 - 2. Manufacturer's approval of installer.

1.7 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Documentation of actual locations and types of actuators.

1.8 QUALITY ASSURANCE

- A. Valve Actuators in NEC Class 1, , Division 1 or 2, Group C & D, Hazardous Locations: Comply with NFPA 70.
- B. Minimum NEMA Enclosure Classification:
 - 1. Non-submergence Installations: NEMA 4X.
 - 2. Submergence Installations: NEMA 6P/IP68.
- C. Perform Work according to Municipality of Rome, New York Department of Public Works standards.
- D. Maintain a copy of each standard affecting Work of this Section on Site.
- E. Single Source Requirements:

1. Furnish electric motor actuators in the scope of the project by the same manufacturer. Coordinate this requirement with actuated valves and gates included in scope of vender furnished equipment.
 2. Furnish actuators, floor stands, stem guides, stems, extensions, and accessories for slide gate assemblies by slide gate manufacturer.
- F. Mate actuators to equipment at equipment manufacturers or integrators facility.
1. Test assembled product. Certify ready for installation prior to shipment to job site.
 2. For extremely large assemblies requiring disassembly for installation, the actuator may be disassembled for shipment and remounted in the field.

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.

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. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
 3. Provide additional protection according to manufacturer instructions.

1.11 EXISTING CONDITIONS

- A. Field Measurements:
 1. Verify field measurements prior to fabrication.
 2. Indicate field measurements on Shop Drawings.

1.12 WARRANTY

- A. Manufacturer's Special Warranty: Submit standard written warranty against manufacturing defects for actuators.
 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Refer to valve and gate schedule for actuator type, accessories, and sizing information.
- B. Provide clockwise closed actuation unless otherwise noted on the valve and gate schedule.
- C. Supply chain actuators for manual valves located 7 feet or higher above finished floor.

2.2 ACCESSORIES

A. Floor Stands:

1. Materials:

- a. Stand: fabricated steel.
- b. Stem Bushing: Sintered bronze.
- c. Position Indicator: Bronze.

2. Height to input shaft or handwheel: 36 inch.

3. Base Mounting Requirements:

- a. Concrete Floor Mounting: Type 316 stainless-steel anchor bolts.
- b. Face of Basin or Offset Mounting: Heavily reinforced, adjustable wall bracket with required anchor hardware using Type 316 stainless steel.

4. Actuator Mounting Requirements:

- a. Manual Actuator: Cast iron handwheel on top of floor stand with dual ball type thrust bearings, grease fitting on bearing bowl, hardened machined alloy bronze lift nut (for rising stem). Where manual effort is greater than 40 lb rim pull with 2 feet diameter wheel, provide geared actuator with a handwheel or crank.

- 1) Handwheel casting to include the word "OPEN" and an arrow indicating the direction of operation.

- b. Gearbox or Direct Powered Actuator: Through bolt holes matched to actuator or gearbox bolting pattern.

5. Non-rising stem position indicator: Mechanical indicator connected to and driven by stem extension and cast position marks on floor stand with the word "OPEN" cast at the top of the travel, and a field mounted aluminum "CLOSED" tag supplied with drive rivets, installed based on number of valve turns.

6. Rising Stem Position Indicator: Permanent markings on transparent stem covers.

B. Stem Covers: Fracture-resistant clear polycarbonate stem covers for rising stems. Closed top with position indicator markings.

C. Extension Stems and Stem Guides:

1. Extension stems and couplings to actuate recessed, buried, below slab valves and gates via operating nut or floor stand mounted actuator.
2. Stem Extensions and Stem Couplings: Alloy steel, hardware of Type 316 stainless steel unless specified otherwise in the respective slide gate specification.
3. Stem and Stem Couplings: Rated for five times the maximum input torque capacity of the actuator.
4. Adjustable, Cast Iron Wall Bracket Type Stem Guides: Include bronze bushing.
5. Spacing: 10 feet spacing or at spacing calculated by manufacturer to prevent buckling with a safety factor of 2 based on design thrust, shaft material and shaft size.

D. Torque Tubes:

1. Supply where shown on the Drawings or Valve and Gate Schedule.
2. Supported by/mated to valve bonnet/yoke.
3. Sized by supplier for the required actuator torque.
4. Drilled specifically for valve and actuator bolt pattern.
5. Internal extension keyed or shaped specifically to mate to valve shaft and fabricated of Type 316 stainless steel.
6. Internal extension designed for axial adjustment for mating purposes.

2.3 MANUAL ACTUATORS

A. Operating Nuts:

1. 2-inch cast iron AWWA design.
 - a. Painted Carbon Steel Tee Handle Operator: 2-inch AWWA nut socket end extension length for nut actuated valves where nuts are recessed in valve boxes.
 - b. Tee Extension Length: Determine based on nut height as shown on Drawings with handle height approximately 3 feet above operating surface.
2. Operating Nuts Recessed on Concrete: Cast iron floor box with cover and tee handle operator with 2-inch AWWA nut socket end.
3. Nut Operated Non-Rising Stem Buried Valves: Cast iron bonnet skirts, extension pipes valve box and cover. Stem extensions with AWWA nut end to elevation shown on the Drawings or scheduled.
4. Two tee handles for every ten buried or encased non-rising stem application with 2-inch AWWA operating nut.

B. Gear-Assisted Manual Valve Actuators:

1. Provide:
 - a. For manually actuated valves and gates larger than 8 inch nominal diameter and for ball and plug valves 6 inch and larger.
 - b. With power actuators where torque requirements dictate.
2. Comply with AWWA C504.
3. Handwheel Diameter: 8-inch
4. Maximum Handwheel Pull: 40 lbs maximum.

5. Housings: Cast or ductile iron.
 6. Worm or helical gear type.
 7. Gears: Hardened steel, machine cut and mated.
 8. Bearings: Permanently lubricated bronze.
 9. Input and Output Shafts: Sealed with greased, waterproof machine shaft seals.
 10. Filled with waterproof grease and designed for submerged service where scheduled.
 11. Handwheel: Removable.
 - a. Diameter: 8-inch up to 12-inch valve size.
 - b. Diameter: 12-inch diameter up to 16-inch valve size.
 - c. Diameter: 18-inch diameter for larger than 16-inch valve size.
 - d. Maximum Diameter: 24-inch diameter.
 12. Include mechanical top mounted valve position indication, opening direction, and adjustable stops.
- C. Chain Wheels:
1. Supply for manual valves 3-inch to 7 feet 5-1/2 feet Basis-of-Design: Trumbull, Model 'Chain Up' as manufactured by Trumbull Manufacturing, Inc., or equal.
 6. Chain Wall Hooks: Include where feasible to prevent chain from impeding personnel egress.
- D. Direct Manual Slide Gate Actuators:
1. Small Gates not Requiring Gear Reduction to Achieve Rim Pull Requirements: Yoke or floor stand mounted handwheel with dual ball type thrust bearings, grease fitting on bearing bowl, hardened machined alloy bronze lift nut.
- E. Gear-Assisted Manual Slide Gate Actuators:
1. Provide manually actuated slide gates where direct mount actuators cannot meet rim pull requirements and design safety factors.
 2. Include power actuators where torque requirements dictate.
 3. Comply with AWWA C504.
 4. Yoke mount for self-contained gates and floor stand mount for non-self-contained gates.
 5. Accessories specified hereinabove where pertinent to the application.
 6. Handwheel or crank style operator with maximum rim or crank pull of 40 lbs
 - a. Crank operators of cast iron construction with revolving brass grip.
 - b. Handwheel casting to include the word "OPEN" and an arrow indicating the direction of operation.
 7. Gear Boxes:
 - a. Bevel or parallel shaft as required by installation geometry.
 - b. Fully enclosed cast or ductile iron housings.
 - c. Suitable for pedestal or yoke (bench) mounting.
 - d. Mechanical seals on input shafting.
 - e. Shafting fully supported with anti-friction ball or roller bearings throughout.

- f. Precision machined high strength bronze lift nuts.
 - g. Precision cut steel gears.
 - h. Input Shafts: Type 316 stainless steel.
 - i. AWWA drive nut for removable crank, wheel or portable power operator to be 2 inches
 - j. Single or compound reduction as required to achieve rim pull requirements.
 - k. No damage to gearbox components with 100 lbs rim pull.
 - l. Coordinate with gate stem design such that catastrophic failure occurs at stem nut prior to stem buckling.
8. Tandem gear drives where indicated on Gate Schedule. Tandem drives include parallel gear boxes, Type 316 stainless-steel interconnecting shafting, and flexible couplings furnished by the manufacturer.

2.4 ELECTRIC MOTOR ACTUATORS

A. General:

1. Where specified on the Valve and Gate Schedule.
2. Comply with AWWA C542.
3. Actuators for Valves 3 inches and Smaller: 120 Volt, 1 Phase, 60 Hertz power supply.
 - a. Actuators for Valves Larger than 3 inches and for slide gates and weir gates: 480 Volt, 3 Phase, 60 Hz power supply.

B. 120 Volt Power Actuators:

1. Actuators to have reversing motor, reduction gearing, local position indicator, position limit switches, provision for manual override, 100 to 1000 in-lbs torque range and motor thermal and electronic control protection.
2. Enclosure:
 - a. Cast aluminum or steel alloy.
 - b. Powder coated or fusion bonded epoxy finish.
 - c. NEMA 4X.
3. Power Train:
 - a. Self-locking planetary epicyclical gear design.
 - b. Hardened steel gears with bronze bearings.
 - c. Housing Penetrations: Seal with mechanical seals.
 - d. Housing: Equip with space heaters.
 - e. Mounting System: ISO 5211.
4. Actuator for Open/Close/Jog Reversing Service: Proportional/modulating service where required in the equipment specifications or Instrumentation Drawings.
5. Motors:
 - a. Design for valve actuation service.
 - b. Insulation: Class F.

- c. Split phase capacitor protection.
 - d. Duty Cycle: 40 percent at 100 degrees F for open/close duty, and 100 percent for modulating duty.
 - e. 90-Degree Travel Time: 10 to 20 seconds depending on actuator size.
 - f. Actuator Switches: Have two SPDT 15 Amp rated switches for remote open/close valve position indication.
 6. Products: Subject to compliance with requirements, provide one of the following or equal:
 - a. Series 92 as manufactured by Asahi/America.
 - b. EPM-6 by Hayward.
 - c. P Series as manufactured by Promotion Engineering, Inc.
 - d. Or equal.
- C. 480 Volt Power Actuators:
 1. General: 2 phase 60 hz supply rated, self-contained, totally enclosed with motor, integral reversing starters, local controls, reduction gearing, limit switch gearing, limit switches, control power transformer, torque switches, bored and keyed drive sleeve for non-rising stems, declutch lever, auxiliary handwheel, and local position indication.
 2. Separately seal motor and control compartments with space heaters in limit switch, motor, and control compartments.
 3. Suitable for indoor and outdoor use, fully functional in ambient temperature range from 40 to 140 degrees F at 100 percent relative humidity.
 4. Size to guarantee full travel, seating and unseating torque or thrust as specified by the valve or gate manufacturer.
 5. Size to provide torque required to operate valve or gate at 90 percent of nominal voltage.
 6. Design Travel Rate:
 - a. As indicated on valve and gate schedule, and if not so indicated:
 - 1) Gate Valves and Slide Gates: 12 inches per minute.
 - 2) Globe Valves: 4 inches per minute.
 - 3) Quarter Turn Valves: 30 seconds per 1 foot of throat diameter.
 7. Enclosure:
 - a. Cast iron construction.
 - b. NEMA 4X for watertightness from pressure hose.
 - c. NEMA 6 for submergence up to 6 feet for 30 minutes.
 - d. NEMA 6P for submergence up to 15 feet for 72 hours.
 - e. IP 68-8 for submergence up to 26 feet for 96 hours per EN 60529.
 - f. NEMA 7 for Class 1, Division 1 & 2, Groups C & D hazardous environment.
 - g. Operate successfully a minimum of 10 full cycles under submersion.
 - h. External Fasteners: Type 316 stainless steel.
 - i. Include anti-condensation heater, suitable for continuous operation with alarm output to indicate heater failure.

8. Motors:
 - a. High-starting torque; low stall torque, low inertia, designed and built by actuator manufacturer.
 - b. Embed thermistor in each motor winding for thermal protection.
 - c. Insulation: Class F, with a duty rating of at least 15 minutes at 40 degrees F ambient temperature.
 - d. Electrical disconnection by means of plug and socket. Allow motor removal without loss of lubricant.
 - e. Hardware to ensure motor runs with correct rotation for required direction of valve travel regardless of power supply connection sequence.

9. Motor Protection:
 - a. De-energize without damage in the event of a stall condition when attempting to move a jammed valve.
 - b. De-energize in the event of an over-torque condition.
 - c. Imbed a minimum of three thermal devices in motor windings to de-energize the motor in case of overheating.
 - d. Lost phase protection algorithm.

10. Gear Train:
 - a. Grease filled, O-ring sealed in cast or ductile iron gear case.
 - b. Suitable for operation in any orientation.
 - c. Hardened, machine cut steel gears, and precision machined alloy bronze worm gear.
 - d. Reduction gearboxes as specified in Paragraph "Gear-Assisted Manual Valve Actuators."

11. Manual Operation:
 - a. Handwheel which does not rotate during motor operation.
 - b. Output contact with declutch mechanism to indicate manual operation.
 - c. Utilize actuator worm shaft/worm wheel to maintain self-locking gearing and to facilitate changeover from motor to manual operation when the actuator is under load. Do not use designs that bypass actuator worm gear or break valve load at worm gear.
 - d. Automatic return from manual to motor operation upon starting motor.
 - e. Manual operation capable with seized motor.

12. Position and Torque Calibration:
 - a. Sensing by absolute encoder using hall effect sensors. Incremental encoders requiring batteries to retain settings upon loss of power are not acceptable. Settings stored in permanent non-volatile memory.
 - b. Torque and travel adjustment parameters:
 - 1) Position Setting Range: 1 to 500 or 10 to 5,000 turns depending on the size of the valve, with resolution of 2.81 degrees and accuracy to 5.0 degrees of actuator output.

- 2) Torque Setting: 40 to 100 percent of rated torque.
 - c. Torque switch bypass for the torque sensing system to inhibit torque switch trip during unseating or during starting in mid-travel against high inertia loads.
13. Wiring and Terminals:
 - a. Tropical grade insulated stranded cable of appropriate size for the control and 3-phase power.
 - b. Include a removable plug and socket head for termination of all external wiring. Include actuators without plug and socket terminal connections having power and control disconnect switches for ease of maintenance and safety.
14. Controls:
 - a. Microprocessor: Based with mechanically and electronically interlocked reversing contactors for Open/Close duty and solid-state contactors for modulating duty.
 - b. Local/Off /Remote Selector Switch and Open/Stop/Close Pushbuttons: Mount on actuator face with red and green indication lights for open/close and amber for fault.
 - c. Remote On/Off Service: Actuator to accept one remote signal to open and a second remote signal to close.
 - d. Modulating Service: When in remote mode, actuator to accept a 4 to 20 mA DC position control signal and position valve 0 to 100 percent of travel in proportion to control signal.
 - e. Monitoring Relays: Remotely indicate fault signal for indication of power failure, phase failure, thermal switch tripped, torque switch tripped between travel stops, and Local-Off-Remote selector switch position.
 - f. Gear Actuated Position Transmitter: On modulating duty actuator that is a two-wire device, produce 4 to 20 mA DC signal proportional to 0 to 100 percent travel.
 - g. Transmitter: Have easily accessible zero and span adjustment potentiometers.
 - h. DC Power Supply: Integral with operator and powered from 110-volt AC internal transformer. Positioner board to provide repeatable accuracy to 0.25 percent of span and have separate trim pots for zero, span, and dead band adjustment.
15. Where noted in valve and gate schedules, actuators to have a digital control module to allow valves or gates to be positioned remotely via a 2-wire non-proprietary field bus protocol. Equip digital control module with serial communication ports to allow actuation by the Plant's SCADA system linked by a 2-wire local area network utilizing Modbus function code (report by exception). Arrange in a self-healing ring configuration with multi-drop taps to each actuator.
16. Position Indication: Continuous mechanical dial indication of valve and gate position in step with the actuator at all times in both the hand wheel and motor operation. For modulating applications, graduations on mechanical dial position indicator to be 0 to 100 percent scale.
17. Limit Switches:
 - a. Adjustable type to trip at any point between fully opened and fully closed.
 - b. Mid-travel Switches: Provide as noted in valve and gate schedule.
 - c. Do not allow set position to be lost if over travel occurs in either manual or electric modes of operation.

- d. Two independent and fully adjustable rotary type position limit switches each with 15 Amp DPDT contacts for remote open/close position indication.
18. Torque Switches: Actuator with adjustable torque switches and be responsive to load encountered in either direction of travel.
19. Terminal Compartment:
- a. Separate from the inner electrical components of actuator with a watertight seal.
 - b. Three threaded cable entries.
 - c. Stud-type Terminals: Embed in a terminal block of high tracking-resistance compound.
 - d. Three-phase Power Terminals: Shroud from control terminals by means of an insulating cover.
20. Remote Control Stations:
- a. For actuators located below the operating floor or located more than 7 feet above the operating floor, provide a UL Listed remote control station at the operating floor level with the same enclosure rating as the actuator.
 - b. Include a Local/Off/Remote selector switch, Open/Stop/Close pushbuttons and Open/Close indicating lights.
 - 1) Local/Off/Remote selector to include padlock mount for the Off position.
 - c. Include auxiliary contacts for remote indication of switch position.
21. Manufacturers: Provide products by one of the following or equal.
- a. IQ/IQM as manufactured by Rotork, Plc.

2.5 SOURCE QUALITY CONTROL

A. Factory Testing:

- 1. Shop inspect and test completed assemblies.
- 2. Factory performance test each actuator and supply individual test certificates. Submit test certificates prior to shipment of valve actuators. Test equipment to simulate a typical valve and gate load, and record the following parameters:
 - a. No load current.
 - b. Current at maximum torque setting.
 - c. Stall current.
 - d. Torque at maximum torque setting.
 - e. Stall torque.
 - f. Test voltage and frequency.
 - g. Flash test voltage.
 - h. Actuator output speed.

- B. Owner Inspection:
 - 1. Make completed valve and gate and actuator assembly available for inspection at manufacturer's factory prior to packaging for shipment.
 - 2. Notify Owner at least seven days before inspection is allowed..

- C. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify field dimensions are as indicated on Drawings.

3.2 INSTALLATION

- A. Install products plumb, square, and true according to manufacturer's published installation instructions.
- B. Securely mount actuators using brackets or hardware specifically designed for attachment to valves/gates.
- C. Extend chain actuators to 5-1/2 feet above operating floor level.

3.3 FIELD QUALITY CONTROL

- A. After installation, inspect for proper supports and interferences according to manufacturer's requirements and Section 400551 "Common Requirements for Process Valves".
- B. Repair damaged coatings with material equal to original coating as specified in Section 099676.56 "Wastewater Transmission System Coatings".

3.4 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Perform adjustments during normal occupancy hours.

3.5 DEMONSTRATIONS

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain actuators.
 - 1. Time Duration: Allow four hours during a single day.

END OF SECTION 400557

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SECTION 400561 - GATE 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. Solid wedge, metal-seated gate valves.
 - 2. Solid wedge, resilient-seated gate valves.

- B. Related Requirements:

- 1. Section 400551 “Common Requirements for Process Valves”: Basic materials and methods related to valves commonly used for process systems.
 - 2. Section 400557 “Actuators for Process Valves and Gates”.

1.3 DEFINITIONS

- A. Outside screw and yoke (os&y) valve: A valve in which the operating screw is driven by a threaded nut that is built into the handle.

1.4 SUBMITTALS

- A. As specified in Section 400551 “Common Requirements for Process Valves”: Submittal requirements for compliance with this section.

1.5 QUALITY ASSURANCE

- A. Test valves in accordance with AWWA C500, C509, C515.
- B. Provide Installation Inspection and Operator Training per Section 400551.
- C. Provide testing and inspection certificates.

PART 2 - PRODUCTS

2.1 SOLID WEDGE, METAL-SEATED GATE VALVES – Tag Type GV1

A. Manufacturers:

1. Mueller Co, J&S Valve, M&H/Clow Valve, American Flow Control, American R/D Valve.
2. Shipham Valve; Xanik valve.
3. Clow Valve Company; a subsidiary of McWane, Inc.
4. J & S Valve.

B. Description:

1. As specified in Section 400551 “Common Requirements for Process Valves”.
2. Comply with AWWA C500.
3. Minimum Working Pressure: 145 psig at 100 deg. F.
4. Maximum Process Fluid Temperature: 100 deg. F.
5. Wedge: One piece, solid.
6. End Connections: ASME B16.1, ASME B16.5, and ASME B16.42, flanged.
7. Greater Than 16 Inches: Rollers, tracks and scrapers for valves.

C. Body: Tongue and grooved guides for wedges.

D. Operation:

1. As specified in Section 400551 “Common Requirements for Process Valves”.
2. Buried Service: Nonrising stem.
3. Interior and Exposed Service:
 - a. Outside screw and yoke (OS&Y).
 - b. Provide NRS valves with position indicators.
4. Gear Actuators for Manual Valves: Comply with AWWA C500.
5. Valves 18 Inches (450 mm) and Larger: Furnish bevel or spur gear operator.

E. Materials:

1. Comply with AWWA C500.
2. Body, Bonnet, Wedge, and Gland: ASTM A536, ductile iron.
3. Body, Disc and Bonnet: ASTM A536, ductile iron
4. Handwheel Nut: Type 316 stainless steel.
5. Stem: Type 316 stainless steel.
6. Trim: Bronze.
7. Packing: Non-asbestos graphite.
8. Wedge Seating Surfaces and Body Seat Rings: B62 bronze.
9. Rollers and Tracks: Bronze.
10. Rubber Components: Buna-N.
11. Connecting Hardware: Type 316 stainless steel.

F. Finishes:

1. As specified in Section 400551 “Common Requirements for Process Valves”.
2. Interior ferrous surfaces: AWWA C550, Epoxy, 4-mil minimum thickness.
3. Ferrous surfaces not painted: Coating of manufacturer recommended grease.

2.2 SOLID WEDGE, RESILIENT-SEATED GATE VALVES – TAG TYPE GV2

A. Manufacturers:

1. M&H Valve; J&S Valve,
2. American R/D Valve;
3. Stockham Valve, Walworth.

B. Description:

1. Wastewater service.
2. As specified in Section 400551 “- Common Requirements for Process Valves”.
3. Comply with AWWA C509.
4. Minimum Working Pressure: 145 psig at 100 deg. F.
5. Maximum Process Fluid Temperature: 100 deg. F.
6. End Connections: ASME B16.1, ASME B16.5, and ASME B16.42, flanged
7. Gear Actuators for Manual Valves: Comply with AWWA C509.
8. Body: No recesses in valve body.

C. Operation:

1. As specified in Section 400551 “- Common Requirements for Process Valves”.
2. Stem: Rising for exposed service and Nonrising for buried service.
3. Handwheel.
4. Furnish gear operators for valves 8 inches and larger, and chainwheel operators for valves mounted over 8 feet above operating floor.

D. Materials:

1. Wedge: Resilient ASTM A126, cast iron, fully encapsulated with Buna-N.
2. Body and Disc: ASTM A536, ductile iron, coated.
3. Stem, Stem Nuts, Glands, and Bushings: Type 316 stainless steel.
4. Connecting Hardware: Type 316 stainless steel.

E. Finishes:

1. As specified in Section 400551 “- Common Requirements for Process Valves”.
2. Body, Internal and External, Including Bonnet: AWWA C550, Epoxy, 4-mil minimum thickness.
3. Gate: ASTM D2000 EPDM encapsulated, ASTM D429 Method B Bonded and vulcanized.

2.3 SOURCE QUALITY CONTROL

- A. As specified in Section 400551 “Common Requirements for Process Valves”.
- B. Testing: Test gate valves according to AWWA C509.
- C. UL and FM approved.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. According to AWWA C500 and C509.

END OF SECTION 400561

SECTION 400562 - PLUG 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: Eccentric plug valves.
- B. Related Requirements:
 - 1. Section 400551 “Common Requirements for Process Valves”: Basic materials and methods related to valves commonly used for process systems.

1.3 SUBMITTALS

- A. As specified in Section 400551 “Common Requirements for Process Valves”: Submittal requirements for compliance with this Section.

1.4 QUALITY ASSURANCE

- A. Test valves in accordance with AWWA C517
- B. Provide Installation Inspection and Operator Training per Section 400551.
- C. Provide testing and inspection certificates.

PART 2 - PRODUCTS

2.1 ECCENTRIC PLUG VALVES – Tag Type PV1

- A. Manufacturers:
 - 1. DeZurik.
 - 2. M&H Valve
 - 3. Clow Valve Company; a subsidiary of McWane, Inc.
 - 4. Henry Pratt Company; a Mueller brand.
 - 5. Kennedy Valve Company; a division of McWane, Inc.
 - 6. Val-Matic Valve & Manufacturing Corp..

B. Description:

1. As specified in Section 400551 “Common Requirements for Process Valves.
2. Type:
 - a. Offset disc type
 - b. Non-lubricated
 - c. Serviceable (able to be repacked) under full line pressure
 - d. Eccentric.
 - e. Capable of sealing in both directions at the rated pressure
 - f. unobstructed flow path when open
 - g. Drop tight shut-off to the full valve rating with pressure on either side of the plug.
3. Body:
 - a. 30,000-psi tensile strength
 - b. Top entry, bolted bonnet
 - c. Body shall be cast with integral piping connections
4. Plug:
 - a. To be removable without removing the valve from the line.
 - b. To have an integral upper and lower shaft:
 - 1) seals on the upper and lower journals to prevent entrance of solids into the journals.
 - c. one piece for all valves.
5. Bearings:
 - a. Permanently lubricated
6. Minimum Working Pressure: Per valve schedule.
 - a. At the above rated minimum working pressures, certified by the manufacturer as permitting zero leakage for a 5-minute duration with full pressure applied in either direction.
7. Maximum Process Fluid Temperature: 100 deg. F.
8. Ports:
 - a. Configuration: Round.
 - b. Minimum Port Area: 80 percent of nominal pipe area for valves 20 inches (500 mm) and smaller; 70 percent for valves larger than 20 inches (500 mm).
9. Seats:
 - a. Full 360 degree seating by contact of a resilient seating material on the plug mating with welded-in seating surface in the body.
 - b. Screw in body seats not acceptable.

- c. Resilient and of the continuous interface type having consistent opening and closing torques.
 - d. Non-jamming in the closed position.
 10. Stem Bearings: Self-lubricating.
 11. Stem Seals:
 - a. Type: V-ring.
 - b. Externally adjustable and repackable without removing the bonnet from the valve, or self adjusting.
 12. Packing and Gland: Accessible and externally adjustable.
 13. End Connections:
 - a. Mechanical Joint: Comply with ANSI/AWWA C111/A21.11
 - b. Flanged: Comply with ASME B16.1 and B16.42.
- C. Operation:
 1. As specified in Section 400551 “Common Requirements for Process Valves”.
 2. A suitably sized steel actuator mounting bracket shall be provided to provide an air gap between the actuator and the valve stem seal. Under no circumstance shall the gear box be mounted directly to the top body flange such that leakage could directly enter the gear box.
 3. Provide adjustable limit stops for both opening and closing and a clearly marked position indicator.
 4. 4 Inches (75 mm) and Smaller: Manual, provided with its own securely attached lever.
 5. Greater Than 4 Inches (75 mm): Worm gear manual operators with handwheel.
 6. Furnish chain wheel operators for valves mounted over 7 feet (2.3 m) above operating floor.
- D. Materials:
 1. Body:
 - a. Cast iron, AWWA C517.
 - b. Lining: Elastomer, as recommended by valve manufacturer for service conditions.
 2. Plug:
 - a. Cast iron, AWWA C517.
 - b. Lining: Buna-N
 3. Seats: Nickel.
 4. Stem: Type 316 stainless steel.
 5. Stem Bearings: Stainless steel.
 6. Seals: PTFE.
 7. Connecting Hardware: Type 316 stainless steel
- E. Finishes: As specified in Section 400551 “Common Requirements for Process Valves”.

2.2 ROUND, FULL PORT PLUG VALVES – Tag Type PV2

- A. Manufacturers:
 - 1. VAG/GA ECO Centric.
 - 2. Pratt Ballcentric.
 - 3. Milliken.
 - 4. Mueller.
 - 5. Val-Matic Valve & Manufacturing Corp.
- B. Round full port plug valves shall be equal in all respects as Tag Type PV1 except plug shape shall provide for a round, 100% open area viewing the open valve from the end.

2.3 SOURCE QUALITY CONTROL

- A. As specified in Section 400551 “Common Requirements for Process Valves”.
- B. Testing: Hydrostatic Test Per ANSI B16.1 and B16.5 .
- C. Submit an affidavit of compliance stating that the valves have been manufactured and tested in accordance with AWWA C504-00, Section 5.2.4 and specifically list all exceptions.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. According to AWWA C517.
- B. Horizontal Piping: Stem horizontal, Plug opening to crown of body.
- C. Vertical Piping: Plug at top when closed.
- D. Plugs: On top when open and on pressure side when closed.

END OF SECTION 400562

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. Two-Piece Iron Body Ball Valves
- 2. Plastic ball valves.

- B. Related Requirements:

- 1. Section 400551 “Common Requirements for Process Valves”: Basic materials and methods related to valves commonly used for process systems.

1.3 SUBMITTALS

- A. As specified in Section 400551 “Common Requirements for Process Valves”: Submittal requirements for compliance with this Section.

1.4 QUALITY ASSURANCE

- A. Test valves in accordance with AWWA C504, API 598, MSS SP61 as applicable for types listed herein.
- B. Provide Installation Inspection and Operator Training per Section 400551.
- C. Provide testing and inspection certificates.

PART 2 - PRODUCTS

2.1 TWO-PIECE IRON BODY BALL VALVES- Tag Type BV1

- A. Manufacturers:

- 1. Sureflow 125BV1S, American Valve Series 4000
- 2. Substitutions: As specified in Section 016000 - Product Requirements.

B. Description:

1. Comply with MSS SP 72, ANSI B16.10, AWWA C507-Proof of Design.
2. Minimum Working Pressure: 200 psi WOG
3. Maximum Temperature Rating: 353 Deg. F.
4. Body: two piece, bolted
5. Ball: full port, floating design.
6. Seats: Resilient and replaceable
7. Stem: blow out proof, O ring sealed.
8. End Connections: Class 125 Flange, Flat Faced
9. Stem Seals/Packing:
 - a. Multiple Chevron Rings
 - b. mechanically retained

C. Actuator:

1. Per valve schedule.
2. Gear Actuators for Manual Valves: Comply with AWWA C504.

D. Materials:

1. Body: Cast iron ASTM A126, Class B
2. Ball: Cast Iron, PFA Fused.
3. Seats: PTFE.
4. Seat Ring: RPTFE/Graphite
5. Stem: 316 SS
6. Stem Seal/Packing: PTFE

2.2 TWO-PIECE STAINLESS STEEL BODY BALL VALVES 3-INCH AND SMALLER- Tag Type BV3

A. Manufacturers:

1. Apollo Valve.
2. Milwaukee Valve.
3. NIBCO Inc.

B. Description:

1. Standard: MSS SP-110
2. SWP Rating: 150 psi (1035 kPa).
3. CWP Ratings for Valves NPS 1/4 to NPS 2 (DN 8 to DN 50): 600 psi (4140 kPa).
4. CWP Ratings for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 400 psi (3447 kPa).
5. Body Design: Two-piece.
6. Body Material: 316 Stainless steel
7. Ends: Threaded.
8. Seats: RPTFE and PTFE.
9. Stem Material: 316 Stainless steel.

10. Stem Extension Sleeve Material: Aluminum to extend operating handle past pipe insulation.
11. Ball Material: 316 Stainless steel
12. Port: Full.
13. Packing Material: PTFE.
14. Operator: Steel lever with zinc plating and vinyl grip.

2.3 THERMOPLASTIC BALL VALVES – Tag Type BV2

A. Manufacturers:

1. George Fischer,
2. ASAHI,
3. Spears.

B. Description:

1. Minimum Working Pressure: 120 psig at 70 deg. F.
2. Maximum Process Fluid Temperature: 120 deg. F.
3. Ports: Full size.
4. End Connections:
 - a. Union.

C. Operator: Hand lever.

D. Materials:

1. Body and Ball: PVC, ASTM D1784.
2. Seats: PTFE.

2.4 SOURCE QUALITY CONTROL

- A. Section 014000 “Quality Requirements”: Requirements for testing, inspection, and analysis.
- B. As specified in Section 400551 “Common Requirements for Process Valves”.
- C. Testing: Test ball valves according to AWWA C507.

PART 3 - EXECUTION

3.1 INSPECTION

- A. As specified in Section 400551 “Common Requirements for Process Valves”: Submittal requirements for compliance with this Section.

3.2 INSTALLATION

- A. According to AWWA C507.
- B. As specified in Section 400551 “Common Requirements for Process Valves”.

END OF SECTION 400563

SECTION 400565.23 - 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: Check valves 3 inches (75 mm) and larger.
- B. Related Requirements:
 - 1. Section 400551 “Common Requirements for Process Valves”: Basic materials and methods related to valves commonly used for process systems.

1.3 COORDINATION

- A. Section 400551 “Common Requirements for Process Valves”: valve schedule
- B. Coordinate Work of this Section with piping and equipment connections as specified in other Sections and as indicated on Drawings.

1.4 SUBMITTALS

- A. Comply with Section 400551 “Common Requirements for Process Valves”.
- B. Product Data: Submit manufacturer's catalog information, indicating materials of construction and compliance with indicated standards.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Source Quality-Control Submittals: Indicate results of factory tests and inspections and provide required certifications.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- F. Qualifications Statement:

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of piping, valves and other appurtenances, connections, and invert elevations.

1.6 QUALITY ASSURANCE

- A. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.
- B. Perform Work according to City of Rome, New York standards.
- C. Maintain a copy of each standard affecting Work of this Section on Site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 400551 "Common Requirements for Process Valves".
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. 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. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.
 - 4. Provide additional protection according to manufacturer instructions.

1.9 WARRANTY

- A. Furnish five-year manufacturer's warranty for check valves.

PART 2 - PRODUCTS

2.1 IRON BODY SWING CHECK VALVES 4-INCH AND LARGER - Tag Type SCV1

- A. Manufacturers:
 - 1. Kennedy Valve,
 - 2. GA Industries,
 - 3. Valve and Gate Group,
 - 4. Pratt, Mueller Co.,
 - 5. Val-Matic
 - 6. or approved equal.

B. Description:

1. Comply with AWWA C508.
2. Size: 4 inches (76 mm) and larger.
3. Type: Swing, metal disc, with hinge shaft extended from body, sealed with stuffing box, packing and gland. Furnish outside lever and control specified below or in valve schedule.
4. Seat: Resilient.
5. Minimum Working Pressure: 175 psig 4 to 12-inch diameter, 150 psig 14 to 30-inch diameter at 70 deg. F .
6. Maximum Fluid Temperature: 100 deg. F (38 deg. C).
7. Disc Controller:
 - a. Adjustable weight.
 - b. Oil cylinder cushion..
8. Mounting: Horizontal or vertical.
9. End Connections: Flanged, ASME B16.42..

C. Materials:

1. Body and Cover: Ductile iron, ASTM A536.
2. Disc: Ductile iron, ASTM A536.
3. Seat: Field replaceable, Type 304 stainless steel.
4. Cover hardware: 316 stainless steel.
5. Chamber and Plunger: Bronze, ASTM B62.
6. Hinge Shaft and Key: Stainless steel.
7. Hinge Shaft Gland: A582 Type 416 Stainless Steel.
8. Packing and O-Ring: Reinforced Teflon .
9. Grease Fittings: 316 stainless steel.
10. Rubber Components: Viton.
11. Connecting Hardware: Type 304 stainless steel.

D. Controls

1. Position switches: lever type, NEMA 7 enclosure, SPST, 120VAC, 6A, Square D Type 9007CR or approved equal.
2. Bracket and hardware: Type 316 stainless steel.

E. Finishes: As specified in Section 400551 “Common Requirements for Process Valves”.

2.2 SWING CHECK VALVES 3-INCH AND SMALLER: Tag Type SCV3

A. Manufacturer:

1. Solder or thread end Hammond 1B-940, or Jenkins Figure 996.
2. Flanged end Hammond 1R-1124 or Jenkins Figure 587J.

B. Description:

1. Comply with MSS SP-71, 80.

C. Finishes: As specified in Section 400551 “- Common Requirements for Process Valves”.

2.3 DUCK BILL CHECK VALVES 4-INCH AND SMALLER: Tag Type DBCV

A. Manufacturers:

1. Red Valve Company, Inc.
2. Or approved equal.

B. Description

1. Type: Duck bill
2. Minimum Working Pressure: 35 psi.
3. Maximum Fluid Temperature: 90 deg. F.
4. Mounting: Horizontal.
5. End Connections: Flanged, ASME B16.5.

C. Materials:

1. Body: EPDM
2. Retaining Rings: 316 stainless steel.
3. Flange: Elastomer

2.4 SOURCE QUALITY CONTROL

A. Section 400551 “Common Requirements for Process Valves”.

B. Testing:

1. Hydrostatically test check valves at twice rated pressure according to AWWA C508.
2. Permitted Leakage at Indicated Working Pressure: None.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field dimensions are as indicated on 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 099676.53 “Wastewater Transmission System Coatings”.
2. Solvent-clean surfaces that are not shop primed.
3. Clean surfaces to remove loose rust, mill scale, and other foreign substances by power wire brushing.
4. Prime surfaces as specified in Section 099676.53 “Wastewater Transmission System Coatings”.

3.3 INSTALLATION

- A. According to AWWA C508 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 Architect/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.
- B. After installation, clean valve interior of soil, grit, loose mortar, and other debris.

END OF SECTION 400565.23

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SECTION 400574.23 - PINCH 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: Pinch valves.
- B. Related Requirements:
 - 1. Section 400551 “Common Requirements for Process Valves”: Basic materials and methods related to valves commonly used for process systems.

1.3 SUBMITTALS

- A. As specified in Section 400551 “Common Requirements for Process Valves”: Submittal requirements for compliance with this Section.
- B. Section 013300 “Submittal Procedures”: Requirements for submittals.
- C. Product Data: Submit manufacturer information, indicating materials of construction and compliance with indicated standards.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- H. Qualifications Statement:
 - 1. Submit qualifications for manufacturer and installer.
 - 2. Submit manufacturer’s approval of installer.
- I. American Iron and Steel (AIS): Submit certification indicating compliance with requirements.

1.4 QUALITY ASSURANCE

- A. Perform Work according to AWWA C110 standards.
- B. Provide Installation Inspection and Operator Training per Section 400551.
- C. Provide testing and inspection certificates.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 “Product Requirements”: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- 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 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

1.8 WARRANTY

- A. Section 017700 “Closeout Procedures”: Requirements for warranties.
- B. Furnish five-year manufacturer's warranty for pinch valves.

PART 2 - PRODUCTS

2.1 PINCH VALVES

A. Manufacturers:

1. Red Valve Company, Inc, Carnegie, PA;
2. Onyx Valve Company, Cinnaminson, NJ;
3. General Rubber Flex Valve, South Hackensack, NJ;
4. Flowrox Oy, Finland

B. Description:

1. Service: Modulating
2. Type: Mechanically pinched
3. Design Capacity: 800 gpm
4. Type of Housing: Closed frame
5. Working Pressure: As indicated in valve schedule.
6. Maximum Pressure Drop: 14.3 PSID
7. Maximum Fluid Temperature: As indicated in valve schedule.
8. Sleeves: Cone with Positive Pull Tabs
9. Fluid Characteristics: Linear to quick-opening.
10. Rangeability: 10:1.
11. Leakage: ANSI V
12. Upper Pinch Bar Actuation: Manual and Electric.
Actuation:
13. Stem: non-rising
14. Furnish electric actuators with handwheel.
15. Size: As indicated in valve schedule.
16. End Connections:
 - a. Flanged.
 - b. Comply with ASME B16.1 and B16.5

C. Materials:

1. Body: Cast Ductile iron, ASTM A536.
2. Sleeve: Viton lined

2.2 SOURCE QUALITY CONTROL

A. Section 014000 "Quality Requirements": Requirements for testing, inspection, and analysis.

B. Provide shop inspection and testing of completed assembly.

C. Owner Inspection:

1. Make completed pinch valves available for inspection at manufacturer's factory prior to packaging for shipment.

2. Notify Owner at least seven days before inspection is allowed.
3. Upon request, manufacturer will provide sizing calculations showing cavitation range.

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. As specified in Section 400551 "Common Requirements for Process Valves".

3.2 INSTALLATION

- A. As specified in Section 400551 "Common Requirements for Process Valves".

3.3 FIELD QUALITY CONTROL

- A. As specified in Section 400551 "Common Requirements for Process Valves".

END OF SECTION 400574.23

SECTION 400578.29 - COMBINATION AIR VALVES FOR WASTEWATER SERVICE

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: Combination air valves for wastewater treatment facilities.
- B. Related Requirements:
 - 1. Section 099679 Atmospheric Protection and Plant Service Areas Coatings : Preparing, priming, and painting surfaces, including field-applied and equipment finishing.
 - 2. Section 400507 “Hangers and Supports for Process Piping”: Anchors and supports.
 - 3. Section 400551 “Common Requirements for Process Valves”: Typical product and installation requirements for valves specified in this Section.
 - 4. Section 404213 “Process Piping Insulation”: Insulation applied to process piping systems.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination
 - 1. Section 013100 “Project Management and Coordination”: Requirements for coordination.
 - 2. Coordinate Work of this Section with installation of process piping.

B. PREINSTALLATION MEETINGS

- 1. Section 013100 “Project Management and Coordination”: Requirements for preinstallation meeting.
- 2. Section 400551 “Common Requirements for Process Valves”.

1.4 ACTION SUBMITTALS

- A. Section 013300 “Submittal Procedures”: Requirements for submittals.
- B. Shop Drawings: Indicate materials, dimensions, weights, and end connections on assembly drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

- B. Product Data: Submit manufacturer catalog information.
- C. Manufacturer Instructions: Submit special procedures and setting dimensions.
- D. Source Quality-Control Submittals: Indicate results of tests and inspections.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections and provide required certifications.
- F. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions.
- G. Qualifications Statements:
 - 1. Submit qualifications for manufacturer and installer.
 - 2. Submit manufacturer's approval of installer.
 - 3. American Iron and Steel (AIS): Submit certification indicating compliance with AIS requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Section 017700 "Closeout Procedures": Requirements for submittals.
- B. Project Record Documents: Record actual locations of combination air valves.

1.7 QUALITY ASSURANCE

- A. Manufacturer Quality Management System: Certified to ISO 9001.

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. Section 016000 "Product Requirements": Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. 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.

1.10 FIELD CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

A. Section 017700 “Closeout Procedures”: Requirements for warranties.

PART 2 - PRODUCTS

2.1 COMBINATION AIR VALVES FOR WASTEWATER SERVICE – Tag Type ASC

A. Manufacturers:

1. DeZURIK
2. Val-Matic Valve & Manufacturing Corp.

B. Description:

1. Type:
 - a. Fully automatic, float operated.
 - b. Body: Single.
2. Comply with AWWA C512.
3. Size: As indicated on Drawings.
4. Suitable for sewage service.
5. Provide with flushing capabilities.
6. Pressure Rating: 150 psig.
7. Combination air valves:
 - a. perform the functions of an air/vacuum valve (exhaust large quantities of air on start-up, admits air on shut-down) and air release valves (release air continuously during operation) to maintain system efficiency and prevent pipeline surges.

C. Materials:

1. Body and Cover: Stainless steel, ASTM A351.
2. Float: Type 316 stainless steel.
3. Seats: Buna-N.

4. Seals: Buna-N.
5. Trim:
6. Hardware: Stainless steel

D. End Connections - Single Body:

1. Size 4 Inches and Smaller:
 - a. Threaded, NPT.
 - b. 1-Inch Valves: Furnish 2-inch inlet.
2. Backwash Accessories: Furnish three additional NPT connections.

E. Valve Body Connections:

1. Threaded, NPT.
2. Cleanout: 2 inches.
3. Drain: 1 inch.

F. Accessories:

1. Backwash accessories, including inlet shutoff valve, blowoff valve, rubber supply hose, and quick-disconnect couplings.

2.2 FINISHES

- A. Prepare piping appurtenances for field finishes as specified in Section 099679 Atmospheric Protection and Plant Service Areas.

2.3 SOURCE QUALITY CONTROL

- A. Section 014000 "Quality Requirements": Requirements for testing, inspection, and analysis.

- B. Provide shop inspection and testing of completed assembly.

C. Owner Inspection:

1. Make completed air release valve assembly 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 fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.

2. Specified shop tests are not required for Work performed by approved fabricator.

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 flanges mate properly.

3.2 PREPARATION

- A. Section 017300 “Execution”: Requirements for installation preparation.
- B. Thoroughly clean end connections before installation.
- C. Close pipe and equipment openings with caps or plugs during installation.
- D. Cleaning: Clean surfaces to remove foreign substances.

3.3 INSTALLATION

- A. According to manufacturer instructions.
- B. Provide access for operation, removal, and maintenance, and to avoid discharge to occupied areas or other equipment.
- C. Vent the valve properly and pipe outlet to nearest drain or as directed by the Engineer.

3.4 FIELD QUALITY CONTROL

- A. Section 014000 “Quality Requirements”: Requirements for inspecting and testing.
- B. Inspect for interferences and proper supports.
- C. Testing:
 1. As specified in Section 400551 “Common Requirements for Process Valves”.
 2. Demonstrate operation without undue noise or vibration.
- D. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than 8 hours on Site for

installation, inspection, startup, field testing, and instructing Owner's personnel in operation and maintenance of equipment.

E. Equipment Acceptance:

1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
2. Make final adjustments to equipment under direction of manufacturer's representative.
3. Repair damaged coatings with material equal to original coating.

F. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.5 CLEANING

- A. Sections 017300 "Execution" and 017700 "Closeout Procedures": Requirements for cleaning.
- B. Keep interior of air release valves clean as installation progresses.

3.6 DEMONSTRATION

- A. Section 017900 "Demonstration and Training": Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 400578.29

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. The manufacturer of the driven equipment shall provide the associated motor.
- C. Related Requirements:
 - 1. Section 260526, “Grounding and Bonding for Electrical Systems”.
 - 2. Section 260553, “Identification for Electrical Systems”.

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:
 - 1. Descriptive bulletins, including full description of insulation system.
 - 2. Bearing design data.
 - 3. Efficiency at ½, ¾ and full load.
 - 4. Power factor at ½, ¾ and full load.
 - 5. Conduit entry points and sizes.
 - 6. Special features and accessories (i.e. space heaters, temperature detectors, etc.).

7. 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. Electric motors driving identical equipment shall be identical.
- B. Motors shall be 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.

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".
- C. Unless otherwise noted, all motors ½ through 100 horsepower shall be rated 230/460 Volt, three-phase, 60 Hertz A.C.; motors 125 horsepower and above shall be rated 460 Volt, three-phase, 60 Hertz; and motors below ½ horsepower shall be rated 115/230 Volt, single phase, 60 Hertz A.C.
- D. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet 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 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 duty rated and comply 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.
 - 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.
 - 5. Rotor: Random-wound, squirrel cage.
 - 6. 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.
 - 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:
 1. Provide hollow shaft and P flange mounting to allow driven shaft to extend through provide for vertical pump applications.
 2. Coupling for connecting the motor shaft to the driven shaft is located in the top of the motor.
 3. Where solid shaft is provided couple the driven shaft below the P flange face.
6. Rotor Core:
 1. Solid, built-up stack of fully processed and coated, high-grade, low-loss silicon steel laminations.
 2. Die cast aluminum or fabricated copper bars or their respective alloys.
 3. Rotors on frames 213T and above to be keyed to shaft and rotating assembly dynamically balanced.
7. Rotor Assembly:
 1. Coated with corrosion resistant epoxy insulating varnish or other protective coating, thermally stable, statically and dynamically balanced.
 2. 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 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 50,000 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 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. Winding temperature RTDs: Six 100 Ohm platinum (PT 100), three-wire resistance-type temperature detectors (RTDs) embedded in the stator windings, two per phase, symmetrically installed between stator coils where highest temperature will occur. RTD leads brought out to separate terminal box on the motor frame. One RTD set in each phase to be operational and one RTD set to be spare.
- E. Bearing temperature sensing: Number, type, and location for motor and driven equipment per process equipment specification.
 - 1. RTD: Replaceable 100 Ohm platinum (PT 100) three-wire RTD's, with spring loaded tip. Mount RTD as close as possible to outer surface of each bearing. RTD includes conduit connection head, terminal block, and cabling brought out to a common terminal box.
 - 2. Dial type thermometer.
 - 3. Temperature relay, furnished with indicating scale.
 - 4. Iron or copper constantan thermocouple.
- F. Motor shaft currents: insulate the ODE bearing and provide a shaft grounding strap. Insulate bearing probes to prevent shorting out bearing insulation.
- G. Shaft grounding rings: maintenance free, circumferential micro fiber type, AEGIS™ SGR by electro Static Technology or equal to discharge shaft currents to ground.
- H. Vibration Sensors: Number, type, and location for motor and driven equipment per process equipment specification. Provide machined surfaces at each bearing housing for attaching a magnetic mounted accelerometer in order to monitor motor vibration in vertical, horizontal and axial directions. Coordinate with the supplier of the machine monitoring equipment.
- I. 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.
- J. 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 POWER FACTOR CORRECTION CAPACITORS

- A. Select the PFCC rating to provide an operating power factor of the motor between 93 to 95 percent at full load and 95 to 98 percent when partially loaded. The capacitor current shall not exceed the motor no-load magnetizing current.
- B. Provide the required capacitor and capacitor information to the motor control center (MCC) manufacturer for inclusion inside the MCC.
- C. Capacitors: UL listed, NEMA rated and tested, three phase dry film or non-PCB dielectric liquid insulated, with three current limiting fuses rated for 100 kA interrupting capacity at 480 Volts, equipped with internal discharge resistors and fuse loss indicators, mounted in hermetically sealed steel enclosures suitable for conduit connection. Covers shall be gasketed, bolt-on type.

2.6 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.

2.7 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. 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 shall be 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.

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

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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, the PCSS will also serve as the Applications Engineer System Supplier (AESS) and is required to modify the existing SCADA system as specified for this Transfer Pump Station system.
- C. Provide all instrumentation tagged as provided by Div. 40 on drawing I drawings.
- D. Provide modifications as necessary to existing Thickening Building No. 1 PLC panel and Maine Pump Station PLC panel to accommodate new I/O signals shown on P&IDs. Provide surge protection for all signals coming into PLC from outside of building as specified in Section 407856.
- E. Test all signals from new valves and flowmeters to existing PLC at Main Pump Station as shown on I-4.
- F. 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.
- G. All equipment and installations to satisfy applicable Federal, State and local codes. Refer to Electrical drawings for area classifications for Class and /Division ratings.
- H. 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.
- I. Related Requirements:
 - 1. Section 4067XX Sections for Control System Equipment Panels and Racks.
 - 2. Section 407000 “Instrumentation for Process Systems.”

3. Section 4071XX Sections for flow measurement.
4. Section 407276 “Level Switches”
5. Section 4073XX Sections for pressure measurement.
6. Section 4078XX “Sections for control panel components\

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. Maintenance of Plant Operations (MOPO): A construction plan which prevents or limits process disruptions during construction.
- D. Section 4062XX “Sections for Computer System Hardware”: The XX in the number indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference.

1.4 PREINSTALLATION MEETINGS

- A. Conduct a project kickoff coordination meeting within two weeks after submitting the Project Plan. The purpose of the meeting is to discuss the PCSS's Project Plan, to summarize the PCSS's understanding of the project; discuss any proposed substitutions or alternatives; schedule testing and delivery deadline dates; provide a forum to coordinate hardware and software related issues; and request any additional information required from the Owner. The meeting will last up to 1 hour. Meeting will be virtual.
- B. Up to 3 general coordination meetings with Engineer, Contractor, Vendors as required prior to any field start-up or activity testing begins. Meetings will be virtual.
- C. Schedule the mandatory coordination meetings as described herein. Hold the meetings at the Owner's designated location and include attendance by the Owner, the Engineer, the Contractor, the PCSS's Project Engineer, and the AESS Project Engineer, if applicable. Other Division 40 specifications may require additional meetings. Prepare and distribute an agenda for this meeting a minimum of one week before the scheduled meeting date. Schedule the meeting for a minimum of one week before the requested meeting date.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, mountings, 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. Detail fabrication and assembly of control equipment, control panels, and instrumentation as specified herein.
4. Include diagrams for power, signal, and control wiring.

C. 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. Arrange the I/O list with 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.
4. Sort the I/O list in order by:
 - a. Physical location.
 - b. I/O Type.
 - c. Loop Number.
 - d. Device Tag.
5. For I/O layout requirements, refer to Section 406343 "Programmable Logic Controllers."

D. Field Instruments, PLC Hardware, Control Panel and Panel Layout/Wiring Submittal:

1. Refer to the Instruments section for submittal requirements.
2. For each hardware component specified, 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-TR20.00.01-2001 (updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.

E. Panel Layout Drawings and Wiring Diagrams Submittal (include as part of above submittal):

1. Panel Layout Drawings: Submit modified panel drawings for Thickener Building PLC 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." or existing plant standards.
 - b. Modifications to existing cabinet assembly and layout drawings to accommodate new I/O points if necessary. Include an updated 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.
2. Wiring Diagrams Submittal:
 - a. PCSS to provide modified wiring diagrams for Thickener Building PLC panel showing all wiring connections in the I/O system where direct hardwired interfaces exist between the PCSS control panels, 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. 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. Testing Plan Submittals:

1. Refer to Section 406121.20 "Process Control System Testing" for specific testing submittal requirements.

1.6 INFORMATIONAL SUBMITTALS

- A. None

1.7 CLOSEOUT SUBMITTALS

- A. The following O&M manuals may be submitted as one document for this project.
- B. 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.
 - c. Equipment Operations and Maintenance Information:
 - 1) Provide ISA-TR20.00.01-2001(updated in 2004-2006) data sheets for all field instruments. For non-field instrumentation devices, provide a cover page for each device, piece of equipment, and OEM software that lists date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2001(updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.
 - 2) Provide either new documentation written specifically for this project or modified standard vendor documentation to the vendor O&M documentation for each device, piece of equipment, or OEM software. Indicate with arrows or circles all portions that apply to all standard vendor documentation furnished. Neatly line out or cross out all portions that do not apply. Remove groups of pages or sections that do not apply to the specific model supplied.
 - 3) Provide the record documentation of the completed test forms as specified in Section 406121.20 “Process Control System Testing.”
 - 4) Include instrument/equipment calibration and configuration forms.

d. As-Built Drawings:

- 1) Complete updated 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 AutoCAD ".dwg" format and] in Adobe Acrobat ".pdf" format
- 2) Include any 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.

e. I/O list indicating quantity and type of I/O, programming related functions and "as installed" notes.

f. List of project personnel with contact information

C. 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.

D. Include information as specified in Section 017823 "Operation and Maintenance Data" on the cover and edge of each volume.

1.8 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.

1.9 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.
- B. The pre-selected PCSS for this project is:
 - 1. AquaLogics Systems Inc., Syracuse, NY
Contacts: Andrew Colerick: (315) 413-0400 (x707) or Don Ballway: (315) 413-0400 (x701)
- C. Refer to bid form for AquaLogics allowance for PCSS/AESS work defined in this Division 40.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 016000 "Product Requirements" for delivery, storage, and handling requirements.

1.11 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 operate between 20 to 95 percent relative, non-condensing humidity. All other equipment operates between 5 to 100 percent relative, condensing humidity.
- D. Do not ship control system equipment located in the control room until the control room areas comply with specified ambient temperature and humidity and free of dust and debris.

1.12 WARRANTY

- 1. Warranty Period: One 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 utilize 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 as outlined, 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. Switches and/or signals indicating an alarm, failure or upset condition wired in a fail-safe manner as shown on the P&IDs. A fail-safe condition is when an open circuit generates an alarm state (i.e. contact opens).
6. Materials and equipment UL approved whenever such approved equipment and materials are available.
7. All equipment furnished designed and constructed so that in the event of power interruption, the systems specified all go through an orderly shutdown with no loss of memory and resume normal operation without manual resetting when power is restored, unless otherwise noted.
8. 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 EXAMINATION

- #### A. Proceed with installation only after any unsatisfactory conditions have been corrected.

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.

- B. Provide sunshades for equipment mounted outdoors in direct sunlight. Include sunshades standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the North to minimize the impact of glare and ultraviolet exposure on digital readouts.

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.”
- B. Refer to Section 406126 “Process Control System Training.”
- C. Engage a factory-authorized service representative to perform startup service as specified in individual hardware and instrument specification sections.
- D. On-site coordination meetings with Engineer, Contractor, Vendors, as required during active construction period.

END OF SECTION 406100

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 406196 “Process Control Descriptions” for monitoring and control requirements and automatic control strategies.
 - 3. 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 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Refer to Section 4061000 “Process Control and Enterprise Management Systems General Provisions.”

1.5 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) Submit testing forms prior to start of testing.

- 1. 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) 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.

1.6 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For Test Documentation of system:

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 are submitted and approved. Submittal of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.

1.7 CLOSEOUT SUBMITTALS

- ### A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

1.8 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. 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 method 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. Test UPS to verify UPS switch power correctly while keeping all UPS powered loads online. Also, test sizing of UPS by switching off-line power to UPS and verify if they maintain specified run time.

L. For all panels with enclosures modified by this Contract, test internal control panel temperature under full running conditions to ensure proper cooling/ventilation is being provided.

M. 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.

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

PLC	Signal Tag	Description	Range of Active State when closed	P&ID	Signal	Reck Slot	Chain Slot	Instru- ment Alarm Setpoint	Calibrate, config., and Wiring complete	PCSS I/O testing	Date	I/O Testin g to the HMI	Date	Notes
PLC-SC	LI-4000-1	Secondary Clarifier No. 1 Sludge Level	0-10 ft	8	AI	2	1	0						
PLC-SC	LI-4010-3	Secondary Clarifier No. 3 Sludge Level	0-10 ft	8	AI	2	1	1						
PLC-SC	SI-4100-1	RAAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	2						
PLC-SC	SI-4100-4	RAAS Pump No. 4 Speed Feedback	0-100%	15	AI	2	1	3						
PLC-SC	FI-4102-1	RAAS Flow Pumps 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	RAAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	0						
PLC-SC	SC-4100-2	RAAS Pump No. 2 Speed Setpoint	0-100%	14	AO	2	7	1						
PLC-SC	SC-4100-3	RAAS 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	WAH-4000-1	Secondary Clarifier No. 1 High High Torque	Normal	8	DI	3	1	3						
PLC-SC	YI-4000-1	Secondary Clarifier No. 1 On/Off	On	8	DI	3	1	4						
PLC-SC	YI-4000-1	Secondary Clarifier No. 1 In Remote	In Remote	8	DI	3	1	5						
PLC-SC	YI-4100-1	RAAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	6						
PLC-SC	FAL-4100-1	RAAS Pump No. 1 Low Flow	Normal	14	DI	3	1	7						
PLC-SC	Spare	Spare	Normal	14	DI	3	1	8						
PLC-SC	YRI-4100-1	RAAS Pump No. 1 Running	Running	14	DI	3	1	9						
PLC-SC	YI-4100-1	WAS Pump No. 1 In Remote	In Remote	14	DI	3	1	10						
PLC-SC	YI-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	YI-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	RAAS 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	RAAS 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	HSC-7117-2	Sludge Holding Tank Discharge Valve No. 2 Open CMD	Open	17	DO	4	6	12						
PLC-SC	HSC-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						

[Project Name] Appendix B - Automatic Control Strategies Sign-Off Form

4-Jun-14

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 CONTAINMENT AREA HIGH LEVEL DETECTION	14			
LOOP 2051, 2052, 2053	DIESEL ENGINE GENERATOR STATUS	14			
LOOP 2055	TRANSFER SWITCH STATUS	14			
LOOP 2060	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 406126 - PROCESS CONTROL SYSTEM TRAINING

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 training for provided devices and systems.
- B. Related Requirements:
 - 1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.4 ACTION SUBMITTALS

- A. Preliminary Training Plan Submittal:
 - 1. Prior to preparation of Final Training Plans, submit outlines of each training course including course objectives and target audience, resumes of instructors, prerequisite requirements for each class, and samples of handouts for review.
- B. Final Training Plan Submittal:
 - 1. Upon receipt of Engineer's comments on preliminary training plan, submit specific proposed training plan with the following:
 - a. Definitions, objectives, and target audience of each course.
 - b. Schedule of training courses including proposed dates, duration, and locations of each class.
 - c. Complete copy of all proposed handouts and training materials bound and logically arranged with all materials reduced to a maximum size of 11 inch by 17 inch, then folded to 8.5 inch by 11 inch for inclusion into the binder.

1.5 CLOSEOUT SUBMITTALS

- A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

- A. Directly relate the training and instruction to the system being supplied. Training program represents a comprehensive program covering all aspects of the operation and maintenance of the system.
- B. Coordinate all training schedules with and at the convenience of Owner, including shift training required to correspond to Owner's working schedule.
- C. All onsite instructors must be intimately familiar with the operation and control of Owner's facilities.
- D. Provide detailed training manuals to supplement the training courses including specific details of equipment supplied and operations specific to the project. Provide the manuals in hardcopy for each student. Provide electronic copy of each training manual in PDF format for Owner's future use.
- E. Make use of teaching aids, manuals, or slide/video presentations as required. After training services, deliver training materials to Owner.
- F. Owner reserves the right to videotape all custom training sessions. Training tapes become sole property of Owner.
- G. Cost of Travel for off-site training:
 - 1. Cost of Travel for off-site training is paid directly by entity employing the staff doing the traveling.

3.2 TRAINING SUMMARY

- A. Provide following training courses listed in the summary table below:

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	Covered in AESS scope of work			
Operator Control System Training	Covered in AESS scope of work			

System Reports and Historian Implementation	Covered in AESS scope of work			
Installed Control System	2	4	1	Maintenance, Administrator
Instruments - Operator familiarity	4	4	1	Operations

B. Definitions of Audience Roles:

1. Administrator: Personnel responsible for maintaining the HMI / SCADA system.
2. Maintenance: Personnel responsible for maintaining the field controller hardware and instrumentation system.
3. Operations: Personnel responsible for daily plant operations.
4. Management: Non-daily operations personnel.

3.3 ONSITE TRAINING

A. Training personnel are required to be intimately familiar with the control system equipment, its manipulation, and configuration. Training personnel are required to command knowledge of system debugging, program modification, troubleshooting, maintenance procedure, system operation, and programming, and capable of transferring this knowledge in an orderly fashion to technically oriented personnel.

B. Installed Control System Training:

1. Provide training for Owner's personnel in the functionality, maintenance, and troubleshooting, of the installed Control System. Conduct training before Functional Demonstrator Test (FDT), but not more than 1 month before.
2. Provide training and instruction specific to the system that is being supplied.
3. Provide training consisting of classroom instructions and hands-on instruction utilizing Owner's system.
4. Provide detailed training on the actual configuration and implementation for this Contract covering all aspects of the system that will allow Owner's personnel to maintain, modify, troubleshoot, and develop future additions/deletions to the system. Provide training covering the following subjects:
 - a. System overview.
 - b. System hardware components and specific equipment arrangements.
 - c. Periodic maintenance.
 - d. Troubleshooting and diagnosis.

C. Instruments - Operator familiarity:

1. Provide operator level instruction on the use of the field and panel instrumentation for Owner's operations staff. Conduct training before the site acceptance test, but no more than 1 month before and at a time suitable to Owner. This training takes place at Owner's facility. Include hands on demonstration of information each transmitter indicates, and method used to retrieve any operator information from transmitter, including use of pushbuttons and interpretation of international graphic symbols used on the instruments.

END OF SECTION 406126

SECTION 406196 - PROCESS CONTROL DESCRIPTIONS

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. Applications Engineer System Supplier (AESS) Programming Scope

1. Develop the control system applications to implement the process control descriptions for all new and existing systems. This Section is provided to define control strategies to be used for PLC programming of the system.
2. The Contract Documents are a single integrated document, and as such, all Drawings, Specifications Divisions and Specifications Sections apply. It is the responsibility of the Contractor and Subcontractors to review all Sections to ensure a complete and coordinated project.
3. The AESS is cautioned to read this Section and all related Sections and their entirety prior to starting any programming. Many general control strategies and requirements are defined once in the body of this Section with the specific requirement called out in the individual control strategy. Implement the general strategies throughout this Section 3.1 unless an existing plant standard exists or specifically directed otherwise in the individual loop process control descriptions.
4. Follow loop and device tagging criteria shown on the Drawings without exception.

- B. Related Requirements:

1. Section 406100 "Process Control and Enterprise Management Systems General Provisions."
2. Section 406863 "Configuration of HMI Software."
3. Section 406866 "Configuration of Controller 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 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 SCADA system used for device level control and monitoring.

- E. Operator Workstation (OWS): A hardware component of the SCADA system used for supervisory level control and monitoring.
- F. 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.
- G. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.
- H. Supervisor Control and Data Acquisition (SCADA): Hardware and software components used for high-level supervisory monitoring of industrial processes. Typical devices that are part of the SCADA network include computers (OWS), PLCs, Ethernet switches, OITs, and HMIs.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Control System Hierarchy

1. The control descriptions are broken into a hierarchical layer concept. There may be one layer or multiple layers per loop, depending upon that loop. An example of multiple layered loop is shown in Figure 1.

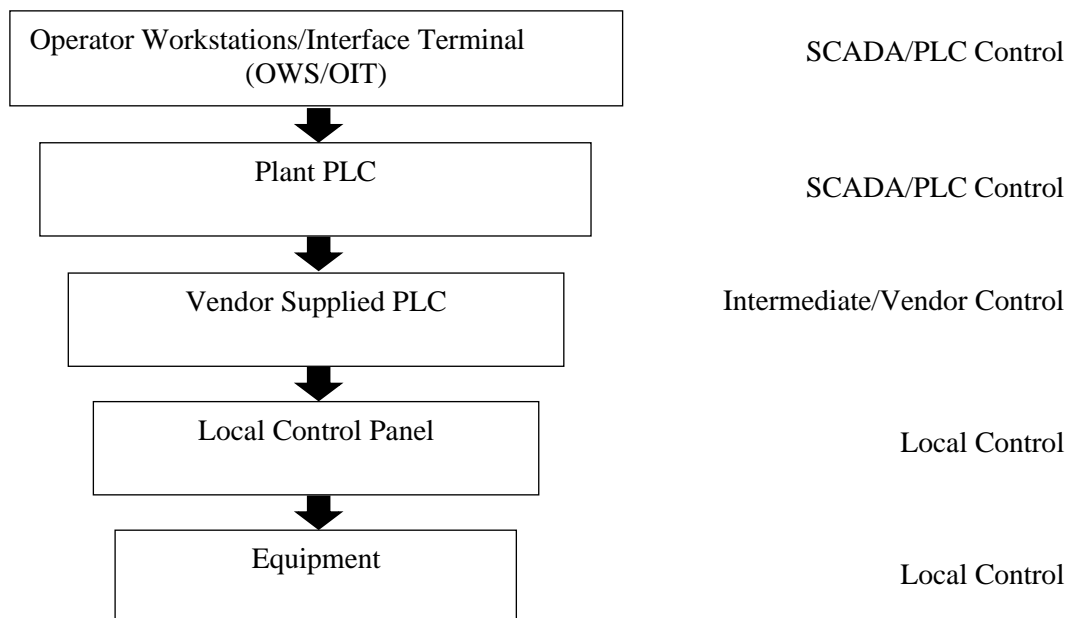


Figure 1. Control System Hierarchy

B. Loop Numbering

1. Refer to Drawings

3.2 GENERAL CONTROLS AND MONITORING

A. Overview

1. These guidelines are to be used whenever an existing plant programming standard does not already exist for each item below.
2. The hardware and/or software functions noted by this paragraph reference are to be implemented in the PLC control system.
3. Setpoints, as defined by this section, refer to numerical values adjustable from the HMI.
4. The PLC is responsible for resetting command bits sent from the HMI to the PLC. If the commanded state cannot be achieved for any reason, the PLC resets the bit to allow the operator to set the command bit again. For example, when pressing the AUTO button on the HMI, the PLC resets the AUTO command from the HMI after the device is in the AUTO Mode. If the AUTO Mode is not available for any reason, the PLC resets the bit, so the AUTO button can be selected at the HMI once AUTO control is available.

B. Interlocks

1. Hardwired interlocks will interlock the controls locally, at the vendor PLC, and at the plant PLC. If the interlock occurs, the shutdown will cause the equipment to be inoperable at all levels of control.
2. Software interlocks are represented in a particular layer of the operation description and interlock the controls in that layer and the layers above it. However, the interlock does not interlock the commands in the layer before it. For example, a software interlock implemented at the SCADA/PLC level will not stop equipment from being controlled locally.
3. Interlocks that shutdown (stop a piece of equipment and prevent it from being restarted or moved) are displayed on the faceplate pop-up graphic for that piece of equipment.

C. Motors

1. Provide monitoring and control of the signals shown on the P&IDs.
2. Hardwired and software interlocks are defined in individual loop descriptions.
3. Motors can be started manually by the operator at the HMI, or automatically by the control strategy.
4. Automatic control strategies are defined in individual loop descriptions.
5. The SCADA system stops a motor or drive, if it does not receive the AUTO or REMOTE status or one of its software interlocks trips. If the drive or motor is in HAND or LOCAL, it will continue to run but the SCADA start/stop output will be open.
6. If a motor stops for any reason, it cannot be restarted automatically once the problem with the motor has been resolved. A manual reset from the OWS or OIT is required to resume operation.
7. Motors that have a HAND-OFF-AUTO (HOA) selector, indicate to the operator that the pump is being run in the HAND position. A motor is being run in HAND when the AUTO position is not true and the run confirm status is true. If not in AUTO, the SCADA PLC output contact will open and stop (shutdown) the pump.

D. Valves

1. Provide monitoring and control of the signals shown on the P&IDs.
2. Hardwired and software interlocks are defined in individual loop descriptions.

3. Valves with only full travel capability can be opened or closed manually by the operator at the HMI, or automatically by the control strategy.
4. Modulating valves with position feedback can be positioned between 0% and 100% open manually by the operator at the HMI, or automatically by the control strategy.
5. Automatic control strategies are defined in individual loop descriptions with their corresponding process variable used for control.

E. Analog Instruments

1. Analog instruments refer to indicating devices capable of providing a continuous output relative to time.
2. Provide monitoring of the analog signals shown on the P&IDs.
3. Analog signals may be a continuous voltage (-10V to 10V, 0V to 5V, 0V to 10V) or current (0 mA to 20mA, 4mA to 20mA) as determined by the output of the field instrument. The output range corresponds to the minimum and maximum full-scale measurement.
4. The PLC will linearly scale the output range (voltage or current) to the equivalent values in engineering units.
5. Provide cutoff deadbands for when the analog signal is approaching the minimum or maximum full-scale measurement.
 - a. An analog signal measuring less than or equal to 2% of full-scale will be forced to zero after an adjustable time delay.
 - b. An analog signal measuring greater than 100% of full-scale will be clamped at 100%.
6. Provide a CALIBRATION mode with an adjustable time setpoint (in hours).
 - a. When entering CALIBRATION mode, the last good value is held prior to CALIBRATION mode being activated. The value is held until the calibration time setpoint expires.
 - b. The Operator may enter a calibration value, which will be the value held until the calibration time setpoint expires.
 - c. When active, clearly indicate the instrument is in CALIBRATION mode on any local OITs and in the HMI system.

F. Discrete Instruments

1. Discrete instruments refer to indicating devices with any number of non-continuous defined states (e.g., ON/OFF, 0 or 1)
2. Provide monitoring of the discrete signals shown on the P&IDs.
 - a. When a contact or status from the instrument is true, the PLC will receive power to its input channel. The PLC registers this as a binary bit of 1.
 - b. When a contact or status from the instrument is false, the PLC will receive no power (open circuit) to its input channel. The PLC registers this as a binary bit of 0.

G. PLC Hardware

1. Monitor status and communication faults at the HMI.
 - a. Implement watchdog timers to monitor CPU and I/O module health, and execution time for PLC routines.
 - b. Generate an alarm at the HMI if any watchdog timer expires.

2. Program the system time for all PLCs to synchronize with a Network Time Protocol (NTP) server once every 24 hours.

H. Input Validation

1. Provide input validation for setpoints used in process control (e.g., chemical dosage setpoints, pump flow setpoints).
2. The PLC will verify that the HMI setpoint is within an acceptable predefined range.
3. Out of range values will be rejected by the PLC and the current value will be retained.

3.3 HISTORICAL DATA COLLECTION

- A. Provide historical data collection for all analog inputs, process control setpoints, flow totals, equipment runtimes, and discrete equipment statuses (ON/OFF), unless otherwise stated in the individual loop descriptions. Historical data collection is as follows:

Collection Options	
Collection Type:	Polled
Collection Interval:	1 minute
Collection Offset:	0 seconds
Time Resolution:	Milliseconds
Compression:	Enabled
Collector Deadband:	0.5 Percent Range
Collector Compression Timeout:	15 minutes

3.4 ACCUMULATORS AND TOTALIZERS

A. Accumulators

1. Display accumulated run time for all equipment with a RUNNING status. Each run time accumulation is resettable from the HMI with a reset push button.
2. The PLC will update the flow totals at 12:00 a.m. local time.

Runtime	Display Format
Current Day:	XX.XX Hrs.
Yesterday:	XX.XX Hrs.
Current Month:	XXX.X Hrs.
Previous Month:	XXX.X Hrs.
Accumulated Total:	XXXXXXX Hrs.

B. Flow Totalizers

1. Totalize all flow indications.
 - a. If the flowmeter provided has a configurable pulse output for totalized flow, perform flow totalization using the pulse output. The PLC calculates totalized flow by multiplying the number of pulses by the volume per pulse.
 - b. If the flowmeter provided does not have a configurable pulse output for totalized flow, perform flow totalization using the analog 4-20mA signal.
 - 1) Do not totalize if the analog signal is outside the 4-20 mA range.

- 2) Do not totalize if the value of the flow input is less than 2% of the full range of the input.
 - 3) Do not totalize if a discrete status exists that can be used to determine if flow is present (for example, no flow can be present unless a pump is running).
2. Each flow totalization is resettable from the HMI/OIT with a reset push button.
 3. Display totalized flow in million gallons (MG), thousands of gallons (kGal), or Gallons (Gal) in accordance with the following:

Totalizer	MG Format	kGal Format	Gal Format
Current Day:	X.XXX	XXX.XX	XXXX.X
Yesterday:	X.XXX	XXX.XX	XXXX.X
Current Month:	XXX.X	XXX.X	XXXX
Previous Month:	XXX.X	XXX.X	XXXX
Accumulated Total:	XXXX	XXXX	XXXX

4. Use appropriate flow totalizer units for the total volume anticipated for the time period. Unless requested by the Owner, water process flows are totalized in million gallons (MG) and chemical flows are totalized in gallons (Gal). Auxiliary flow (e.g., backwash) units are determined based on the total flow for the day.
5. Chemical systems which do not have flowmeters will calculate usage based on the chemical tank volume. The PLC will calculate tank volume based on the measured level and the vessel geometry or the measured weight and the specific weight of the chemical.
6. The PLC will update the flow totals at 12:00 a.m. local time.

3.5 ALARMING AND EQUIPMENT FAILURES

A. Analog Alarms

1. Provide analog alarming capability for all analog signals monitored by the PLC.
2. Supervisor level users can set a common time setpoint (initially set to 5 seconds) that is used to generate alarms. The following alarms (setpoints to be Supervisor adjustable) are generated based on the analog feedback value. Each alarm includes the ability for individual enabling and disabling.
 - a. High-High
 - b. High
 - c. Low
 - d. Low-Low
 - e. Loss of Signal
3. LOSS OF SIGNAL alarm is generated when an analog signal goes outside the 4-20 mA range due to a failure at the instrument or PLC card. The following SCADA programming occurs:
 - a. If the analog signal is used in a control loop or ratio control loop, that loop is placed into MANUAL.
 - b. If the analog signal is used in a calculation, that calculation uses the last good analog signal. If the calculation is used in a control loop, that loop is placed into MANUAL.

4. SETPOINT REJECTED alarm is generated at the HMI when an analog setpoint is out of range and rejected by the PLC.

B. Discrete Alarms

1. Program all discrete alarm signals wired to the PLC (float switches, pressure switches, overload alarms) to alarm after an HMI adjustable time delay expires.
2. The maximum alarm delay for Safety related alarms (e.g., E-stop) is 500ms. Set each alarm timer during startup.

C. Valve Failures

1. Supervisor level users can set a common time setpoint that is used to generate the following alarms. When a valve position alarm is active, the PLC output is maintained unless explicitly stated in the individual loop descriptions (e.g., a fail to open alarm does not trigger the PLC to close the valve).
 - a. All discrete valves (OPEN-CLOSE) being remotely controlled generate a FAIL-TO-OPEN alarm when the PLC sends the OPEN command to the valve and it does not reach the OPENED limit within a supervisor adjustable time setpoint.
 - b. All discrete valves (OPEN-CLOSE) being remotely controlled generate a FAIL-TO-CLOSE alarm when the PLC sends the CLOSE command to the valve and it does not reach the CLOSED limit within a supervisor adjustable time setpoint.
 - c. All modulating valves (POSITIONING) being remotely controlled generate a FAIL-TO-POSITION alarm when the valve feedback does not match the PLC commanded position within a supervisor adjustable time setpoint.

3.6 INDIVIDUAL CONTROL DESCRIPTIONS AND CONTROL SEQUENCES

LOOP No.	LOOP DESCRIPTION	PAGE No.
LOOP 1010-1,2	– WASTE TRANSFER PUMP NOS 1 & 2	77
LOOP 1030	– WASTE STORAGE TANK LEVEL MONITORING	88
LOOP 1032	– WASTE HANDLING STORAGE TANK DISCHARGE FLOW	99
LOOP 1035	– WASTE HANDLING STORAGE TANK DISCHARGE VALVE	99
LOOP 1040	– FILTRATE SUMP PUMP AND FLOW	1010
LOOP 1050	– RETURNED ACTIVATED SLUDGE (RAS) FLOW CONTROL.....	11

LOOP 1010-1,2 – WASTE TRANSFER PUMP NOS 1 & 2

A. General

1. Waster transfer pump with constant speed drive transfers leachate from the leachate trucks to the waste handling storage tank. The waste transfer pump shall be controlled locally by the operator at the LCS. The pumps operate in duty/standby configuration as determined by Operators.

B. Hardwired Interlocks

1. The pump cannot run if the following alarms are detected:
 - a. Waste Storage Tank High Level (Loop 1030 - PSH)

- b. High Motor Temperature
 - c. Motor Fault
- C. Software Interlocks
 - 1. None
- D. Control
 - 1. Waste Transfer Pumps 1 and 2 operate in a duty/standby configuration from a local “Waste Transfer Pump Control Panel” (LCP-1010). The pumps are controlled by the operator using ON/OFF selector switches and status lights indicate running and fault status. See specification section 431329 for further details on this control panel.
- E. Alarms/Monitoring
 - Transfer Pump No.1 Running
 - Transfer Pump No.2 Running
 - Transfer Pump No.1 Fault Alarm
 - Transfer Pump No.2 Fault Alarm
- F. Historical Data Collection
 - Transfer Pump No.1 Runtime and Starts
 - Transfer Pump No.2 Runtime and Starts

LOOP 1030 – WASTE STORAGE TANK LEVEL MONITORING

- A. General
 - 1. Tank level is measured and alarmed by in-line pressure transmitter and switches.
- B. Hardwired Interlocks
 - 1. Waste Storage Tank High Level (PSH- hardwired to LCP-1010).
- C. Software Interlocks
 - 1. Waste Storage Tank Low Level (PAL) to close the flow control valve (PCHV-1035). Operator shall have ability to enable/disable this software interlock to completely drain the tank past this point.
- D. Alarms/Monitoring
 - Tank Level (PIT: 0 – 29.5 FT)
 - Tank Level High Alarm 28.5 FT (set at PSH and programmed in SCADA off of PIT)
 - Tank Level Low Alarm 3 FT (set at PSL and programmed in SCADA off of PIT)
- E. Data Collection:

Tank Level

LOOP 1032 – WASTE HANDLING STORAGE TANK DISCHARGE FLOW

A. General

1. The discharge flow from the Waste Handling Storage Tank is measured using a magnetic flowmeter , and signals are sent to the SCADA.

B. Control

1. Flow indication is used to control the Waste Handling Storage Tank Discharge Valve (PCHV-1035).

C. Alarms/Monitoring

Discharge Flow (FIT: 0-300 GPM)

No Flow Alarm, When the discharge valve (PCHV-1035) is open, and no flow is measured after an operator entered time delay.

D. Data Collection:

Flow Totalization

LOOP 1035 – WASTE HANDLING STORAGE TANK DISCHARGE VALVE

A. General

1. Waste handling storage tank discharge valve, transfer the leachate from the storage tank to the filtrate pump station, when the valve is open. OPEN-STOP-CLOSE (OSC) and POSITION controls are available both at the local control station and from SCADA/HMI.

B. Software Interlocks

1. The Waste Handling Storage Tank level (PSL-1030) Low alarm should close the valve and inhibit it from opening until the low level alarm is reset from the reset push button in SCADA.
2. The Filtrate Pump Station High Level (LSH-1040) will close the valve and inhibit it from opening until the High level alarm is reset from the reset push button in SCADA. Additionally, the operator will have the ability in SCADA to enable or disable this interlock.

C. Control

1. Valve can be positioned at the local control station if the LOCAL-OFF-REMOTE (LOR) selector is in LOCAL. If the selector is in the REMOTE position, control is transferred to SCADA.
2. The valve can be controlled at SCADA in MANUAL mode or AUTO mode. In MANUAL mode, the Operator manually OPEN or CLOSE the valve from the HMI, using the operator adjustable valve position setpoint. In AUTO mode, the valve is

positioned by FLOW PID control as described in the “Automatic Controls” Article. The process variable (PV) to the FLOW PID controller is the measured Waste Handling Storage Tank Discharge Flow (FIT-1032) and the output (CV) of the FLOW PID is Valve Position Command (%). The Flow setpoint (SP) will be operator adjustable from SCADA.

3. When the Valve is in AUTO mode, Desired Valve Operation Start and End Time setpoints should allow the operator to choose at what time of the day the discharge valve operation shall be enabled and when shall it be disabled from SCADA.

D. Alarms/Monitoring

Discharge Valve in Remote

Discharge Valve Closed Status

Discharge Valve Opened Status

Discharge Valve Fault

Discharge Valve Position Feedback

Discharge Valve Position Command

Discharge Valve Fail to Open Alarm (software)

Discharge Valve Fail to Close Alarm (software)

Discharge Valve Fail to Position Alarm (software)

E. Historical Data Collection:

Discharge Valve Position Feedback

Discharge Valve Position Command

LOOP 1040 – FILTRATE SUMP PUMP AND FLOW

A. General

1. The filtrate sump pump operation is based on the float switches in the sump. The operation of the pump shall be available both at the local control panel and from SCADA/HMI. Effluent flow from filtrate sump is measured with a magnetic flowmeter.

B. Hardwired Interlocks

1. The pump cannot run if the following alarms are detected:
 - a. Sump Pump High Motor Temperature
 - b. Sump Pump Fault

C. Software Interlocks

1. None

D. Control

1. The filtrate sump pump is operated based on the filtrate sump level. The pumps can be controlled from both the local “Sump Pump Control Panel” (LCP-1040) and SCADA/HMI. The pumps are controlled at the LCP by the operator using a HAND/OFF/AUTO selector switch and status lights indicate running and fault status. See specification section 432513 for further details on this control panel.

E. Alarms/Monitoring

Sump Pump Running Status

Sump Pump Fault

Sump Level Low

Sump Level High Alarm

Fail to Stop Alarm at Low Level

Filtrate Flow (FIT: 0-500 GPM)

F. Historical Data Collection

Sump Pump Runtime and Starts

Flow Totalization

LOOP 1050 – RETURNED ACTIVATED SLUDGE (RAS) FLOW CONTROL – LINE 1

A. General

1. A new magnetic flow meter and modulating flow control valve replace existing equipment to control the flow from Final Settling Tanks to Aeration Distribution Chamber.

B. Hardwired Interlocks

1. None

C. Software Interlocks

1. None

D. Control

1. The operator shall have the ability to enter in a flow control setpoint at SCADA to automatically position the new valve to maintain a desired RAS flowrate to the Aeration Chamber. The valve must be “In Remote” in order to be controlled automatically from SCADA. An Auto/Manual switch at SCADA shall allow operators to position valve manually or control automatically.

E. Alarms/Monitoring

RAS Valve in Remote

RAS Valve Closed Status

RAS Valve Opened Status

RAS Valve Fault

RAS Valve Position Feedback

RAS Valve Position Command

RAS Valve Fail to Open Alarm (software)

RAS Valve Fail to Close Alarm (software)

RAS Valve Fail to Position Alarm (software)

RAS Flow (FIT: 0-XXX GPM – Match existing scaling on meter being replaced)

F. Historical Data Collection

Discharge Valve Position Feedback

Discharge Valve Position Command

Flow totalization

LOOP 1051 – RETURNED ACTIVATED SLUDGE (RAS) FLOW CONTROL – LINE 2

Loop is functionally identical to Loop 1050.

END OF SECTION

END OF SECTION 406196

SECTION 406717 – INDUSTRIAL ENCLOSURES

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 industrial enclosures.
- B. Related Requirements:
 - 1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
 - 2. Section 406733 “Panel Wiring.”

1.3 DEFINITIONS

- A. Not used.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”
- B. Shop Drawings:
 - 1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

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 508.
- B. Provide components compatible with functions required to form complete working system.
- C. Provide UL 508 label on complete assembly.
- D. Maintain one copy of panel drawings on site in enclosures.

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."
- B. Manufacturer's Warranty: Manufacturer agrees to repair or replace components that fail(s) in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 INDUSTRIAL ENCLOSURES

- A. Manufacturers
 - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
 - a. nVent: Hoffman.
 - b. Rittal.
 - c. Saginaw.
 - d. Substitutions: Or equal

B. Structure and Enclosure

1. Panels in indoor, dry, non-corrosive environments:
 - a. NEMA 12, painted steel or aluminum construction, as required by the schedule in PART 3.
2. Panels in outdoor, wet, or chemically corrosive environments:
 - a. NEMA 4X, stainless-steel or FRP construction, as required by the schedule in PART 3.
3. Panels located in hazardous locations:
 - a. Rated for the type of hazard (e.g., NEMA 7 for Class 1, Division 1).
4. Construction:
 - a. Freestanding and floor-mounted vertical panels:
 - 1) Panels of 12-gauge sheet steel
 - 2) Front panels or panels containing instruments: provide 10-gauge stretcher-leveled sheet steel, reinforced to prevent warping or distortion.
 - b. Wall and Unistrut mounted panels:
 - 1) Panels no less than 14-gauge steel,
 - c. Consoles:
 - 1) Panels of 12-gauge sheet steel
 - 2) Front panels: provide 10-gauge stretcher-leveled sheet steel, reinforced to prevent warping or distortion.
5. Provide angle stiffeners on the back of the panel face to prevent panel deflection under instrument loading or operation, as follows:
 - a. Structural framework internal to the panel allows for instrument support and panel bracing.
 - b. Interior structure framework to permit panel lifting without racking or distortion.
 - c. Removable lifting rings designed to facilitate simple, safe rigging, and lifting of the control panels during installation.
6. Full height and fully gasketed access door with full-length, continuous, piano type stainless steel hinges with stainless steel pins.
 - a. Provide doors with three-point stainless steel latch and heavy-duty stainless-steel locking handle.
 - b. Provide front access doors of sufficient width to permit instrument or control device mounting without interference from flush mounted instruments.
 - c. Clamp-type door latches are not permitted.

7. Avoid kinks and sharp bends in wiring.
 - a. Route wiring for easy access to other components for maintenance and inspection purposes.
8. Panel suitable for top and bottom conduit entry as required by the Electrical Drawings
 - a. For top mounted conduit entry, provide panel top with nominal one-foot square removable access plates, which may be drilled to accommodate conduit and cable penetrations.
 - b. Provide all conduit and cable penetrations with ground bushings, hubs, gasketed locknuts, and other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.

C. General Requirements

1. UL labeled control panels and cabinets.
 - a. UL listing includes enclosure, specific equipment supplied with enclosure, and equipment installation and wiring within and on the enclosure. If required for UL labeling, provide ground fault protective devices, isolation transformers, fuses and other equipment necessary to achieve compliance with UL 508A requirement. The Drawings do not detail all UL 508A requirements.
2. Panel door handles with lock, or a hasp and staple for padlocking; key the locks for all control panels provided under this Contract alike.
3. Arrange devices for rear of panel mounting within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment.
 - a. Locate heat generating devices, such as power supplies, at or near the top of the panel.
4. Mount all components in a manner that permits servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component.
 - a. Mount interior panel components on removable plates (sub-panels) and not directly on the enclosure.
 - b. Unless shock mounting is required by the manufacturer to protect equipment from vibration, provide rigid and stable mounting.
 - c. Mount and orient components in accordance with manufacturer's recommendations.
 - d. Identify internal components with suitable plastic or metal engraved nametags mounted adjacent to (not on) each component identifying the component in accordance with the drawings and specifications.
5. Mount all panel components on a single rear-of-panel sub-panel unless the density of devices exceeds the panel mounting space permitted by the minimum panel dimensions specified. Side panel mounted components are not permitted without review and approval by Engineer.
6. Type 316 stainless-steel hardware and fasteners:

- a. Provide drilled and tapped mounting screws; self-tapping screws are not permitted.
 7. Install suitable gaskets and faceplates, required to maintain NEMA rating of the panel.
- D. Mounting Elevations
1. Refer to ISA Recommended Practice RP60.3 for guidance on layout and arrangement of panels and panel mount components. Account for housekeeping pad dimensions.
 2. Locate centerline of indicators and controllers no lower than 48 inches or higher than 66 inches above the floor on a panel face.
 3. Locate centerline of lights, selector switches, and pushbuttons no lower than 32 inches or higher than 70 inches above the floor on a panel face.
 4. Locate tops of annunciators no higher than 86 inches above the floor on a panel face.
 5. Install panel components in accordance with manufacturer's guidelines.

2.2 TEMPERATURE CONTROL

- A. Provide force air ventilation or air conditioning units as required to prevent temperature buildup inside of panel.
- B. Heat Load Calculations:
1. Submit heat load calculations for all control panels located in areas where either venting is not possible due to NEMA rating of panel or control panel is located in an area or building without air conditioning.
 2. Utilize manufacturer available thermal calculators to determine heating/cooling requirements (i.e. Saginaw SCE thermal calculator, nVent Hoffman cooling selection tool, or equivalent).
 3. Ensure the internal temperature of the panel is regulated between 45 to 104 degrees F (7 to 40 degrees C) under all conditions.
 4. Account for the following conditions in the heat load calculations:
 - a. Loading and dissipation effects on all surfaces of the enclosure. Account for surfaces not available for heat transfer (e.g., against a wall).
 - b. Internal heat load of components (load and duty cycle).
 - c. For outside temperature limits, refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."
- C. Sun Shields:
1. Provide custom fabricated sun shields for all outdoor panels in accordance with the following requirements:
 - a. Fabricate sun shields from a material suited for the area classification rating of its environment.
 - b. Design, fabricate, install, and support the unit to fully cover and shade the top, sides, and back of the enclosure, and to partially shade the front panel of the enclosure from direct exposure to sunlight from sunrise to sunset.

- c. Depending on overall size, sun shields may be fabricated in single or multiple segments for attachment to the enclosure support framing or to separate free standing framing around the enclosure, to preserve rigidity.
- d. Design and mount sun shields with a minimum 3-inch air gap around the enclosure for air circulation and heat dissipation.
- e. Drilling holes or welding studs directly to the enclosure for sun shield mounting is not permitted.
- f. Slope the top section of the sun shield a minimum angle of 5 degrees from horizontal.
 - 1) Wall mounted enclosures: slope the top section downward away from the wall and towards the front of the enclosure.
 - 2) Free standing, floor mounted, and frame mounted enclosures: slope the top section downward towards the back side of the enclosure.
- g. Incorporate a narrow and more steeply sloped drip shield segment on the front edge of the top section to shed water away from the front of the enclosure and prevent dripping or running directly onto the front panel of the enclosure.
- h. Fabricate sun shields with continuous seam welds that are ground smooth.
- i. Smooth round or chamfer exposed corners, edges, and projections to prevent injury.

D. Louvers

- 1. If louvers are used, provide louver plate and filter kit.
- 2. Provide louver plates of stamped sheet metal construction.
- 3. Provide washable and replaceable filters.
- 4. Install louvers on the rear, top, or bottom of the panel, as required by the panel installation location.
- 5. For wall mounted enclosures with their backs directly adjacent to a wall, install louvers on the sides.

E. Forced Air Ventilation:

- 1. Provide forced air ventilation fans to create positive internal pressure within the panel.
- 2. Provide washable and replaceable filters.
- 3. Fan motors operate on 120-volt, 60-Hz power.

F. Air Conditioning:

- 1. For panels with internal heat that cannot be adequately dissipated with natural convection and heat sinks, or forced air ventilation, provide an air conditioner sized to deliver sufficient cooling.
- 2. NEMA rating equivalent to the NEMA rating of the panel. Maintain NEMA rating of panel when installed.
- 3. Provide air conditioner with conformal coating on exposed surfaces.
- 4. Mount air conditioners on panel side. If provided, cut sun shields to accommodate air conditioner.

G. Heating:

1. Provide an integral heater, fan, and adjustable thermostat for outdoor enclosures and enclosures located in unheated areas indoors or in areas subject to humidity and moisture, to reduce condensation and maintain the minimum internal panel temperature.
 - a. Mount unit near enclosure bottom with discharge away from heat-sensitive equipment.
 - b. Provide Hoffman DAH series, Stego PTC series, or equal.

2.3 ACCESSORIES

A. Nameplates

1. Identify the panel and individual devices as required, unless otherwise indicated:
 - a. Include up to three lines:
 - 1) First line containing the device tag number as shown on the Drawings.
 - 2) Second line containing a functional description (e.g., Recirculation Pump No. 1).
 - 3) Third line containing a functional control description (e.g., Start).
2. Unless escutcheon plates are specified or unless otherwise noted on the Drawings:
 - a. Furnish nameplates as 3/32-inch thick, black against white background unless otherwise noted, Lamicoid with engraved inscriptions. Bevel and smooth edges of nameplate.
 - b. Nameplates with chipped or rough edges are not acceptable.
3. Mount or fasten cabinet mounted nameplates with epoxy adhesive or stainless-steel screws.
4. Provide a panel nameplate with a minimum of 1-inch-high letters for every panel.
5. Provide legend plates or 1-inch by 3-inch engraved nameplates with 1/4-inch lettering for identification of door mounted control devices, pilot lights, and meters.
6. Use single Lamicoid nameplates with multiple legends for grouping of devices such as selector switches and pilot lights that relate to one function.

B. Print Storage Pockets

1. Provide print storage pockets of steel construction, welded onto the door of the enclosure.
2. Size storage pockets to accommodate all prints required to service the equipment, and to accommodate 8.5-inch by 11-inch documents without folding.

C. Corrosion Control

1. Protect panels from internal corrosion by use of corrosion-inhibiting vapor capsules. Size and quantity as necessary per manufacturer recommendations.
2. Manufacturer:
 - a. Zerust VC.

- b. Hoffman Model AHCI.
- c. Or equal.

2.4 GENERAL FINISH REQUIREMENTS

- A. Descale, degrease, fill, grind and finish sections.
- B. Finish steel-fabricated enclosures with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which are applied by either hot air spray or conventional cold spray methods.
 - 1. Brushed anodized aluminum, stainless steel, and FRP panels do not require a paint finish.
- C. Grind smooth, sandblast and then clean with solvent. Fill surface voids and grind smooth.
- D. Immediately after cleaning, apply one coat of a rust-inhibiting primer inside and outside, followed by an exterior intermediate and topcoat of a two-component type epoxy enamel.
 - 1. Apply final sanding to the intermediate exterior coat before top coating.
- E. Apply a minimum of two coats of manufacturer's standard, flat light-colored lacquer, on the panel interior after priming.
- F. Unless otherwise noted, finish exterior colors as ANSI 61 gray with textured finish.
- G. Finish products after assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, roofs, and rooms for suitable conditions where industrial enclosures will be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."
 - 3. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

- 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. Install lacing bars and distribution spools.

3.3 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly and lubricate as recommended by manufacturer.

END OF SECTION 406717

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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.
 - 2. Section 406717 “Industrial Enclosures.”
 - 3. Section 407856 “Isolators, Intrinsic Safety Barriers, and Surge Suppressors.”

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 508.
- B. Provide components compatible with functions required to form complete working system.
- C. Provide UL 508 label on complete assembly.
- D. Maintain one copy of panel drawings on site in each panel.

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.
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 be 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 also 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. All programming modifications to be made in accordance with existing plant standards whenever possible. Coordinate with client as necessary for any new programming requirements as part of this project.
- C. Provide all 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. Configuration of the existing FactoryTalk HMI System Software for all equipment shown on the drawings, including equipment provided by vendor package systems.
 - 2. Configuration of any existing alarm dialer as needed.
 - 3. Configuration of the existing SCADA Historian Software as needed.
 - 4. Configuration of existing system reports as needed.
- D. Coordinate all work with plant operating personnel to minimize impacts on daily operation. Note delays caused for any reason and formally submit to the Engineer and the Owner in the form of a letter.
- E. Related Requirements:
 - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions" for submittal requirements.
 - 2. Section 406126 "Process Control System Training."
 - 3. Section 406196 "Process Control Descriptions."
 - 4. Section 406866 "Configuration of Controller 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 PREINSTALLATION MEETINGS

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.” The meetings below are in addition to the meetings specified in that section.
- B. Schedule and conduct a field-testing coordination meeting, two weeks prior to field testing. The purpose of this meeting is to discuss specifics of proposed tests and provide a forum for coordinating required field-testing.

1.5 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 specified 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 406196 “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 - GENERAL

- A. 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.
- B. 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.
- C. 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.
- D. 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.
- E. 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.
- F. Adjust from the operator interface timers, setpoints, alarm actuation levels, unless specifically noted.

- G. 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.
- H. 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.
- I. Identify interlocks that affect equipment operation both by alarm and by HMI indication.
- J. Check analog inputs for out of range (via high and low limit checks) and alarmed.
- K. 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.
- L. Color coding for equipment status and alarms in accordance with plant standards.
- M. 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.
- N. There may be additional general programming requirements listed in Part 1 of the Section 406196 “Process Control Descriptions” that impact the HMI configuration.

3.3 SPECIFIC GRAPHIC SCREENS

- A. At a minimum, provide the following types of graphic screen indicated below.
 - 1. Modifications to Plant Overview screen including a site plan representation, indicating the geographic location of each process and building.
 - 2. Modifications to main menu screen linking all screens and process areas
 - 3. Modifications to main menu screen linking all screens and process areas.
 - 4. Modifications to individual treatment process screens graphically screening key process variables and equipment. Features:
 - a. No operator entries are available from these screens.
 - b. Individual process flow screens for each process include all process components, including tanks, pumps, blowers, mixers, drives, flow meters, valves, mechanical devices, as well as manual shutoff and isolation valves.
 - c. These diagrams are generally depicted from the P&ID's with at least 1 screen per P&ID on average.
 - 5. New individual unit process screen depicted from the P&ID's are used for control and screen of each major item of process equipment, process variables, and control devices,

including pumps, blowers, valves, gates, mixers, and drives. Navigational buttons consist of the P&ID's flow arrows to other individual unit processes. The unit process screens provide the ability for the operator to go to individual equipment popup screens. These diagrams are generally depicted from the P&ID's with at least 2 screens per P&ID on average.

6. Provide popup screens for each piece of equipment to start/stop equipment, open / close valves, implement automatic control, adjust set points, establish and adjust tuning parameters, set alarm limits and initiate a sequence.
7. PLC system diagnostic screens, showing the operational status, and fault conditions of all PLC components, including processors, I/O modules, OIT's, power supplies and UPS units.
8. Modifications to existing maintenance screens to display the raw value for each analog and digital I/O point in the system. They allow the operators/maintenance personnel to enter an override value for an analog point that is then used by the system instead of the value read from the input card / communications link.
9. New trend screens with the capability to screen up to eight, operator assigned, analog and/or digital process variables. Each analog value will be shown on a trend screen.
10. Additions to main alarm summary screen includes the following information for each alarm: Time, tag name, description, alarm type, current value and status. An acknowledge alarm button acknowledges all new unacknowledged alarms. Display alarms in the alarm summary screen and in the alarm banner as follows or in accordance with plant standards:
 - a. Unacknowledged and active alarm: Displayed on screen, blinking
 - b. Acknowledged and active alarm: Displayed on screen, not blinking.
 - c. Unacknowledged and inactive alarm: Displayed on screen, blinking. Text/background of the alarm displayed in a different color than active alarms.
 - d. Acknowledged and inactive alarm: Not displayed in banner.
11. Modifications to any analog variable screens showing a tabular summary of all plant process variables, in operator assigned groupings.

3.4 SECURITY

- A. Configure and implement the established system security to prevent unauthorized access. The system allows authorized changes to system operation through defined user accounts and password verification.
- B. Coordinate with Owner user account information, including login name and password for each account.

3.5 ALARM/EQUIPMENT STATUS REPORTING

- A. Display on the alarm log all alarms as they occur. Include on the alarm message the time of occurrence, tag name, tag number, and whether it is a low, high, or failure alarm. When the point in alarm returns to normal, the time, point identification number, and return to normal are displayed. Include on all reports the plant equipment number of the associated device.

- B. Log the equipment status whenever a change in status occurs (i.e., start, stop). Include on the equipment status log the time, equipment name, tag number, and the particular change in status.

3.6 HISTORICAL DATA MANAGEMENT

- A. Implement in accordance with existing plant standards.

3.7 REPORTS

- A. Modify existing reports for new equipment and instrumentation.

3.8 TESTING

- A. Refer to Section 406121.20 “Process Control System Testing”.
- B. Supplement to Field Testing requirements.
 - 1. 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.
 - 2. Loop Tuning – Tune all PID control loops (single or cascade) following device installation but prior to commencement of the Functional Demonstration Test.
 - a. 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.
 - b. 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.
 - c. 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.
 - d. Verify loop performance and stability by step changes to setpoint in the field.
 - e. Submit loop tuning documentation as specified in Part 1 of this Section.

3.9 TRAINING

- A. Refer to Section 406126 “Process Control System Training” for general training requirements
- B. Furnish training as shown in the table below.

Description	Minimum Course Duration (hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audience

Description	Minimum Course Duration (hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audience
Onsite Training				
Operator Training (Post start-up)	2	4	1	Operations

C. Operator Control System Training (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 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.
3. At a minimum, provide the following teaching aids for distribution during Operator training sessions:
 - a. Final O&M Manuals (post-startup).
 - b. P&IDs.
4. 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.

END OF SECTION 406863

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. All programming modifications to be made in accordance with existing plant standards whenever possible. Coordinate with client as necessary for any new programming requirements as part of this project.
- C. Provide all 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 configuration of the existing Thickener PLC and Main Pump Station PLC for all new equipment shown on the drawings, except for controls equipment shown being provided as part of a vendor package system.
- D. 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.
- E. Related Requirements:
 - 1. Section 406100 "Process Control and Enterprise Management Systems General Provisions" for submittal requirements.
 - 2. Section 406196 "Process Control Descriptions."
 - 3. 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 PREINSTALLATION MEETINGS

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.” The meetings below are in addition to the meetings specified in that section.
- B. Refer to Section 406863 “Configuration of HMI Software” for requirements of the standards and conventions workshop.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONTROLLER PROGRAMS

- A. Develop 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.

END OF SECTION 406866

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 4071XX "Sections for flow measurement."
 - 3. Section 4072XX "Sections for level measurement."
 - 4. Section 4073XX "Sections for pressure measurement."

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. Section 4071XX "Sections for flow measurement": The XX in the number indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference.

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.

- 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.

- F. Submit index and data sheets in electronic format as well as hard copies on 8-1/2" x 11" formats. Submit electronic copies in Microsoft Excel or Word format on DVD disk or USB thumb drive.

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

END OF SECTION 40700

SECTION 407000 APPENDIX-A: FIELD INSTRUMENT SCHEDULE

Drawing No.	Loop No.	Type	Range	Units	Location & Description	Provided by	Spec.	Installation Detail (I drawing unless otherwise stated)
I-3	PSH-1030	High Pressure Switch	Initially set at 28.5	FT	Waste Storage Tank High Level Switch	40	407336	A
I-3	PSL-1030	Low Pressure Switch	Initially set at 3.5	FT	Waste Storage Tank Low Level Switch	40	407336	A
I-3	PIT-1030	Pressure Transmitter	0-29.5	FT	Waste Storage Tank Level Monitoring	40	407326	A
I-3	PI-1030	Pressure Gauge	0-29.5	FT	Waste Storage Tank Level	40	407313	A
I-3	FE/FIT-1032	Magnetic Flow Meter	0-300	GPM	Waste Handling Storage Tank Discharge Flow	40	407113	B
I-3	FE/FIT-1040	Magnetic Flow Meter	0-500	GPM	Filtrate Sump Pump Flow	40	407113	B
I-4	FE/FIT-1050	Magnetic Flow Meter	PCSS to Field Verify	GPM	Returned Activated Sludge (RAS) Flow Control – Line 1	40	407113	B
I-4	FE/FIT-1051	Magnetic Flow Meter	PCSS to Field Verify	GPM	Returned Activated Sludge (RAS) Flow Control – Line 2	40	407113	B

SECTION 407113 - MAGNETIC FLOW METERS

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 magnetic flow meters.
- B. Related Requirements:
 - 1. Section 260503 "Equipment Wiring Connections."
 - 2. Section 406100 "Process Control and Enterprise Management Systems General Provisions."
 - 3. Section 407000 "Instrumentation for Process Systems."

1.3 DEFINITIONS

- A. Not used.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Refer to Section 407000 "Instrumentation for Process Systems."
- B. Shop Drawings:
 - 1. 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. None Required

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 System General Provisions.”

1.11 WARRANTY

- A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Furnish sensors, field preamplifiers, signal conditioners, offset and span adjustments, amplifiers, transducers, transmitters, control devices, interconnecting cables, and unit conversions and algorithms as required for application.

2.2 MAGNETIC FLOW METERS

- A. Manufacturers:
 - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
 - a. ABB Instrumentation
 - b. Endress+Hauser
 - c. Foxboro
 - d. Krohne
 - e. Rosemount

- f. Siemens
- g. Substitutions: Or equal.

B. General:

- 1. Low-frequency, electromagnetic induction-type flow meter, producing a linear signal directly proportional to flow rate, consisting of flow tube, signal cable, and transmitter.

C. Type:

- 1. Between-flange mounting.
- 2. Comply with AWWA M33.

D. Performance and Design Criteria:

- 1. Process Fluid: Wastewater
- 2. Flow Rate Range: 0 to 300 GPM.
- 3. Accuracy: Plus or minus 0.5 percent of actual flow rate over a 30:1 range, within velocity limits of 0.1 to 10 ft/secSize: As shown on Drawings and instrument schedule in Section 407000.
- 5. Flow Tubes:
 - a. Body Material: Carbon Steel
- 6. Liner: Hard Rubber
- 7. Flanges: ANSI 150lb or DIN PN 16
- 8. Flange Material: Carbon steel.
- 9. Environment: For meters with remote mounted transmitters, meters below grade to be suitable for submergence for up to 48 hours to a depth of 30 feet. Meters above grade to be NEMA 4X (IP65).

E. Electrodes:

- 1. Type 316L stainless steel.
- 2. Bullet-nose, self-cleaning.

F. Accessories:

- 1. Rated for hazardous area, where applicable.
- 2. Provide automatic, nonmechanical electrode cleaning system without taking meter out of service.
- 3. Provide manufacturer cable between transmitter and receiver.
- 4. Furnish stainless-steel grounding rings, wires, and gaskets as recommended by the manufacturer. All materials must be suitable for the process and surrounding pipe.

2.3 TRANSMITTERS

A. Manufacturer: Same manufacturer as meter.

B. Transmitter Output:

1. 4- to 20-mA DC analog signal.
- C. Housing: NEMA 4X (IP65), suitable for surface or pipe stand mounting.
- D. Display:
1. Touch-screen programming, functioning through enclosure window without opening enclosure.
 2. Size: Four lines by 16 characters.
 3. Type: Backlit digital display.
 4. User-selectable engineering units.
 5. Readout of diagnostic error messages.
- E. Control Power:
1. 120VAC, single phase, 60 Hz.
 2. Wire in accordance with Section 260503 “Equipment Wiring Connections.”
 3. Provide local transformers as required.
- F. Mounting:
1. Mounting: Remote, up to 100 feet from flow meter.
 2. Remote Mounting Locations Less Than 4 feet above Grade: Provide stainless-steel mounting posts.
- G. Required Accessories:
1. A fully configurable and locally viewable totalizer integral to the transmitter.
 2. Current signal output simulation.
 3. Empty pipe detection.
 4. Self-diagnostics.
 5. Signal Cable: Provided by flow meter manufacturer.
 6. Automatic zero adjust.
 7. Provide bi-directional flow indication, and transmission by means of a relay output or a second analog output.
 8. For outdoor installations, provide sunshield of sturdy, corrosion- and UV-resistant material.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, roofs, and process area for suitable conditions where magnetic flow meters will be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method:
 - 1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures:
 - 1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

- A. Refer to Section 260526 "Grounding and Bonding for Electrical Systems."

3.4 IDENTIFICATION

- A. Refer to drawings for tagging designations

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Magnetic flow meters will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 MAINTENANCE SERVICE

- A. Not Required

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407113

SECTION 407276 - LEVEL 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 level switches.
- 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. Single Pole Double Throw (SPDT): A switch with one input and two output contacts.
- B. Double Pole Double Throw (DPDT): A switch with two inputs and two output contacts.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Refer to Section 407000 “Instrumentation for Process Systems.”
- B. Shop Drawings:
 - 1. 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. 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. Level Switches: Full-size units equal to 15 percent of quantity installed, but no fewer than 1 unit.

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 SELF-COUNTERWEIGHTED FLOAT LEVEL SWITCH

- A. Manufacturers:
 - 1. Manufacturers and their products are subject to compliance with requirements. Provide the following:
 - a. SJE Megamaster Control Switch.
 - b. Substitutions: Not Permitted.
- B. Type:
 - 1. Mercury free self-counterweighted floating switch.

C. Function/Performance:

- a. Differential: Less than 8-inch.
- b. Type of Switch: SPDT snap switch
- c. Switch Rating: 1A at 120 VAC (Maximum Load) and 1mA at 4 VDC (Minimum load).

D. Physical:

1. Float: Polypropylene body, which consists of a double airtight chamber with high-pressure melted polypropylene re-injection sealing to ensure a perfect seal against infiltration.
2. Totally encapsulated switch.
3. Cable shall be heavy-duty, PVC or equivalent jacketed integral to float.

E. Required Accessories:

1. Provide stainless steel hardware.
2. Lead wire to be a waterproof cable of sufficient length so that no splice or junction box is required in the vault.
3. Provide cast-aluminum weatherproof junction box outside the sump pit with terminals for all floats and tapped as required for conduit connections.
4. Provide mounting and support equipment as shown on the drawings and installation detail.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, roofs, and process area for suitable conditions where level switch will be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.

3.3 CONNECTIONS

- A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

- A. Refer to drawings for tagging designations.

3.5 FIELD QUALITY CONTROL

- A. Level switches will be considered defective if it does not pass tests and inspections.
- B. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 MAINTENANCE SERVICE

- A. Not Required

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407276

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.”
 - 3. Section 407363 “Diaphragm Seals.”

1.3 DEFINITIONS

- A. Not used.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Refer to Section 407000 “Instrumentation for Process Systems.”
- B. Shop Drawings:
 - 1. 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. None Required

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.
- 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: Provide scale in both PSI and FT. Match range of pressure transmitter.
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. Pressure Snubber:
 - a. Material: Type 316 stainless steel.
 - b. Provide isolation valve.
2. Shutoff Cocks: Furnished by gauge manufacturer.

3. Provide diaphragm seals as shown on the drawings.
4. Special scales: Engineer reserves the right to require special scales and/or calibration if the manufacturer's standard is not suitable for the application.
5. Liquid fill gauges at the factory.

2.2 SOURCE QUALITY CONTROL

- A. Section 014000 "Quality Requirements" for testing, inspection, and analysis.
- B. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, roofs, and process area for suitable conditions where pressure gauges will be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 IDENTIFICATION

- A. Tag Items in this specification as follows:
 1. PI-1030 – Waste Storage Tank Level

3.3 FIELD QUALITY CONTROL

- A. Pressure and differential pressure gauges will be considered defective if it does not pass tests and inspections.
- B. Prepare test and inspection reports.

3.4 STARTUP SERVICE

- A. Perform startup service.
 1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 MAINTENANCE SERVICE

- A. Not Required

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:

How to calibrate, install, troubleshoot, read the diagnostics, and maintain the sensor

END OF SECTION 407313

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SECTION 407326 - GAUGE-PRESSURE TRANSMITTERS

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 gauge-pressure transmitters.
- B. Related Requirements:
 - 1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
 - 2. Section 407000 “Instrumentation for Process Systems.”
 - 3. Section 407363 “Diaphragm Seals.”
 - 4. Section 407856 “Isolators, Intrinsically Safe Barriers, and Surge Suppressors.”

1.3 DEFINITIONS

- A. Not used.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Refer to Section 407000 “Instrumentation for Process Systems.”
- B. Shop Drawings:
 - 1. 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. None Required.

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 GAUGE PRESSURE TRANSMITTERS

- A. Manufacturers:
 - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
 - a. ABB 266HRH.
 - b. Foxboro IGP20.
 - c. Rosemount 3051CG.
 - d. Siemens Sitrans P DS III.
 - e. Smar LD301M.
 - f. Or equal
- A. Type:
 - 1. Microprocessor based, intelligent type.

B. Function/Performance:

1. Measuring Range: As shown in “Section 406196 – Process Control Descriptions.”
2. Accuracy: 0.075 percent of span.
3. Operating Temperature: -4 to 176 degrees F.
4. Temperature Effect: Combined temperature effects less than 0.2 percent of maximum span per 82 degrees F temperature change.
5. Output Signal: 4 to 20 mA DC linear with pressure, with HART protocol.
6. Output: Zero adjustable over the range of the instrument calibrated span is greater than the minimum calibrated span.
7. Stability: 0.05 percent of upper range limit for 1 year.
8. Response Time: Less than 1 ms.
9. Display: Digital indicator displaying pressure in the engineering units indicated on the Drawings or in the instrument device schedule.
10. Diagnostics:
 - a. Self-diagnostics with transmitter failure driving output to above or below out of range limits.
 - b. Simulation capability for inputs and loop outputs.
 - c. Test terminals available to ease connection for test equipment without opening the loop.
 - d. Registers to record minimum and maximum pressure and temperatures transmitter has been exposed to be available.
11. Over Range Protection: Provide positive over range protection to 150 percent of the maximum pressure of the system being monitored.

C. Physical:

1. Power Supply: 24 VDC loop power.
2. Enclosure:
 - a. NEMA 4X (IP66), explosion proof
 - b. Approved for Class I, Division 1, Groups C and D.
 - c. Instruments for hazardous locations have Factory Mutual (FM), Canadian Standards Association (CSA), and CENELEC approvals and certifications as specified herein and as indicated on the Drawings or in the instrument device schedule.
3. Process Wetted Parts (except for ozone/oxygen service):
 - a. Isolating diaphragm and other wetted metal parts: Type 316L stainless-steel.
 - b. Gaskets and O-rings: Teflon.
4. Sensor Fill Fluid (except for ozone/oxygen service): Silicone.

D. Required Accessories:

1. Two Valve Manifold: Provide Anderson-Greenwood or equivalent as shown on the installation detail drawing.
2. Provide diaphragm seals as shown on the drawings.

2.2 SOURCE QUALITY CONTROL

- A. Section 014000 “Quality Requirements” for testing, inspection, and analysis.
- B. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, roofs, and process area for suitable conditions where gauge pressure transmitter will be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer’s instructions for installation of each gauge-pressure transmitter.
- B. Comply with NECA 1.
- C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

- A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

- A. Refer to drawings for tagging designations
- B. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for component identification requirements.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections:

1. Test and inspect components, assemblies, and equipment installations, including connections.
 2. All tests and inspections required by the manufacturer to certify installation.
 3. All tests and inspections required by Section 406121.20 "Process Control System Testing."
- C. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- D. Gauge-pressure transmitters will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports in accordance with Section 406100 "Process Control and Enterprise Management General Provisions."
- F. Prepare evaluation reports in accordance with Section 406121.20 "Process Control System Testing."

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.

3.7 MAINTENANCE SERVICE

- A. Not Required

3.8 DEMONSTRATION

- A. Refer to Section 406126 "Process Control System Training" for specific instrument training requirements.

END OF SECTION 407326

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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."
 - 3. Section 407363 "Diaphragm Seals."
 - 4. Section 407326 "Gauge Pressure Transmitters."

1.3 DEFINITIONS

- A. Not used.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Refer to Section 407000 "Instrumentation for Process Systems."
- B. Shop Drawings:
 - 1. 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. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Pressure and Differential Pressure Gauges: Full-size units equal to 15 percent of quantity installed for each size indicated, but no fewer than 1 units.

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 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. Substitutions: 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 Section “406196 – Process Control Descriptions.”
 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.
 2. Provide diaphragm seals as shown on the Drawings.
 3. Where indicated on the drawings, provide Type 316 stainless-steel pressure snubber for pulsation dampening.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, roofs, and process area for suitable conditions where pressure and differential pressure switches will be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.

3.3 CONNECTIONS

- A. Refer to Section 260526 "Grounding and Bonding for Electrical Systems."

3.4 IDENTIFICATION

- A. Refer to drawings for tagging designations

3.5 FIELD QUALITY CONTROL

- A. Pressure and differential pressure switches will be considered defective if it does not pass tests and inspections.
- B. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 MAINTENANCE SERVICE

- A. Not Required

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407336

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SECTION 407363 - DIAPHRAGM SEALS

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 diaphragm seals.
- B. Related Requirements:
 - 1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
 - 2. Section 407000 “Instrumentation for Process Systems.”
 - 3. Section 4073XX “Sections for pressure, strain, and force measurement.”

1.3 DEFINITIONS

- A. Section 4073XX “Sections for pressure, strain, and force measurement”: The XX in the number indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Refer to Section 407000 “Instrumentation for Process Systems.”
- B. Shop Drawings:
 - 1. 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. None Required.

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 DIAPHRAGM SEALS – THREADED

- A. Manufacturers:
 - 1. Manufacturers and their products are subject to compliance with requirements. Provide the following:
 - a. Rosemount
 - b. Ashcroft
 - c. Ronnigen-Petter Company
 - d. Siemens

- e. Substitutions: Or equal.
- B. Type:
 - 1. Threaded, mounted directly to pressure gauge assembly.
 - 2. Provide flexible, stainless-steel-armored capillary.
- C. Physical:
 - 1. Wetted Parts and Bolt Materials: Corrosion resistant to process fluid.
 - 2. Provide fill/bleed screw for filling of diaphragm seal.
 - 3. Instrument Connection: NPT, 1/4 inch.
 - 4. Process Connection: NPT, 1/2 inch.
 - 5. Flushing Connection: NPT, 1/4 inch.
 - 6. Working Pressure Rating: Pipeline working pressure.
 - 7. Calibration: Provide cleanout ring to be removed for recalibration or cleaning, without loss of filling liquid or change in calibration.
 - 8. Factory-assemble, fill, and calibrate entire assembly, including gauges, switches and transmitter, prior to shipment. Field filling is not acceptable.
- D. Provide manufacturer's assembly drawing of complete configuration as part of instrumentation submittal specified in Section 406100.
- E. Provide shop inspection and testing of completed assembly and submit results as part of testing documentation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, roofs, and process area for suitable conditions where diaphragm seal will be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Diaphragm seals will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.4 MAINTENANCE SERVICE

A. Not Required

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407363

SECTION 407816 - INDICATING LIGHTS

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 indicating lights.
- B. Related Requirements:
 - 1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
 - 2. Section 406717 “Industrial Enclosures.”
 - 3. Section 407000 “Instrumentation for Process Systems.”

1.3 DEFINITIONS

- A. Not used.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Refer to Section 407000 “Instrumentation for Process Systems.”
- B. Shop Drawings:
 - 1. 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. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Indicating Lights: Full-size units of each color light provided per panel including 10 spare light bulbs per panel.

1.8 QUALITY ASSURANCE

- A. Provide components compatible with functions required to form complete working system.

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 PILOT TYPE INDICATING LIGHTS

- A. Manufacturers:
 - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
 - a. Allen Bradley.
 - b. Eaton Cutler-Hammer
 - c. General Electric.
 - d. Square D.
 - e. Substitutions:
 - f. Or equal
- B. Type:
 - 1. Energy efficient, Solid-State LED Lamps.

C. Function/Performance:

1. Low voltage LED lamps suitable for the voltage supplied.
2. Integral reduced voltage transformers for 120VAC powered lights.
3. Replaceable lamps from the front of the unit.
4. Push-to-test operator type.

D. Physical:

1. NEMA 4X
2. Lens caps: 1.18-inch (30 mm) diameter.
3. Lens color:
 - a. Running, on, open - Red.
 - b. Stopped, off, closed - Green.
 - c. Alarm - Amber.
 - d. White - Power on.
 - e. Blue - All other status indications not covered by the above.
4. Provide legend faceplates engraved to indicate the required function of each device.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, roofs, and process area for suitable conditions where indicating lights will be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with for installation of manufacturer.
- B. Comply with NECA 1.
- C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

- A. Refer to Section 260526 "Grounding and Bonding for Electrical Systems."

3.4 IDENTIFICATION

- A. Refer to drawings for tagging designations

3.5 FIELD QUALITY CONTROL

- A. Indicating lights will be considered defective if they do not pass tests and inspections.
- B. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Perform start-up service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 MAINTENANCE SERVICE

- A. Not Required

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407816

SECTION 407819 - SWITCHES AND PUSH BUTTONS

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 switches and push buttons.
- B. Related Requirements:
 - 1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
 - 2. Section 406717 “Industrial Enclosures.”
 - 3. Section 407000 “Instrumentation for Process Systems.”

1.3 DEFINITIONS

- A. Not used.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Refer to Section 407000 “Instrumentation for Process Systems.”
- B. Shop Drawings:
 - 1. 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. 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. Switches and Push Buttons: Full-size units equal to 1 of each type installed for each panel provided.

1.8 QUALITY ASSURANCE

- A. Provide components compatible with functions required to form complete working system.

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 SELECTOR SWITCHES AND PUSHBUTTONS

- A. Manufacturers:
 - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
 - a. Allen Bradley.
 - b. Crouse Hinds (NEMA 7).
 - c. Cutler-Hammer.
 - d. General Electric.
 - e. Square D.
 - f. Substitutions: Or equal
- B. Type:
 - 1. Heavy-duty oil tight type with stackable contact blocks.

C. Function/Performance:

1. Contact arrangement and switching action as required for the control system specified.
2. For 120VAC service, provide contacts rated 10A at 120VAC. For 24VDC service, provide silver sliding contacts rated 5A at 125VDC. For electronic (millivolt/milliamp) switching, provide contacts rated 1A at 28VDC.
3. Colors to match same functionality of pilot lights in “Section 407816 – Indicating Lights”

D. Physical:

1. NEMA 4X.
2. Size: 1.18-inch (30 mm) diameter.
3. Pushbuttons: Flush type operators.
4. Selector switches: Knob or wing lever operators.
5. Provide legend plates denoting switch/pushbutton position and/or function.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, roofs, and process area for suitable conditions where switches and push buttons will be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with for installation of manufacturer.
- B. Comply with NECA 1.
- C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

- A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

- A. Refer to I drawings for tagging designations.

3.5 FIELD QUALITY CONTROL

- A. Switches and push buttons will be considered defective if they do not pass tests and inspections.
- B. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 MAINTENANCE SERVICE

- A. Not Required

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407819

SECTION 407853 - RELAYS

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 relays.
- B. Related Requirements:
 - 1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
 - 2. Section 406717 “Industrial Enclosures.”

1.3 DEFINITIONS

- A. Not used.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Refer to Section 407000 “Instrumentation for Process Systems.”
- B. Shop Drawings:
 - 1. 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. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Relays: Full-size units that include sockets. Two of each type provided for each control panel.

1.8 QUALITY ASSURANCE

- A. Provide components compatible with functions required to form complete working system.

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 GENERAL PURPOSE RELAYS AND TIME DELAYS

- A. Manufacturers:
 - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
 - a. Allen Bradley.
 - b. IDEC
 - c. Omron
 - d. Schneider Electric.
 - e. Substitutions: Or equal Edit the following descriptive specifications to identify Project requirements and to eliminate conflicts with manufacturers specified above.

- B. Type:
 - 1. General purpose plug-in type.
- C. Function/Performance:
 - 1. Provide all relays with number of poles required to meet the design intent.
 - 2. Mechanical life expectancy to be in excess of 10 million.
 - 3. Provide solid state time delays with polarity protection (DC units) and transient protection.
 - 4. Time delay units in ranges from .1 second to 4.5 hours.
- D. Physical:
 - 1. Mounting: DIN rail.
 - 2. Integral indicating light to indicate if relay is energized.
 - 3. For 120 VAC service, provide contacts rated 10A at 120VAC. For 24 VDC service, provide contacts rated 5A at 28VDC. For electronic (milliamp/millivolt) switching applicator, provide gold plated contacts rated for electronic service.
 - 4. Dust and moisture resistant covers.
- E. Required Accessories:
 - 1. Provide DIN rail mounted relay socket for each relay, rated 10A at 300VAC.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, roofs, and process area for suitable conditions where relays will be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.

3.3 CONNECTIONS

- A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

- A. Tag items in this specification as follows:
 - 1. CR-X (X= #, sequential)

3.5 FIELD QUALITY CONTROL

- A. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- 1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 MAINTENANCE SERVICE

- A. Not Required.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407853

SECTION 407856 - ISOLATORS, INTRINSICALLY SAFE BARRIERS, AND SURGE SUPPRESSORS

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 isolators, intrinsically safe barriers, and surge suppressors.
- B. Related Requirements:
 - 1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
 - 2. Section 406717 “Industrial Enclosures.”
 - 3. Section 407000 “Instrumentation for Process Systems.”
 - 4. Section 4072XX “Sections for level measurement.”

1.3 DEFINITIONS

- A. Section 4072XX “Sections for level measurement”: The XX in the number indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Refer to Section 407000 “Instrumentation for Process Systems.”
- B. Shop Drawings:
 - 1. Refer to Section 407000 “Instrumentation for Process Systems.”
 - 2. Clearly indicate which instruments will have surge protection and either separate enclosures or conduit mounts. Provide listings and/or tables indicating location for both building and field devices.

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. 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. Isolators, Intrinsicly Safe Barriers, and Surge Suppressors: 1 unit of each type provided.
 - 2. Surge Protection Devices: 2 units of each type provided.

1.8 QUALITY ASSURANCE

- A. Provide components compatible with functions required to form complete working system.

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 SIGNAL ISOLATORS/BOOSTERS/CONVERTERS

- A. Manufacturers:
 - 1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

- a. Acromag.
- b. Action Instruments Slim Pak.
- c. Substitutions: Or equal.

B. Type:

1. Solid state, ASIC technology; electronic type.

C. Function/Performance:

1. Accuracy: 0.15 percent.
2. Inputs: Current, voltage, frequency, temperature, or resistance as required.
3. Outputs: Current or voltage as required.
4. Isolation: Complete isolation between input circuitry, output circuitry, and the power supply.
5. Adjustments: Zero and span adjustment.
6. Protection: Provide RFI protection.

D. Physical:

1. Mounting: DIN Rail.

2.2 INTRINSIC SAFETY BARRIERS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
 - a. Gems – 54800 (4-20mA) and 65800 (dry contacts).
 - b. R. Stahl - Intrinspak
 - c. Siemens Water Technologies – IS1 (4-20mA) and IS6 (dry contacts).
 - d. Substitutions: Or equal

B. Type:

1. Solid state electronic type in which the energy level of the sensing or actuation circuit is low enough to allow safe usage in hazardous areas.

C. Function/Performance:

1. Provide a barrier for instrumentation and equipment transmitting analog or digital signals that originate in a hazardous area as indicated in the design documents.
2. Locate in non-hazardous areas.
3. Match power supply provided.

D. Physical:

1. Mounting: DIN Rail.

2.3 INTRINSIC SAFETY BARRIERS (FOR 2-WIRE TRANSMITTER SYSTEMS)

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. [Provide one of the following:
 - a. Gems.
 - b. P&F.
 - c. Unitech.
 - d. Substitutions: Or equal

B. Type:

1. Passive devices requiring no external voltage supply.

C. Function/Performance:

1. Supplied with series resistors, series fuse and shunt zener diodes to limit the transfer of energy to levels required by intrinsically safe protection between safe and hazardous locations.
2. Factory Mutual approved and certified for use in accordance with National Fire Protection Association (NFPA 493).

D. Physical:

1. Mounting: DIN Rail.

2.4 SURGE PROTECTION FOR CONTROL SYSTEMS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:
 - a. Citel
 - b. MTL Surge Technologies
 - c. Phoenix Contact
 - d. Transtector
 - e. Substitutions: Or equal

B. Function/Performance:

1. Provides surge protection of electronic instrumentation from induced surges propagated along the signal and power supply lines from lightning, utility, or the plant electrical systems.
2. Protection system lower than the instrument withstand level, while not interfering with normal operation.
3. Maintenance free and self-restoring.
4. Response time: Within nanoseconds.

C. Required Surge Protection:

1. Control Panel Power Feed (120VAC)
 - a. Provide protection of 120VAC power feed into control panels, server racks, network racks, and communication enclosures.
 - b. Nominal Discharge surge current: 20kA (at an 8x20µs impulse waveform) when nominal Current is 20A and accepts 12-24 AWG wire connection
 - c. Provide surge protector from one of the following:
 - 1) Citel DS40 series
 - 2) MCG Surge Protection PT Series (for Control Panels)/ 400 series (For Equipment)
 - 3) Phoenix Contact "PLT/PT" or VAL-US series
 - 4) Transtector AC SPD I2R Series
 - 5) Substitutions: Or equal.
2. 4-Wire Field Instrument Power:
 - a. Provide surge protection at the field device to protect 120 VAC power and 24 VDC power to analog instrument.
 - b. Mount transmitter surge protectors in separate NEMA 4X enclosure for field installations.
 - c. Nominal Discharge surge current: 2.5kA (at an 8x20µs impulse waveform).
 - d. Provide Field Mounted (at instrument) surge protector from one of the following:
 - 1) Phoenix Contact BoxTrab BXT-N4X Series
 - 2) MTL Surge Technologies SDyyX series
 - 3) Substitutions: Or equal.
3. Analog Signal (4-20mA) Circuits:
 - a. Provide surge protection where any part of the circuit is outside of the building envelope.
 - b. Mount transmitter surge protectors in separate NEMA 4X enclosure or conduit mount for field installations.
 - c. Protect circuits at both the transmitter side and the PLC panel side of the circuit.
 - d. Nominal Discharge surge current: 10kA (at an 8x20µs impulse waveform). Provide Field Mounted (at instrument) surge protector from one of the following:
 - 1) Phoenix Contact SurgeTrab S-PT Series
 - 2) MTL Surge Technologies TP48
 - 3) Citel TSP M series.
 - 4) Substitutions: Or equal.
 - e. Provide panel mounted surge protector for Field Mounted Instruments from one of the following:
 - 1) Phoenix Contact TermiTrab TTC Series
 - 2) MTL Surge Technologies SD series
 - 3) Citel DLA series. DLC series

- 4) Substitutions: Or equal.
4. Discrete Inputs:
 - a. Provide surge protection where any part of the circuit is outside of the building envelope.
 - b. Provide surge protection at the PLC panel for discrete signal connections.
 - c. Nominal Discharge Current (24 VDC circuit): 5kA (at an 8x20µs impulse waveform)
 - d. Nominal Discharge Current (120 VAC circuit): 2.5kA (at an 8x20µs impulse waveform)
 - e. Provide surge protector from one of the following:
 - 1) Phoenix Contact TermiTrab TTC Series or PT series
 - 2) MTL Surge Technologies SD series
 - 3) Citel DLA series. DLC series
 - 4) Substitutions: Or equal.
 5. Inductive Loads:
 - a. Provide coil surge suppression devices, such as varistors or interposing relays, on all process controller outputs or switches rated 120VAC or less that drive solenoid, coil, or motor loads.
 - b. Nominal Discharge surge current: 20kA (at an 8x20µs impulse waveform)
 - c. Provide surge protector from one of the following:
 - 1) Citel DS240S series
 - 2) Phoenix Contact PT series
 - 3) Substitutions: Or equal
 6. Non-Fiber Based Data Highway or Communications Circuits:
 - a. Provide protection on all communication and data highway circuits that leave a building or are routed external to a building.
 - b. Provide circuit protection at both ends of the line.
 - c. Nominal Discharge surge current: 2kA (at an 8x20µs impulse waveform)
 - d. Provide surge protector from one of the following based on specific application:
 - 1) Phoenix Contact DATA Trab or PlugTrab PT Series,
 - 2) Transtector FSP Series, CPX series
 - 3) MTL Surge Technologies ZoneBarrier NC Series,
 - 4) Citel DLA series, MSP Series
 - 5) Substitutions: Or equal.
 7. Ethernet Connection:
 - a. Provide protection on all communication and data highway circuits that leave a building or are routed external to a building.
 - b. Mount surge protectors in enclosures for field installations.
 - c. Provide circuit protection at both ends of the line.
 - d. Nominal Discharge surge current: 2kA (at an 8x20µs impulse waveform)

- e. Provide surge protector from one of the following based on specific application:
 - 1) Phoenix Contact DATA Trab Series,
 - 2) Transtector FSP Series, CPX series
 - 3) MTL Surge Technologies ZoneBarrier NC Series,
 - 4) Citel DLA series, MJ8 Series
 - 5) Substitutions: Or equal

8. Serial Connection (RS-485/RS-232):
 - a. Provide surge protection on RS-485 connection. Connection method to device by 9-position D-SUB connector
 - b. Mount surge protectors in separate NEMA 4X enclosure for field installations.
 - c. Provide circuit protection at both ends of the line.
 - d. Nominal Discharge surge current: 5kA (at an 8x20 μ s impulse waveform)
 - e. Provide surge protector from one of the following based on specific application:
 - 1) Phoenix Contact DATA Trab Series, DT-UFB-485/BS
 - 2) Transtector FSP Series,
 - 3) MTL Surge Technologies Zone Barrier Series,
 - 4) Citel Data Line, DD series
 - 5) Substitutions: Or equal

9. RF Coaxial Cable:
 - a. Provide protection on communication cables between radios and antennas, mounted either inside the panel, or in the wall of the enclosure.
 - b. Protected in accordance with NEMA and UL 497E standards.
 - c. Nominal Discharge surge current: 5kA (at an 8x20 μ s impulse waveform)
 - d. Provide surge protector from one of the following:
 - 1) Citel P8AX series
 - 2) Polyphaser GT Series
 - 3) Phoenix Contact Coax Trab series
 - 4) Substitutions: Or equal.

10. Telephone Circuits:
 - a. Provide Telephone Company approved line protection units for all telephone lines used for telemetry or SCADA system use under this Contract.
 - b. Nominal Discharge surge current: 10kA (at an 8x20 μ s impulse waveform)
 - c. Provide surge protector from one of the following:
 - 1) Citel MJ8-Telecom or DLA series
 - 2) Phoenix Contact Data Trab Series or PT-IQ Series
 - 3) Substitutions: Or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls, floors, roofs, and rooms for suitable conditions where products will be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.

3.3 CONNECTIONS

- A. Refer to Section 260526 "Grounding and Bonding for Electrical Systems."

3.4 IDENTIFICATION

- A. Tag items in this specification as follows:
 - 1. Incorporate loop numbering scheme shown on the drawings.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Isolators, intrinsically safe barriers and surge suppressors will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 MAINTENANCE SERVICE

- A. Not Required.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407856

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SECTION 408000 - COMMISSIONING OF PROCESS SYSTEMS

PART 1 - PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes Requirements for each Commissioning Phase of the Project. Additional requirements are included in individual specification Sections.
- B. Discharge location of test water shall be to storm ponds, storm sewer, or sanitary sewer and shall be in compliance with applicable permits, approvals, and regulations.

1.2 DEFINITIONS

- A. Clean Water Facility Testing - Testing of complete facility utilizing clean non-potable water for purposes of confirming extended equipment/system operation prior to Process Start-up Phase. Includes verification of inter-system monitoring, interlocks and alarms in SCADA.
- B. Commissioning (“Cx”) - The process of planning, testing, and process start-up of the installation for establishing compliance with Contract requirements and demonstrating through documented verification that the project has successfully met those contractual requirements. It includes training the Owner’s personnel to operate the facility.
- C. Commissioning Phases - The Work activities of facility commissioning are grouped into the phases defined in the table below.

<u>Commissioning (Cx)</u>		
<u>Planning Phase</u>	<u>Testing and Training Phase</u>	<u>Process Start-Up Phase</u>
Owner Training Plan and Schedule	Source Testing	Process Start-up
Commissioning Schedule	Owner Training	Process Start-Up Phase
Subsystem Testing Plan	Installation Testing	Instrumentation and Controls Fine-Tuning
Facility Testing Plan	Functional Testing	
Commissioning and Process Startup Plan	Facility Testing	
	Closeout Documentation	

- D. Component - A basic building block of equipment, subsystems, and systems that requires installation or functional testing but does not have electrical connection or internal electronics. (Examples: filter effluent piping and manual isolation valves).

- E. Device - A basic building block of equipment, subsystems, and systems that requires installation or functional testing and does have electrical connection or internal electronics. (Examples: filter level transmitter or water pump pressure transmitter).
- F. DDC – Direct Digital Controls.
- G. Equipment - An assembly of component(s) and devices(s) that requires installation or functional testing. (Examples: Pump, motor, VFD, , etc.).
- H. Facility - A grouping of process areas, systems, subsystems, equipment, components, and devices (Examples: treatment plant, pump station, etc.).
- I. Functional Testing - Testing performed on a completed subsystem to demonstrate that equipment/system meets manufacturers’ calibration and adjustment requirements and other requirements as specified. Functional testing includes operating equipment/system manually in local, manually in remote (or remote manual), and automatically in remote (in remote auto). Includes verification of intra-system hard-wired and software interlocks as much as possible.
- J. Installation Testing - Testing to demonstrate that subsystem component or device (piping, power, networks, devices, etc.) is ready and meets the Project requirements in advance of functional testing. Installation testing also includes Manufacturers’ Certification of Installation and other requirements as specified to prepare equipment/system for Functional Testing. Includes verification of SCADA registration of status signals, ranges, and alarms, as well as interlocks for all wired components and vendor-supplied panels, as much as possible. Also referred to as Field Acceptance Testing.
- K. Instrumentation and Controls Fine-Tuning – Completion of SCADA integration Punch List activities and HMI screen development for plant-wide systems.
- L. *Manufacturer’s Certificate of Source Testing* - When applicable, the form is used during Source Testing for the manufacturer to confirm that the applicable source tests have been performed and results conform to the Contract Documents. The form is provided at the end of this Section.
- M. *Manufacturer’s Certificate of Installation and Functionality Compliance* - A form that is used during Installation Testing and Functional Testing. It is submitted by the end of Functional Testing to confirm that the equipment/system is installed in conformance with the Contract Documents and that it meets the Functional Testing requirements defined in the Contract Documents. A blank template of this form is provided at the end of this Section.
- N. Process Area - A grouping of systems, subsystems, equipment, components, and devices that divide a facility into functional areas. (Examples: Filter Process Area or Chemical Area).
- O. Process Start-up Phase - Operating the facility to verify performance meets the Contract Document requirements.
- P. Process Start-Up – Activities conducted after Clean Water Facility Testing and training of Owner’s personnel are complete, which are necessary to fully place systems or process

areas into operational service using the intended process fluid. Includes performance testing for those systems (or subsystems) which require specific process fluids or other conditions that cannot otherwise be practically provided during earlier commissioning phases. Includes plant-wide SCADA integration activities. Results of these activities aim to demonstrate that each system and the plant holistically performs to meet the Contract Document requirements in all operating modes.

- Q. Product - A system, subsystem or component.
- R. Source Testing – Testing at the manufacturing facility or site of assembly. Also called “Factory Testing” or “FAT”. Completion is documented using the *Manufacturer’s Certificate of Source Testing* form.
- S. Substantial Completion – Definition as per the General Conditions.
- T. Subsystem - A building block of systems made up from a grouping of components, devices, and equipment that perform a definable function. (Examples: Main Pump Station Pump No. 1 Subsystem, Standby Power Fuel Storage and Conditioning Subsystem).
- U. System - A grouping of subsystems, equipment, components, and devices that perform a definable function. (Examples: Waste holding tank, waste transfer pump, Standby Power System).
- V. TAB – Testing, adjusting, and balancing. Typically used when referring to commissioning of HVAC systems.

1.3 SUBMITTALS

- A. Qualifications:
 - 1. Summary of the Commissioning Coordinator’s (CC’s) qualifications.
 - 2. Qualifications of manufacturer’s representatives.
 - 3. Qualifications of the BAS and HVAC Testing technician(s).
- B. Schedules:
 - 1. Owner Training Plan Schedule.
 - 2. Commissioning Schedule.
- C. Certificates:
 - 1. Manufacturer’s Certificate of Source Testing.
 - 2. Manufacturer’s Certificate of Installation and Functionality Compliance.
- D. Reports:
 - 1. Test reports.

E. Plans:

1. Owner Training Plan.
2. Source Test Plan.
3. Installation Testing Plan.
4. Functional Testing Plan.
 - a. Subsystem Testing Plans.
 - b. System-Wide Testing Plans
5. Clean Water Facility Testing Plan.
6. Commissioning and Process Start-Up Plans.
 - a. Process start-up.
 - b. Instrumentation and Controls Fine-Tuning
7. Commissioning and Startup Plan.

F. Documentation:

1. Preliminary documentation.
2. Final documentation.
3. Closeout documentation.

1.4 COMMISSIONING COORDINATOR (CC)

A. Designate and provide a CC for the Project.

1. Submit summary of the CC's qualifications within 30 days of NTP:
 - a. Include description of previous experience in same role on similar projects for the specifically proposed staff.
 - b. Provide a list of references including contact names, phone numbers and email addresses.
2. Experience requirements:
 - a. The CC shall have minimum of 10 years of experience in start-up and operation of similar wastewater treatment processes.
 - 1) Experience shall include work with systems with average day flows in excess of 5 mgd.
 - 2) Experience shall span all aspects of commissioning of water pumping and treatment facilities, equipment/systems of similar size and type of process.

B. CC responsibilities include the following:

1. Lead efforts relating to Commissioning.
2. Be thoroughly familiar with all commissioning requirements in the Contract Documents.

3. Be regularly engaged and experienced in all aspects of commissioning.
 4. Provide technical instruction for commissioning.
 5. Direct the actual facility operation during the Testing and Training Phase and Process Start-Up Phase.
 6. Provide primary interface with Engineer of Record and Owner's Representative for efforts relating to Commissioning of Project.
 7. Coordinate training efforts.
 8. Strive to deliver a well-coordinated, logically sequenced, timely, and complete set of commissioning activities consistent with the requirements of the Contract Documents.
- C. CC on-site:
1. 30-days prior to first day of Functional Testing: Full-time
 2. Throughout Functional Testing and Process Start-Up Phases: Full-time
- D. Meetings:
1. CC is responsible for setting commissioning coordination meeting dates and times, as well as preparing the agendas and meeting minutes.
 2. CC shall meet with Engineer of Record and Owner's Representative to develop list of personnel to be trained and to establish expected training outcomes and objectives at least 60 calendar days prior to Functional Testing of each subsystem.
 3. CC shall conduct commissioning progress meetings throughout construction, to plan, scope, coordinate, and schedule future activities, resolve problems, etc.
 - a. Frequency: Monthly minimum. Increase frequency as needed based on complexity and quantity of commissioning activities.

1.5 SERVICES OF MANUFACTURER'S REPRESENTATIVES

- A. Qualification of manufacturer's representative as specified in the Contract Documents Sections including the following:
1. Authorized representative of the manufacturer, factory trained and experienced in the technical applications, installation, operation, and maintenance of respective equipment/system with full authority by the equipment/system manufacturer to issue the certifications required of the manufacturer.
 2. Competent, experienced technical representative of equipment/system manufacturer for assembly, installation, testing guidance, and training.
 3. Refer to Section 01 43 33 – Manufacturers' Field Services and the individual technical specification Sections where additional qualifications may be specified.
 4. Submit qualifications of the manufacturer's representative no later than 30 days in advance of required Site activities.
 5. Representative subject to approval by Owner's Representative.
 6. No substitute representatives will be allowed until written approval by Owner's Representative has been obtained.
- B. Completion of manufacturer on-site services: Owner's Representative approval required.

- C. Manufacturer is responsible for determining the time required to perform the specified services.
 - 1. Minimum times specified in the Contract Documents are estimates.
 - 2. No additional costs associated with performing the required services will be approved.
 - 3. Manufacturer required to schedule services in accordance with the Contractor's Project schedule, up to and including making multiple trips to Site when there are separate milestones associated with installation of each occurrence of manufacturer's equipment.

- D. Manufacturer's on-site services as specified in the Contract Documents include the following:
 - 1. Assistance during Testing and Training Phase and Process Start-Up Phase.
 - 2. Provide daily copies of manufacturer's representatives field notes and data to Owner's Representative.
 - 3. Other requirements as specified in the Contract Documents.

1.6 PLANNING PHASE

- A. General:
 - 1. Define approach and timing for Commissioning activities by phase.
 - 2. Contractor shall update and submit to the Owner's Representative the Commissioning and Startup Plan developed during the Design phase of the Project every 6 months to incorporate information discussed at commissioning meetings and the information summarized in the next paragraph.
 - 3. Specific commissioning activities for Source Testing, Installation Testing, Functional Testing, Clean Water Facility Testing, Process Start-Up, and Instrumentation and Controls Fine-Tuning phases are identified in individual Specifications and on Drawings. Refer to the following when developing individual and integrated test plan submittals:
 - a. Section 011000 – Summary.
 - b. Structural Drawings includes notes listing non-destructive testing requirements.
 - c. Section 099600 - High-Performance Coatings for coating testing of sample areas.
 - d. Section 400531 – Thermoplastic Process Pipe
 - e. Section 400551 – Common Requirements for Process Valves
 - f. Individual equipment sections in Divisions 43 and 46 for process mechanical equipment testing requirements.
 - g. Div 40, 43, and 46 technical Sections for testing requirements of instrumentation and SCADA integration.
 - h. Refer to summary list of major mechanical systems and subsystems in Table 01 75 17-1.07A

i.

Table 01 75 17-1.07A Summary List of Major Mechanical Systems and Subsystems

PRIMARY SYSTEM	SUBSYSTEMS	MAJOR MECHANICAL EQUIPMENT (note 1)
Main Pump Station	Dry Well	Dry Pit Submersible Pumps
		Flow Meters
		Valves
		Sump Pump
Filtrate Pump Station	Wet Well	Wet Pit Submersible Pump
		Level Sensors
Waste Handling Tank	Pressure Level/Indicator Vault	Flow Meter
		Pinch Control Valve
		Sump Pump
	Storage Tank	Mixer
	Waste Transfer Station	Waste Transfer Pump
Valves		
Digester No. 2 Control Building	Basement	Valves

TABLE NOTES

1. List offers guidance but is not all-inclusive. Contractor shall identify all components to include in testing of a given system or subsystem in Test Plan Submittal.

B.
B.

B. Owner training plan and schedule:

1. Training outcomes:

a. Owner's operations, maintenance, and engineering staff (Owner's personnel) have the information needed to safely operate, maintain, and repair the equipment/systems provided in the Contract Documents.

2. Training objectives:

- a. To instruct personnel in the operation and maintenance of the equipment/system. Instruction shall include step-by-step troubleshooting procedures with all necessary test equipment/system.
 - b. To instruct personnel in the removal, inspection, and cleaning of equipment/system as needed.
 - c. Training tailored to the skills and job classifications of the staff attending the classes (e.g., plant superintendent, treatment plant operator, maintenance technician, electrician, etc.). Owner's Representative to provide list of staff to train to Contractor 60 days prior to training so Contractor can plan accordingly.
 - d. Provide supporting documentation, such as vendor operation and maintenance manuals.
3. Training schedule:
- a. Schedule Owner's personnel training within the constraints of their workloads through the Owner's Representative. Those who will participate in this training have existing full-time work assignments, and training is an additional assigned task, therefore, scheduling is imperative.
4. Training plan:
- a. Coordinate and arrange for manufacturer's representatives to provide both classroom-based learning and field (hands-on) training, based on training module content and stated learning objectives.
 - b. Conduct classroom training at location designated by Owner's Representative.
 - c. Scope and sequence:
 - 1) Plan and schedule training in the correct sequence to provide prerequisite knowledge and skills to trainees.
 - a) Describe recommended procedures to check/test equipment/system following a corrective maintenance repair.
5. Training scheduling coordination:
- a. CC is responsible for the following:
 - 1) Coordinate schedule for training periods with the Owner's personnel and manufacturer's representatives (instructors).
 - b. Complete Owner training no sooner than 120 calendar days prior to start-up of each system. Contractor shall plan to train during Installation or Functional Testing when manufacturer's representatives are typically onsite, to the maximum extent practical.
6. Submittals:
- a. Submit Training Plan Schedule 90 calendar days before the first scheduled training session, including but not limited to lesson plans, participant materials, instructor's resumes, and training delivery schedules.

- b. Submit training documentation including the following:
 - 1) Training plan:
 - a) Training modules.
 - b) Scope and sequence statement.
 - c) Contact information for manufacturer's instructors including name, phone, and e-mail address.
 - d) Instructor qualifications.
 - 2) Training program schedule:
 - a) Format: Bar chart:
 - (1) Include in the Construction Progress Schedule.
 - b) Contents:
 - (1) Training modules and classes.
7. Training sessions:
- a. Provide training sessions for equipment/system as specified in the individual equipment/system Section.
- C. Commissioning Schedule:
- 1. General:
 - a. Comply with Commissioning Roles and Responsibilities Matrix specified at the end of this Section.
 - b. Submit Commissioning Schedule not less than 60 calendar days prior to planned initial commissioning of equipment and subsystems.
 - c. Submit Commissioning Schedule updates as part of the monthly schedule update and final Commissioning Schedule.
 - 2. Schedule requirements:
 - a. Schedule durations and float for commissioning activities to ensure Work does not fall behind schedule due to complications or delays during commissioning.
 - b. Time-scaled network diagram detailing the Work to take place in the period between 60 calendar days prior to planned initial commissioning of equipment and systems, through to the date of Substantial Completion, together with supporting narrative.
 - c. Provide detailed schedule of commissioning activities including durations and sequencing requirements.
 - 1) Identify the following activities for each subsystem, including all site work.
 - a) Testing and Training Phase:

- (1) Source Testing.
- (2) Owner Training.
- (3) Installation Testing.
- (4) Functional Testing.
- (5) Clean Water Facility Testing.
- (6) Closeout Documentation.

b) Process Start-Up Phase:

- (1) Process Start-Up.
- (2) Process Operational Period.
- (3) Instrumentation and Controls Fine-Tuning.

- d. Schedule manufacturer's services to avoid conflict with other on-site testing or other manufacturers' on-site services.
- e. Verify that conditions necessary to allow successful testing have been met before scheduling services.

D. Installation and Functional Testing Plans:

1. Submit Installation Testing Plans and Functional Testing Plans for equipment, unit process subsystems, and full systems.
2. Subsystem testing plans:
 - a. Submit separate testing plans for each individual subsystem and system that include the following:
 - 1) Approach to testing including procedures, schedule, analytical methods and test equipment to be used, temporary facilities, recirculation requirements, and disposal plan.
 - 2) Test objective: Demonstrate subsystem meets the design requirements as specified in the technical Sections.
 - 3) Test descriptions, need for temporary systems (pumps, piping, etc.), shutdown requirements for existing systems, test forms, test logs, witness forms, and checklists to be used to control and document the required tests. Identify independent and dependent variables, measurement method, units, and number of data points planned for acquisition during each test.
 - 4) Test forms: Include, but not limited to, the following information:
 - a) Tag and name of equipment/system to be tested.
 - b) Test date.
 - c) Names of persons conducting the test.
 - d) Names of persons witnessing the test, where applicable.
 - e) Test data.
 - f) Applicable Project requirements.
 - g) Check offs for each completed test or test step.
 - h) Place for signature of person conducting tests and for the witnessing person, as applicable.

- 5) Define start-up sequencing of unit processes:
 - a) Include testing of alarms, interlocks, permissives, control circuits, capacities, speeds, flows, pressures, vibrations, sound levels, and other parameters.
 - b) Provide detailed test procedures setting forth step-by-step descriptions of the procedures for systematic testing of equipment/system.
 - c) Demonstrate proper rotation, alignment, speed, flow, pressure, vibration, sound level, adjustments, and calibration.
 - (1) Perform initial checks in the presence of and with the assistance of the manufacturer's representative.
 - d) Demonstrate proper operation of each control loop function including mechanical, electrical, alarms, local and remote controls, instrumentation, and other equipment/system functions.
 - (1) Generate IO signals with test equipment/system to simulate operating conditions in each control mode.
- b. Owner's Representative approval of test plan is required prior to performing test.
 - 1) Revise and update test plans based on review comments, actual progress, or to accommodate changes in the sequence of activities.
 - 2) Submit test reports for each phase of testing for each equipment/system.
 - 3) Owner's Representative approval of preceding test reports is required prior to start of next test.
 - 4) Tests will be rescheduled if test plan is not approved by the required deadline.
 - a) Contractor is responsible for any resulting delay.
- c. Submit the final test procedures to the Owner's Representative.
- d. Tests may commence only after Owner's Representative has received approved test plan.
- e. Submittals:
 - 1) Submit test plans not less than 60 calendar days prior to planned installation testing of subsystem or system.
 - 2) Completed Manufacturer's Certificate of Installation and Functionality Compliance.
 - 3) Test procedures and forms: Provide signed-off copy of test forms and test reports upon completion of the test.
 - 4) Test reports:
 - a) Submit preliminary report within 1 day after testing completion.
 - b) Submit final report within 14 days after testing completion.

E. Facility Testing Plan:

1. Submit a Facility Testing Plan equivalent to the requirements of the subsystem test plans a minimum of 60 calendar days prior to Facility Testing.
2. Address all requirements set forth in the Contract Documents for this phase.
3. Plan submittal shall be consistent in terms of level of detail, approach, forms, contents, and format as the subsystem testing plans.
4. Describe plan for hydraulic flow, re-circulation requirements, and endpoint for disposal of all product water, by-products, and waste.

F. Process Start-Up Plan

1. Submit a Process Start-Up Plan for review not less than 180 calendar days prior to planned start date for process start-up.
2. Address all requirements set forth in the Contract Documents for this phase.
3. Plan submittal shall be consistent in terms of level of detail, approach, and format as the subsystem testing plans and the clean water facility testing plan.
4. Include the following information in the Process Start-Up Plan:
 - a. Pre-start-up activities.
 - b. Approach and detailed process start-up sequence.
 - c. Process Operational Period.
 - d. Description of hydraulic flow, re-circulation requirements (if any), and endpoint for disposal of all product water, by-products, and waste.
 - e. Identification of all required testing activities planned to be conducted during this phase – including any Installation Testing, Functional Testing, or Clean Water Facility Testing phase activities that are anticipated to be deferred until Process Start-Up.
 - f. Data to be acquired during this phase and sampling and analysis methodology planned.
 - g. Instrumentation and controls testing or fine-tuning planned to occur during this phase.
 - h. Description of Temporary Testing Arrangements and Test Equipment, if applicable.
 - i. Forms and checklists to be used during this phase.
 - j. Final Process Start-Up Forms and Documentations.
5. Development of the Process Startup Plan for the 30-day Process Startup Phase shall be the responsibility of the Contractor. The Owner and Engineer will provide input into the Process Startup Plan including starting dosages for all chemicals, flow requirements, and rotation schedule for equipment and basins. The Owner will implement the Process Startup Plan and operate the WTP during the Process Startup Phase. CM/GC shall provide labor and vendor/subcontractor coordination in an assistance role during the Process Startup Phase and shall be responsible for the installation of the systems per the Contract Documents. Upon Owner and Engineer review and acceptance of the Process Startup Plan, CM/GC shall be waived of any liability that may arise from any errors and omissions in the execution of the Process Startup Plan by the Owner's staff.

1.7 TESTING AND TRAINING PHASE

A. General:

1. Include specified Source Testing, Owner Training, Installation Testing, Functional Testing, Clean Water Facility Testing, and Closeout Documentation required by this Section and the technical Sections.
2. All phases of testing and training to be coordinated with restrictions and requirements as specified in Section 01 10 00 – Summary.
3. Contractor responsibilities:
 - a. Furnish labor, power, tools, equipment, instruments, and services required for and incidental to completing commissioning activities in accordance with the approved Commissioning Plans.
 - b. The on-site sewer, potable water, storm, systems shall be installed, tested, tied to the corresponding off-site system, fully functional, and have appropriate inspections and permits in place prior to the start of the Installation and Functional Testing period.
 - c. Prior to testing, verify equipment protective devices and safety devices have been installed, calibrated, and tested.
 - d. Acceptable tests: Demonstrate the equipment/system performance meets the requirements stated in the Contract Documents.
 - 1) When the equipment/system fails to meet the specified requirements, perform additional, conduct more detailed testing to determine the cause, then correct/repair/replace the causative components and repeat the testing that revealed the deficiency.
4. Owner's responsibilities:
 - a. Furnish and fill chemicals for testing activities performed by the Contractor:
 - b. Handling and fill of above chemicals and materials will be performed by Owner's personnel who will utilize the installed tanks, pads, fill piping, and associated facilities constructed by the Contractor and approved for use by the Owner's Representative.
 - c. Contractor shall be present during all filling activity to provide assistance related to any issues with installed storage, feed, delivery, containment, etc., systems.
 - d. Furnish labor required to witness testing and attend training sessions in accordance with the Commissioning Schedule agreed upon in advance.
 - e. To allow the Owner to set up contracts with chemical delivery companies, the Contractor shall give the Owner 180 days advanced notice of when bulk treatment chemicals will be required.

B. Source testing:

1. Also referred to as factory testing or factory acceptance testing (FAT).
2. Test components, devices, and equipment/system for proper performance at point of manufacture or assembly as specified in the technical Sections.
3. Notify the Owner's Representative in writing when the equipment/system is ready for source inspection and testing.

4. Source Test Plan:
 - a. As specified in this Section and other individual Specification Sections.
 - 1) Non-witnessed: Provide *Manufacturer's Certificate of Source Testing* for all instances of required source testing in individual Specification Sections.
 - 2) Witnessed: Accommodate up to two individuals (the Owner's Representative and the Engineer of Record) to be present during testing, unless otherwise specified. Provide *Manufacturer's Certificate of Source Testing* for all instances of required source testing in individual Specification Sections.
 - b. Prepared by Contractor as a result of discussions and planning emerging from regularly conducted commissioning meetings for source tests as specified in the Contract Documents.
 - c. Provide the following items for each Source Test:
 - 1) Purpose and goals of the test.
 - 2) Identification of each item of equipment/system, including system designation, location, tag number, control loop identifier, etc.
 - 3) Description of the pass/fail criteria that will be used.
 - 4) Listing of pertinent reference documents (Contract Documents and industry standards or Sections applicable to the testing).
 - 5) Complete description, including drawings or photographs, of test stands and/or test apparatus.
 - 6) Credentials of test personnel.
 - 7) Descriptions of test equipment to be used, product information, and all appropriate calibration records for the test equipment.
 - 8) Test set-up procedures.
 - 9) Detailed step-by-step test procedures.
 - 10) The level of detail shall be sufficient for any witness with a rudimentary technical aptitude to be able to follow the steps and develop confidence that the tests are being performed as planned.
 - a) All steps are significant, and all steps shall be included in the procedures.
 - 11) Sample data logs and data recording forms.
 - 12) Sample computations or analyses with the results in the same format as the final report to demonstrate how data collected will be used to generate final results.
 - a) Complete disclosure of the calculation methodologies.
 - b) Include a sample for each type of computation required for the test and analysis of the results.
 - 13) Detailed outline of the Source Test report.
 - 14) Sample test reports.

- d. Submit Source Test Plan and forms as specified herein and in the technical Sections.
 - 1) Obtain approval of the Source Test Plan at least 21 days before any scheduled test date.
 - 2) Owner's Representative approval of Source Test Plan required prior to beginning source testing.
 - 3) Schedule the testing after approval of the Source Test Plan submittal.
 - e. Indicate the desired dates for source inspection and testing.
 - 1) Notify the Owner's Representative of the scheduled tests a minimum of 30 days before the date of the test.
 - f. When process and/or bulk treatment chemicals are required, the Owner will be responsible for accepting deliveries, loading, usage, production, dosing, and operation of any chemical feed systems. Contractor shall be present during all filling and feeding activities through the startup and commissioning to aid Owner with any issues related to the installed chemical systems.
5. Test results:
- a. Prepare and submit test results with collected data attached.
6. Contractor is responsible for costs associated with Owner's Representative and Engineer of Record's representative witnessing Source Tests for re-tests, if the first test fails, is incomplete, or requires rescheduling at the fault of the Contractor or Manufacturer.
- a. Cost reimbursement for retests will include the following:
 - 1) Transportation:
 - a) Outbound travel the day before the test on commercial airline from Portland to test site, including air flight costs.
 - b) Return travel the day after the test on commercial airline from test site to Portland including air flight costs.
 - c) Rental car from hotel to and from the test site for each person for the duration between the outbound and return flights.
 - 2) Hotel costs at a facility with an American Automobile Association 4-star rating or equivalent for single occupancy room per person per day.
 - 3) Meal allowance of \$60 per person per day.
 - b. If Source Test is not ready when the witnesses arrive or if the Source Test fails, the witnesses will return home with Contractor responsible for reimbursing costs associated with the re-test trip including costs described above plus \$1600 per attendee per day (fixed amount to account for average of billing rates). Contractor is then responsible for rescheduling the Source Test and witnesses' costs associated with the additional trip including costs described above.

7. Contractor is responsible for providing fuel, chemicals, and all other consumables needed for Source Testing.
- C. Owner training:
1. Training instruction format:
 - a. The training for operations and maintenance personnel shall be provided as one entity.
 - b. Instructors shall apply adult education best practices, emphasizing learner participation and activity.
 - c. Training delivery may include problem solving, question/answer, hands-on instruction, practice, evaluation/feedback tools, and lecture.
 - d. Visual aids and hands-on practice sessions shall support training objectives.
 - e. Lecturing should be less than 30 percent of class time.
 - f. Conduct hands-on instruction according to the following descriptions:
 - 1) Present hands-on demonstrations of at least the following tasks:
 - a) Proper start-up, shutdown, and normal and alternative operating strategies.
 - b) Common corrective maintenance repairs for each group.
 - c) Recommended procedures to check/test equipment/system following a corrective maintenance repair.
 - d) Preventative maintenance points.
 - e) Calibration, if applicable.
 - 2) Use tools and equipment provided by manufacturer to conduct the demonstrations.
 - a) Submit requests for supplemental assistance and facilities with the Contractor's proposed lesson plans.
 - 3) Contractor remains responsible for equipment disassembly or assembly during hands-on training situations involving equipment disassembly or assembly by Owner's personnel.
 2. Class agenda:
 - a. Include the following information in the agenda:
 - 1) Instructor name.
 - 2) Listing of subjects to be discussed.
 - 3) Time estimated for each subject.
 - 4) Allocation of time for Owner's personnel to ask questions and discuss the subject matter.
 - 5) List of documentation to be used or provided to support training.
 - b. Owner's Representative may request that particular subjects be emphasized and the agenda be adjusted to accommodate these requests.

- c. Distribute copies of the agenda to each student at the beginning of each training class.
3. Number of students:
 - a. Estimated maximum class size: 12 persons in any one class.
 - 1) Owner's Representative will determine the actual number of students.
 - 2) Owner's Representative will provide an estimated headcount 1 week prior to the class, so that the instructor can provide the correct number of training aids for students.
4. Instructor qualifications:
 - a. Provide instructors completely knowledgeable in the equipment/system for which they are training.
 - b. Provide instructors experienced in conducting classes.
 - c. Provide instructor's technical preparation and instructional technology skills and experience.
 - d. Sales representatives are not qualified instructors unless they possess the detailed operating and maintenance knowledge required for proper class instruction.
 - e. If, in the opinion of the Owner's Representative, an appropriately knowledgeable person did not provide the scheduled training, such training shall be rescheduled and repeated with a suitable instructor.
5. Training aids:
 - a. Instructors are encouraged to use audio-visual devices, P&IDs, models, charts, etc. to increase the transfer of knowledge.
 - b. Instructors shall provide such equipment, models, charts, etc. for each class.
 - c. Instructor is responsible for confirming with Owner's Representative in advance of each class that the classroom has or will be appropriate for the types of audiovisual equipment to be employed.
6. Classroom documentation:
 - a. Trainees will keep training materials and documentation after the session.
 - b. Operations and maintenance manuals, as specified in technical Sections:
 - 1) Provide the quantity of final, approved operations and maintenance manuals as specified in Section 01 78 23 - Operations and Maintenance Information for use during the classroom instruction.
 - 2) Owner reserves the right to delay training for a particular equipment item if the operations and maintenance manuals for that equipment are incomplete, inaccurate, or otherwise unsuitable for use by the Owner's personnel.
 - 3) No Contract Time extensions or extra costs will be allowed for training delays due to operations and maintenance manual submittal delays.
 - c. Provide supplemental documentation handouts to support instruction.

- d. Digitally record audio and video of each training session.
 - 1) Include classroom and field instruction with question and answering periods.
 - 2) Owner's Representative approval required for producer of video materials from one of the following options:
 - a) Qualified, professional video production company.
 - b) Contractor demonstrates satisfactory skill.
 - 3) Record in digital format; recording shall become property of the Owner.
 - a) Provide audio quality that is not degraded during the recording of the field sessions due to background noise, space, distance or other factors.
 - 4) Video files shall be file format and delivery medium as directed and approved by Owner's Representative.
 - 5) Provide 2 complete sets of video materials fully indexed and cataloged with printed labels stating session content and dates recorded.
 - 6) The Contractor shall provide a written release from all Claims to the recorded training material produced, if required.
- e. Training modules:
 - 1) Provide a training module for each equipment category.
 - 2) Divide each training module's instructional content into discrete lesson plans.
- f. Lesson plans:
 - 1) Provide performance-based learning objectives.
 - 2) State learning objectives in terms of what the trainees will be able to do at the end of the lesson.
 - 3) Define student conditions of performance and criteria for evaluating instructional success.
 - 4) Instruction lesson plan outlines for each trade.
 - a) Provide specific components and procedures.
 - 5) Minimum requirements:
 - a) Hands-on demonstrations planned for the instructions.
 - b) Cross-reference training aids.
 - c) Planned training strategies such as whiteboard Work, instructor questions, and discussion points or other planned classroom or field strategies.
 - d) Attach handouts cross-referenced by section or topic in the lesson plan.
 - e) Indicate duration of outlined training segments.

- 6) Provide maintenance instruction lesson plans including mechanical, HVAC, instrumentation, and electrical aspects:
 - a) Equipment operation:
 - (2) Describe equipment's operating (process) function and system theory.
 - (3) Describe equipment's fundamental operating principles and dynamics.
 - (4) Identify equipment's mechanical, electrical, and electronic components and features.
 - (5) Identify support equipment associated with the operation of subject equipment.
 - (6) Detail the relationship of each piece of equipment or component to the subsystems, systems, and process.
 - (7) Cite hazards associated with the operations, exposure to chemicals associated with the component, or the waste stream handled by the component.
 - (8) Specify appropriate safety precautions, equipment, and procedures to eliminate, reduce, or overcome hazards.
 - b) Detailed component description:
 - (9) Define Preventative Maintenance (PM) inspection procedures required on equipment in operation, spot potential trouble symptoms (anticipate breakdowns), and forecast maintenance requirements (predictive maintenance).
 - (a) Review preventive maintenance frequency and task analysis table.
 - (10) Identify each component function and describe in detail.
 - (11) Where applicable, group relative components into subsystems.
 - (12) Identify and describe in detail equipment safety features, permissive and controls interlocks.
- 7) Provide the following information in equipment troubleshooting lesson plans:
 - a) Define recommended systematic troubleshooting procedures as they relate to specific craft problems.
 - b) Provide component specific troubleshooting checklists as they relate to specific craft problems.
- 8) Provide the following information in equipment Corrective Maintenance (CM) troubleshooting lesson:
 - a) Describe recommended equipment preparation requirements as they relate to specific craft problems.

- b) Identify and describe the use of any special tools required for maintenance of the equipment as they relate to specific craft problems.
- c) Describe component removal/installation and disassembly/assembly procedures for specific craft repairs.
- d) Perform at least 2 hands-on demonstrations of common corrective maintenance repairs.

(13) Additional demonstrations may be required by the Owner's Representative.

- e) Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.

7. Class logistics:

- a. Delivery time minimum: 2 hours.
- b. Delivery time maximum: 4 hours.
 - 1) Longer time requires Owner's Representative approval.
- c. Class agenda:
 - 1) Refreshment break: One 10-minute break.
 - 2) Meal break: One 45-minute break, unless otherwise specified.
 - 3) Schedule refreshment breaks and meal breaks to meet the class needs and Owner rules.
- d. Schedule specific sessions:
 - 1) Minimum of 30 days in advance to allow Owner personnel arrangements to take place.
 - 2) At times agreed upon by the Owner's Representative, within the period 7 a.m. to 7 p.m. Monday through Friday.
 - 3) Owner's Representative approval and confirmation required for session schedules.
 - 4) Provide minimum of 2 sessions for each class unless otherwise noted.
 - a) The purpose of having multiple sessions on each class is to accommodate the attendance of as many Owner's personnel working different shifts as possible.
- e. Coordinate with training sessions from Engineer of Record and others on operation of integrated systems.

8. Distribute Training Evaluation Form following each training session.

- a. Training Evaluation Form is included in this Section.
- b. Return completed Training Evaluation Forms to Owner's Representative immediately after session is completed.

- c. Revise training sessions judged “Unsatisfactory” by a majority of attendees.
 - 1) Conduct training sessions again until a satisfactory rating is achieved at no additional cost to Owner.

- 9. Submittals:
 - a. Prior to the training session:
 - 1) Instructor qualifications: Due 30 calendar days prior to initial training session.
 - 2) Training course materials: Due 14 calendar days prior to initial training session.
 - a) Training agenda, lesson plan, presentation, and handouts.
 - b) Other audio-visual aids utilized during each training course.
 - c) Format: Submit electronic copy via e-Builder and provide 20 hard copies organized in notebooks at the training sessions.

 - b. Post training session:
 - 1) Training course materials: Due 14 calendar days after class completion.
 - a) Video recordings.
 - b) Class attendance sheet.
 - c) Training agenda, final lesson plan, presentation, and handouts.
 - d) Other audio-visual aids utilized during each training course.
 - e) Provide materials for all sessions of the class in a single transmittal.
 - f) Format: Submit electronic copies.

- 10. The Contractor is advised that additional training of the Owner’s personnel may be provided by Others during the commissioning period. The Contractor shall coordinate timing, content, and other logistics associated with delivery of Contractor-led training with the Owner’s Representative to properly integrate training being provided by Others into the Contractor’s overall commissioning process and schedule.
 - a. The Engineer of Record will train Owner personnel, the Contractor, and other interested parties for a minimum of five (5) Days at the Site on the intended operation of the WTP in advance of commissioning and startup. Contractor shall assume the Engineer of Record’s training will take a minimum of three separate sessions. Engineer of Record will utilize available documentation (Drawings, 3D models, vendor O&M information, control strategies, eO&M, etc.) as training aids. Contractor shall coordinate timing, content, and other logistics with Engineer of Record and Owner’s Representative to properly integrate the Engineer of Record’s training into the overall commissioning process.

D. Installation Testing:

1. Perform subsystem testing according to approved Subsystem Testing Plans.
2. Initiate activities associated with completion of the *Manufacturer's Certificate of Installation and Functionality Compliance* for all equipment (attached at end of Section; due upon completion of Functional Testing).
 - a. Manufacturer's Certificate of Installation and Functionality Compliance form is included in this Section.
 - b. Manufacturer's Certificate of Installation and Functionality Compliance certifies the equipment meets the following requirements:
 - 1) Has been properly installed, adjusted, aligned, and lubricated.
 - 2) Is free of any stresses imposed by connecting piping or anchor bolts.
 - 3) Is able to be operated as necessary for Functional Testing.
 - c. Form shall be submitted after completion of Functional Testing, as specified in this Section.
3. Installation Testing activities include, but are not limited to inspection and field testing activities specified for:
 - a. Cleaning, pressure, and leak testing of building plumbing, yard piping, and process piping;
 - b. Structural non-destructive testing;
 - c. Hydrostatic testing of cast-in-place reinforced concrete structures ;
 - d. Coating holiday testing as specified in the Division 09 coating Specifications.
 - e. Pressure and leakage testing of logical piping segments and connected equipment skids;
 - f. Electrical devices and subsystems, including completion of power system studies, grounding resistance tests, testing of relays and circuit breakers, direct-current high-potential tests on all cables that will operate at more than 2,000 volts, and testing of motor resistance amperage draw for all motors;
 - g. Instrumentation devices and subsystems, including calibration, scaling, setpoints, local circuit wiring out (verification of signal IO to vendor panels) and hard-wired interlocks at the local level plus and similar activities on IO to SCADA to the maximum extent practical; and
 - h. as specified in individual component Sections
4. Perform mechanical equipment Installation Testing for mechanical equipment components and vendor packages shall include activities as specified below and in individual equipment Sections.
 - a. Remove rust preventatives and oils applied to protect equipment during construction.
 - b. Flush lubrication systems and dispose of flushing oils.
 - 1) Recharge lubrication system with lubricant recommended by manufacturer.
 - c. Flush fuel system and provide fuel for testing and start-up.

- d. Install and adjust packing, mechanical seals, O-rings, and other seals. Replace Defective seals. Verify all installed materials are those approved (via submittal) for the intended application with the process fluid.
 - e. Remove temporary supports, bracing, or other foreign objects installed to prevent damage during shipment, storage, and erection.
 - f. Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver.
 - g. Perform cold alignment and hot alignment to manufacturer's tolerances.
 - h. Adjust V-belt tension and variable pitch sheaves.
 - i. Inspect hand and motorized valves for proper adjustment.
 - 1) Tighten packing glands to ensure no leakage but permit valve stems to rotate without galling.
 - 2) Verify valve seats are positioned for proper flow direction.
 - j. Tighten leaking flanges or replace flange gasket.
 - 1) Inspect screwed joints for leakage.
 - k. Install gratings, safety chains, handrails, shaft guards, and sidewalks prior to functional testing.
5. Electrical devices and subsystems Installation Testing: As specified below and in the technical Sections.
- a. Perform insulation resistance tests on all wiring except wiring and control wiring inside electrical panels.
 - b. Perform grounding resistance tests on grounding systems.
 - c. Test and set relays and circuit breaker trip units for proper operation.
 - 1) Settings as documented in approved electrical studies performed as specified in Section 26 05 73 – Power System Studies.
 - d. Perform direct-current high-potential tests on all cables that will operate at more than 2,000 volts.
 - e. Motors:
 - 1) Windings energized to 1,000 volts DC for 1 minute.
 - a) Motor resistance measured at the end of the test and recorded.
 - 2) Check motors for actual full-load amperage draw and proper rotation.
6. Heating, ventilating, and air conditioning systems: As specified in Section 23 05 93 - Testing, Adjusting, and Balancing (TAB) for HVAC, and technical Sections.
1. Document all planned Installation Testing activities which could not be completed and/or needs repeating during the Functional Testing phase.
7. Apply all tags and signage to equipment, valves, gates, instrumentation, and exposed process piping prior to initiating Functional Testing.

E. Functional Testing:

1. Perform subsystem and system testing according to approved Functional Testing Plan(s).
2. Perform testing with air or water as appropriate.
3. Notify the Owner's Representative 5 days prior to when the Work is ready for Functional Testing.
 - a. Perform testing in the presence of the Owner's Representative.
4. Determine Functional Testing durations with Owner's Representative's input.
 - a. Durations will vary depending on the complexity and importance of the system. Note that the quantity of water available for testing use may be limited.
 - b. Target minimum Functional Test duration: 8 hours.
 - 1) Identify equipment/system that cannot be tested for a minimum of 8 hours as specified in technical Sections.
5. Perform Functional Testing as specified in technical Sections.
 - a. Perform Functional Testing in addition to the other tests (e.g., performance tests) specified in the technical Sections.
 - b. Demonstrate that the component equipment, subsystem, or system functions cohesively and in accordance with the design requirements.
 - c. Demonstrate equipment/system functions in local manual, local auto, remote manual, and remote auto to verify and document proper functionality in all specified modes.
6. Complete Raw Water System and Transmission System full pipeline pressure testing during this phase.
 - a. Repair or replace parts that operate improperly and retest.
 - b. Contractor shall inspect the raw water transmission pipeline during pressure testing and promptly notify Owner of any issues. Repairs of off-site raw water transmission pipeline and costs for retesting due to failures are excluded from the CM/GC scope of work.
7. Submit testing reports as specified in the individual Sections to the Owner's Representative for approval of Functional Testing reports.
 - a. Document any changes recommended to design setpoints, control algorithms, and interlocks which resulted from Functional Testing.
8. Provide completed *Manufacturer's Certificate of Installation and Functionality Compliance* forms for all supplied equipment and vendor packages.
 - a. Certificate form included at end of this Section.

- b. Manufacturer's signature on the completed certificate certifies that the Manufacturer, or their authorized representative, has directly verified that the installed equipment/system meets the following requirements:
 - 1) Is suitable for satisfactory full-time operation under full-load conditions.
 - 2) Operates within the allowable limits for vibration and noise.
 - 3) Electrical and instrumentation requirements:
 - a) Electrical equipment, instrumentation, and control panels are properly installed, calibrated, and functioning.
 - b) Electrical Installation Testing is complete, and test results have been approved by the Owner's Representative.
 - c) Noted deficiencies have been corrected.
 - d) Relays, circuit breakers, and other protective devices are set.
 - e) Control logic for start-up, shutdown, sequencing, interlocks, control, and emergency shutdown has been tested and is properly functioning.
 - f) Motor control is calibrated and tested.

F. Facility Testing:

1. General:

- a. Goals for Facility Testing are 1) to confirm hydraulics of the plant and installed facilities, and 2) complete acceptance tests for select systems/subsystems/components where said testing could not have been completed during earlier testing phases for physical/chemical reasons (e.g., insufficient flow).
- b. Facility Testing may involve re-circulating water using recycle pumps to return water to the front of the plant.
- c. Do not begin Facility Testing until Owner's Representative has approved submittals documenting that all Functional Testing requirements have been completed.
- d. Testing shall occur for a minimum of 7 days with all systems operational to the maximum extent possible.
- e. Perform testing in the presence of the Owner's Representative unless such presence is expressly waived in writing.
- f. Prior to the Process Start-Up Phase, the Contractors CC shall oversee plant operations.

2. Activities:

- a. Upon approved completion of preparatory activities, charge the plant with water and initiate Facility Testing.
- b. Test entire facility at the design flow for the largest single process or system train to ensure proper hydraulic performance. Measure water surface elevations and headloss through piping and major hydraulic restrictions.
 - 1) Note that process area test flows may be limited by upstream and downstream process constraints (i.e., tank and basin volumes) and/or localized recirculation capabilities.

- c. Operate equipment/subsystems/systems in unison to evaluate performance of interdependent systems to the maximum extent practical to reduce risk during the Process Start-Up Phase.
- d. Conduct remaining specified equipment/system performance tests that could not be performed during the Testing and Training Phase due to inter-system and/or treatment process dependencies.
- e. Confirm component, subsystem and system performance is consistent with Contract Documents once hydraulically integrated into the full treatment plant.
- f. Complete SCADA system testing to the maximum extent possible:
 - 1) Test complete system instrumentation, controls and PLC, HMI, and LOI programming for the facility.
 - 2) Coordinate testing of instrumentation and programming
 - 3) Perform control loop tuning.
 - 4) Document any changes recommended to design setpoints, control algorithms, and interlocks which resulted from Clean Water Facility Testing.
3. Repair or replace parts that operated improperly and retest.
4. Submit testing report as specified in the technical Sections to the Owner's Representative for approval. Identify issues encountered and corrective actions taken.

G. Closeout documentation submittals:

1. Refer to Section 01 77 00 - Closeout for closeout requirements.
2. Provide records generated during Commissioning Phase of Project as Submittals to the Owner's Representative, including but not limited to:
 - a. Training documentation.
 - b. Manufacturer's Certificate of Source Testing.
 - c. Manufacturer's Certificate of Installation and Functionality Compliance.
 - d. Daily logs of equipment/system testing identifying tests conducted and outcome.
 - e. Test forms and documentation.
 - f. Functional Testing results.
 - g. Logs of time spent by manufacturer's representatives performing services on the Site.
 - h. Equipment lubrication records.
 - i. Electrical phase, voltage, and amperage measurements.
 - j. Insulation resistance measurements.
 - k. Bearing temperature measurements.
 - l. Data sheets of control loop testing including testing and calibration of instrumentation devices and setpoints. Format: electronic copies via e-Builder.
 - m. Due date: Prior to Substantial Completion.

1.8 PROCESS START-UP PHASE

A. General:

1. The purpose of this phase is to verify performance of the installed and fully integrated facility meets the Contract Document requirements.

2. After the Water Test the Contractor's CC shall oversee the transition to plant operations. Transition to shall be done in close coordination and under the authority of the Owner's licensed operations staff. The Owner's licensed staff will then operate the facility under a permit issued by the State of New York, to send water to the overflow system outflow. The Contractor's CC shall remain on-site to witness operation and to oversee any testing deferred into this phase.
 3. Owner's Representative has the authority to terminate and/or postpone Process Start-Up Phase testing activities to protect public safety and maintain compliance with the permit.
 4. Perform process start-up in the presence of the Owner's licensed operations staff and Owner's Representative.
 5. Testing activities which were approved for deferral from earlier commissioning phases, if any, shall be completed during this phase and prior to Final Acceptance.
 6. Contractor's schedule for the commissioning phase shall be based upon the Process Startup Phase beginning immediately following the Facility Testing.
- B. Pre-startup Activities and Submittals:
1. Completion of all pipeline filling, disinfection, flushing, and testing activities required to put those systems into full time operation. These activities shall be done by Contractor in close coordination with Owner's licensed distribution system operations staff.
 2. Approval by the Owner's Representative of the Contractor's Process Start-Up Plan Submittal.
 3. Commissioning Documentation and Data Review.
 4. Start-Up Go/No-Go Decision Criteria.
 5. Building and Fire Inspection Compliance Check.
 6. Process Start-Up Sequence Review.
- C. Process Start-Up plan for review by Owner's Representative not less than 120 calendar days prior to planned commencement of process start-up activities. Include the following information in the Process:
1. Pre-start-up activities.
 2. Process Start-Up.
 3. Process Operational Period.
 4. Instrumentation and Controls Fine-Tuning.
 5. Description of Temporary Testing Arrangement, if applicable.
 6. Final Process Start-Up Forms and Documentations.
 7. Final Operational Testing Plan.
- D. Process area start-ups.
1. Process start-up individual process areas comprised of multiple interdependent systems where possible and beneficial to reduce complexity and risk of complete facility testing.
 2. Process area test flows may be limited by upstream and downstream process constraints (i.e., tank and basin volumes) and/or localized recirculation capabilities.

E. Facility-wide process start-up.

1. Upon approved completion of pre-start-up activities, perform entire facility process start-up.
 - a. Complete control loop tuning during this phase of process start-up.
 - b. Continue process start-up operations until facility meets or exceeds the Contract requirements.
2. Process control systems testing:
 - a. IO verification and control loop tuning should have been performed with water to the maximum extent possible prior to Process Start-Up. During this phase, the plant will be operating with chemicals and other process fluids as per design intent of a fully operational and integrated treatment facility.
 - b. Re-calibrate instruments where appropriate (e.g., where specific gravity, temperature, viscosity, etc. of the process fluid or true operational conditions differs from that of clean water used in testing during earlier phases). Verify ranges and setpoints for all instruments where such changes are made.
 - c. Complete any remaining open controls testing activities.
 - d. Test complete system instrumentation, controls and PLC, HMI, and LOI programming for the facility. Coordinate testing of instrumentation and programming.
3. HVAC systems start-up and testing:
 - a. Test complete HVAC system for the facility.
4. Ancillary systems start-up and testing:
 - a. Test complete security system, phone system, fire alarm system, etc. for the facility.
5. Remaining equipment/system tests:
 - a. Conduct remaining specified equipment/system performance tests that could not be performed during the Testing and Training Phase due to inter-system and/or treatment process dependencies (e.g., dewatering performance testing once process solids are available).

F. Process Start-Up Phase:

1. Duration: 30 calendar days.
2. Owner's Representative will be present for this phase.
3. Contractor to provide:
 - a. Contractor's CC to support the Owner's licensed operating staff during the Process Start-Up Phase.
 - b. Specified start-up materials and operating supplies.
 - c. Necessary craft of labor assistance, in the event of an emergency equipment failure requiring immediate attention (emergency is defined as a failure of

- function which precludes the further operation of a critical segment of or the whole of the Work) with a response time of not more than 4 hours from the time of notification.
- d. Manufacturer's authorized representative to supervise placing equipment/systems in operation and provide guidance during operational testing per applicable Section.
 - e. Necessary manufacturer's representatives and operating supplies for retesting systems that fail to pass the initial operational testing due to deficiencies in products of workmanship at no additional cost to the Owner.
 - f. List of 24-hour "on-call" representative supervisory persons who will monitor the operational testing and serve as liaison for the Owner's Representative.
 - g. Contractor shall be responsible for the additional cost of power, water, chemicals, and diesel fuel for the standby generator if failed testing requires re-testing which extends the duration of the Process Start-Up Phase beyond 30 days.
4. Owner will provide:
 - a. Operations personnel for duration of Process Start-Up Phase.
 - b. Power and water to be used over a maximum of 30-day duration during the Process Start-Up Phase. However, Contractor shall be responsible for additional costs if failed testing requires re-testing which extends the duration of the Process Start-Up Phase beyond 30 days.
 5. Execute planned Process Start-Up Phase activities in accordance with the approved Process Start-Up Testing Plan submittal.
 6. Conduct remaining specified equipment/system performance tests that could not be otherwise be performed during earlier commissioning phases due to inter-system and/or treatment process dependencies (e.g., mechanical dewatering system).
 7. Complete deferred/open control loop tuning and control systems testing and integration optimization activities.
 8. Demonstrate facility operates in conformance with Contract Document requirements.
 - a. Owner's personnel shall operate any systems used for any water produced to be distributed or used by customers.
 - b. Entire system shall continuously meet performance requirements and shall operate without fault, failure, or defect for a continuous period for the duration of the Process Start-Up Phase.
 - c. Individual equipment/system failures that are corrected within 24 hours and do not prevent the entire Project from continuously satisfying the established operational requirements shall not require the consecutive day test to be restarted unless the failure re-occurs.
 - d. Restart the consecutive test period for any of the following conditions:
 - 1) Any failure of the complete Project construction to meet operational requirements.
 - 2) When malfunctions or deficiencies cause shutdown or partial operation of the facility, or results in failure of the complete Project construction to meet operational requirements.

- 3) Any individual equipment/system failure that meets any of the following conditions:
 - a) Requires more than 24 hours to correct.
 - b) Recurs within the 24-hour correction period requiring further correction.
- e. Immediately correct defects in material, workmanship, or equipment/system which became evident during Process Start-Up Phase.

1.9 INSTRUMENTATION AND CONTROLS FINE-TUNING

A. General:

1. Duration: 90 calendar days total including 30 days during Process Start-up followed by another 60 days after the end of the Process Start-Up Phase.
2. Work to be performed and coordinated by Owner's vendor.

B. Activities and Submittals:

1. Complete instrumentation and automated controls system testing as specified in the Contract Documents to identify issues, make corrections, and fine tune control systems and optimize SCADA system, as needed.
2. Document all final setpoints and changes to control algorithms and interlocks via submittal.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION 408000

ANUFACTURER'S CERTIFICATE OF SOURCE TESTING

OWNER _____ EQPT/SYSTEM _____
PROJECT NAME _____ EQPT TAG NO. _____
PROJECT NO. _____ EQPT SERIAL NO. _____
SPECIFICATION NO. _____
SPECIFICATION TITLE _____

Comments: _____

I hereby certify Source Testing has been performed on the above-referenced equipment/system as defined in the Contract Documents, and results conform to the Contract Document requirements. Testing data is attached.

Date of Execution: _____, 20____

Manufacturer: _____

Manufacturer's Authorized Representative Name (print): _____

(Authorized Signature)

If applicable, Witness Name (print): _____

(Witness Signature)

MANUFACTURER'S CERTIFICATE OF
INSTALLATION AND FUNCTIONALITY COMPLIANCE

OWNER _____ EQPT/SYSTEM _____
PROJECT NAME _____ EQPT TAG NO. _____
PROJECT NO. _____ EQPT SERIAL NO. _____
SPECIFICATION NO. _____
SPECIFICATION TITLE _____

I hereby certify that the above-referenced equipment/system has been: (Check Applicable)

- Installed in accordance with manufacturer's recommendations.
- Inspected, checked, and adjusted.
- Serviced with proper initial lubricants.
- Electrical/instrumentation and mechanical connections meet quality and safety standards.
- All applicable safety equipment has been properly installed.
- Functionally tested.
- System has been performance tested and meets or exceeds specified performance requirements.

NOTES:

Attach test results with collected data and test report.

Attach written certification report prepared by and signed by the electrical and/or instrumentation Subcontractor.

Comments: _____

I, the undersigned manufacturer's representative, hereby certify that I am (i) *a duly authorized representative of the manufacturer*, (ii) *empowered by the manufacturer to inspect, approve, and operate this equipment/system*, and (iii) *authorized to make recommendations required to ensure that the equipment/system furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.*

Date: _____, 20 _____

Manufacturer: _____

Manufacturer's Authorized Representative Name (print): _____

By Manufacturer's Authorized Representative: _____

(Authorized Signature)

COMMISSIONING

TRAINING EVALUATION FORM

EQUIPMENT/SYSTEM ITEM: _____

VENDOR/MANUFACTURER: _____

DATE: _____ NAME OF REPRESENTATIVE: _____

- | | | | | |
|----------------------------------------------------------------------------------------|------------|--------------|----|-----|
| 1. Was representative prepared? | Acceptable | Unacceptable | or | N/A |
| 2. Was an overview description presented? | Acceptable | Unacceptable | or | N/A |
| 3. Were specific details presented for system components? | Acceptable | Unacceptable | or | N/A |
| 4. Were alarm and shutdown conditions clearly presented? | Acceptable | Unacceptable | or | N/A |
| 5. Were step-by-step procedures for starting, stopping, and troubleshooting presented? | Acceptable | Unacceptable | or | N/A |
| 6. Were routine/preventative maintenance items clearly identified? | Acceptable | Unacceptable | or | N/A |
| 7. Was the lubrication schedule (if any) discussed? | Acceptable | Unacceptable | or | N/A |
| 8. Was the representative able to answer all questions? | Acceptable | Unacceptable | or | N/A |
| 9. Did the representative agree to research and answer unanswered questions? | Acceptable | Unacceptable | or | N/A |
| 10. Comments: _____ | | | | |

11. Overall Rating: _____ Satisfactory _____ Unsatisfactory _____

Note:

Sessions judged “Unsatisfactory” by a majority of attendees shall be revised and conducted again until a satisfactory rating is achieved.

COMMISSIONING ROLES AND RESPONSIBILITIES MATRIX

NO.	TASK	OWNER'S REPRESENTATIVE	CONTRACTOR	ENGINEER OF RECORD
Testing and Training Phase				
Source Testing				
1	Source Testing	Witness	Lead	Witness, Review
Installation Testing				
2	Electrical Conductor Testing	Witness	Lead	Witness
3	Electrical Field Acceptance Tests	Witness	Lead	Witness
4	Instrument Field Calibration	Witness	Lead	Witness
5	Network Installation Testing	Witness	Lead	Witness
6	Loop Testing	Witness	Lead	Witness
7	Pressure Testing	Witness	Lead	Witness
8	Leak Testing	Witness	Lead	Witness
9	Holiday Testing	Witness	Lead	Witness
10	HVAC Testing	Witness	Lead	Witness
11	Motor Electrical Testing	Witness	Lead	Witness
Functional Testing				
12	Network Operational Testing	Witness	Lead	Review
13	Preliminary Run Testing Local/Manual Control	Witness	Lead	Review
14	SCADA Functional Testing - Local/Remote/Manual/Auto Control Testing - Alarm Testing - Interlock Testing - Control Loop Testing	Witness	Lead	Review
15	Subsystem Start-Up and Testing	Witness	Lead	Review
16	Equipment/System Start-Up and Testing	Witness	Lead	Review
17	HVAC Start-Up and Testing	Witness	Lead	Review
18	Corrosion Control Start-Up and Testing	Witness	Lead	Review
19	Wide Area Network Communications Testing	Witness	Lead	Witness

NO.	TASK	OWNER'S REPRESENTATIVE	CONTRACTOR	ENGINEER OF RECORD
Testing and Training Phase				
20	Manufacturer's Certificate of Installation and Functionality Compliance	Witness	Lead	Witness, Review
Clean Water Facility Testing				
21	Test Water Management Plan Finalization	Support	Lead	Review
22	Clean Water Facility Testing	Witness	Lead	Witness, Review
Process Start-Up Phase				
Process Start-Up				
23	Commissioning Documentation and Data Review	Review	Support	Lead
24	Start-Up Go/No-Go Decision Criteria	Lead	Support	Review
25	Building and Fire Inspection Compliance Check	No Action	Lead	Witness
26	HVAC Functionality Check	Witness	Lead	Review
27	Start-Up Sequence Review	Support	Lead	Review
28	Temporary Testing Arrangement Finalization	Support	Lead	Support
29	Start-Up Forms Finalization	Support	Lead	Support
30	Operation Testing Plan Finalization	Review	Lead	Review
31	Test Water Management Plan Finalization	Support	Lead	Review
32	System Testing	Support	Lead	Witness
33	Control Loop Tuning	Support	Lead	Witness
34	Process Area Start-Ups	Support	Lead	Witness
35	Facility-Wide Start-Up	Support	Lead	Witness
36	Process Control Systems Testing	Support	Lead	Witness
38	HVAC Final Testing, Adjust, and Balancing	Witness	Lead	Witness, Review
Process Start-Up Phase				
39	Operational Testing	Lead	Support	Witness, Review

NO.	TASK	OWNER'S REPRESENTATIVE	CONTRACTOR	ENGINEER OF RECORD
Testing and Training Phase				
40	Final Testing Reports	Review	Lead	Review
41	Water Quality Testing and Documentation	Lead	Support, Review	Review
Instrumentation and Controls Reliability Phase				
Instrumentation and Controls Reliability Period				
42	By Owner	Lead	Support	Witness, Review
<p><u>Legend:</u></p> <p>Lead: Primarily responsible for organization, coordination, and execution of task Work product or result.</p> <p>Support: Assist the lead with organization, coordination, and execution of task work product or result.</p> <p>Witness: Observe and document completion of task Work product or result.</p> <p>Review: As necessary to accept task Work product result.</p> <p>No Action: Limited or no involvement.</p>				

SECTION 412223.19 - MONORAIL HOISTS

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. Manually powered monorail hoists and components, with chain hoists.
- 2. Monorail system; including monorail runway, supplementary framing, support members and anchorage to building.

- B. Related Requirements:

- 1. Section 099100 "Painting" for exposed piping and repair of damaged coatings.
- 2. Section 055000 "Metal Fabrications" for connections to building structure.
- 3. Section 262923.25 "Variable Frequency Motor Controllers Industrial" for drives for electric motors supplied.

1.3 DEFINITIONS

- A. Hoist: Motor or manual powered hoist with load hook to raise and lower a freely suspended load. Hook supported by one or more wire rope strands that reel from a drum mounted on hoist, or by one or more strands of metal chain. Standard headroom or close headroom construction.
- B. Pendant: A hand-operated controller that hangs from the electric motor-powered hoist by a cable.
- C. Trolley-Mounted Hoist: An assembly consisting of a wheeled trolley that moves along the runway and a hoist suspended from the trolley that provides for the raising and lowering of a freely suspended load.
- D. Runway: The track and support system upon which the crane travels.

1.4 ACTION SUBMITTALS

- A. Product Data:

- 1. Manufacturer catalog information for each hoist, trolley, runway, and support system, including materials, weights, dimensions, capacities, and accessories.

2. Equipment data sheets for hoist selection indicating capacity, lift distance, lift speed, motor data, weight, dimensions, and materials of construction.
3. Equipment data sheets for trolley selection indicating capacity, speed, motor data, dimensions, weight, and materials of construction.
4. Manufacturer data sheets for electrification and controls.
5. List of manufacturer's recommended spare parts.

B. Shop Drawings:

1. Indicate monorail and runway capacities, hook envelope, equipment dimensions, and hoist limits.
2. Indicate runway, trolley, hoist, motors, controls, power cabling and mounting details.
3. Indicate arrangement of runway, including curves and switches, clearances, principal dimensions, details of structural connections, and components.
4. Indicate control panel layout, including wiring diagrams, system schematics.
5. Details for connection of the monorail and runway supports to the building, and vertical and horizontal reactions imposed on the building system.
6. Supplementary framing as required to stabilize and support the monorail runway for longitudinal, transverse lateral and vertical forces, including impact.
7. Detailed bill of materials of monorail system components.

1.5 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. Test and Evaluation Reports: Indicate crane certification documentation.
- D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- E. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Qualifications Statements:
 1. Submit qualifications for manufacturer, installer, and licensed professional.
 2. Submit manufacturer's approval of installer.
 3. Welders: Submit qualification procedures and personnel qualifications according to AWS D14.1/D14.1M.

1.6 DELEGATED DESIGN SUBMITTALS

- A. Delegated Design Certification: As required by Division 00 and Division 01.
- B. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for sizing of runways, connections and supports. Provide all

runway reactions to support framing and clarify if it includes load factors and all impact loading. Sign and seal shall be by a professional engineer registered in New York State.

- C. After the monorail systems have been installed and accepted, submit structural design calculations for the monorail system for record purposes only. Demonstrate compliance with the performance criteria specified herein. Calculations shall be prepared, stamped, and signed by a professional engineer registered in New York State. Calculations will not be reviewed by the Engineer.

1.7 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual layout and dimensioning of monorail systems.
- B. Operation and Maintenance Data:
 - 1. Submit assembly views.
 - 2. Submit list of manufacturer's recommended spare parts including part numbers and availability.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare Parts:
 - 1. Furnish following spare parts for each monorail hoist:
 - a. One complete set of linings for each type and size of brake.
 - b. One set of collector shoes.
 - c. One wire rope of specified length, with end fittings.
 - d. One spare festoon cable.
 - e. One NiCad battery with battery charger.

1.9 QUALITY ASSURANCE

- A. Design and Fabrication: Comply with AISC 325, ASME B30.11, ASME B30.16 ASME HST-1, MH27.1, and OSHA 1910.179.
- B. Construction: Comply with ASME NUM-1, ASME B30.17 and OSHA 29 CFR 1926, Subpart N.
- C. Welding: Comply with AWS D14.1/D14.1M.
- D. All components to be UL listed where UL listed components are available.

1.10 QUALIFICATIONS

- A. Manufacturer Qualifications:

1. Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.
- 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 New York.
- E. Structural design shall be performed by a qualified Professional Engineer registered in New York.

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. 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 for monorail hoists.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Comply with CMAA 74, AISC 325 Steel Construction Manual.
- B. Service: Indoor. Class I, Division 2, Group D.
- C. Duty Class: ANSI MH27.1, A: Standby or infrequent service.

- D. Capacity: 4 tons.
- E. Provide manufacturer installed identification plates of non-corrosive metal showing the manufacturer's name, model number, capacity, power supply, and other essential information. Label the monorail with capacity, legible from the floor on both sides of the beam.
- F. Runway and Supports: Existing to be reused.
- G. Bearings:
 - 1. Type: Antifriction ball, ABMA 9 or roller, ABMA 11.
 - 2. L-10 Life: 5,000 hours.
- H. Motor:
 - 1. Hoist: 4.7 hp, 8.3 amps
 - 2. Trolley: 1.0 hp, 2.7 amps.

2.2 CONTROLS

- A. Control Panel:
 - 1. Factory mounted.
 - 2. NEMA 250 Type 4X,.
 - 3. Single-point power connection and grounding lug.
- B. Controls:
 - 1. Controls to permit inching in both directions under full load, automatically regulated accelerations, and rapid brake response.
 - 2. Pendant Push-Button Station:
 - a. Hanging from crane structure to minimum 3 feet above operating floor.
 - b. Comply with NEMA ICS 8.
 - c. Furnish mounting bracket on hoist to stow pendant when not in use.
 - d. Push Buttons: RAISE; LOWER; FORWARD, REVERSE.
 - e. Pendant cable reel suspension: Adjustable, self-holding in last position.
 - f. NEMA 250 Type 4X, fiberglass reinforced plastic.
 - g. Remote Radio Control for hoist and trolley.
 - 3. Limit Switches:
 - a. Comply with NEMA ICS 2.
 - b. Wire Rope Hoists: Adjustable upper, lower, and secondary, independently wired, upper switch.
 - c. Chain Hoists: Limit stops to prevent overtravel in both raising and lowering directions.
 - d. Trolley stop limit switch control at each terminus of runaway.
 - 4. Overload Cutoff:

- a. Prevent hoist from applying pull that would exceed rated hoist load.
 - b. De-energize raising circuit to hoist motor and reset automatically when overload is removed.
 - c. Comply with NEMA ICS 2.
5. Operation Sequences: Adjustable, mechanical stops to limit lift height.
 6. Hoist Control:
 - a. Pendant Control for hoist and trolley.
 - b. Suspended from hoist.
 - c. Fixed elevation above operating floor: 3 feet.
- C. Disconnect Switch: Readily accessible from operating floor.
- D. Safety Signs: Comply with NEMA 535.

2.3 MOTOR-OPERATED MONORAIL HOISTS

A. Manufacturers:

1. Harrington Hoists, Inc.,
2. Ingersoll-Rand,
3. Spanco Inc.,
4. Coffing Hoists.

B. Hoists General:

1. Comply with ASME HST-1, Class H3 for hoist.
2. Drive: Direct-coupled motor.
3. Brakes: Solenoid type.
4. Drum:
 - a. Material: Steel.
 - b. Construction:
 - 1) Machined grooves for wire rope, with flanges on each end to prevent binding.
 - 2) Minimum Pitch Diameter: 18 times wire rope diameter.
 - 3) Minimum two wraps of hoisting rope to remain on each anchorage when hook is in its lowest position.
5. Sheaves (Pulley): Steel.

C. Main Hoist and Trolley:

1. Headroom: Standard
2. Hoist Duty Class: H1
3. Reeving: Single
4. Chains:

- a. Comply with ASME HST-1.
- b. Type: Roller, Stainless Steel Type 316.
- c. Accessories:
 - 1) Storage bucket for chain hoists with 10-foot (3-m) or greater lift.
 - 2) Chain guides.

5. Hoist Suspension: Trolley.
6. Hoist Capacity: 4 tons.
7. Hoist Lift Distance: 16 feet
8. Hoist maximum allowable headroom: 16 feet.
9. Hoist Lifting Speed: Two 11/2 fpm.
10. Hoist Motor: TEFC, variable speed.
11. Hoist Motor Power: 4.7 hp.
12. Trolley Type: Integral to hoist.
13. Trolley Drive: Electric; See article below.
14. Trolley Speed: Two 80/13 fpm .
15. Trolley Motor: TEFC, variable speed.
16. Trolley Drive Power: 1 hp.

D. Electrification:

1. Provide junction box to connect power feeder from disconnect switch (by Division 26).
2. Tag Line:
 - a. Cable suspended from hoist and fixed support at supply end.
 - b. Conductor sizing/rating: Multi-conductor, UL listed, neoprene jacketed, stranded cable, comply with CMAA 74 and MH27.1.

E. Accessories:

1. Assembly and Mounting Hardware: Type 316 stainless steel.

2.4 FINISHES

A. Factory Coating:

1. Apply factory finish paint or coatings to all exposed component surfaces.
2. Apply rust inhibitive coatings to all ferrous surfaces not designated to be painted.
3. Factory surface preparation, priming, and painting to be manufacturer's standard and as specified in Division 9.
4. Finish coat colors to conform to industry standard. Submit color selections as offered.

2.5 ACCESSORIES

A. Mounting Hardware: Type 316 stainless steel.

B. Hooks:

1. Comply with ASME B30.10.

2. Material: Stainless steel.
3. Bearing: Anti-friction type, allowing 360-degree rotation of load.
4. Furnish spring-loaded safety latch.
5. Furnish nuts keyed to hook shanks by setscrew.
6. Sheaves:
 - a. Material: Forged steel.
 - b. Bearings: Permanently lubricated roller type; ABMA 11.
 - c. Minimum Diameter: 20 times rope diameter.

2.6 SOURCE QUALITY CONTROL

A. Testing:

1. Proof-test load chains with load equivalent to at least 150 percent of rated load of hoist, divided by number of chain parts supporting load.

B. Perform shop inspection and testing of completed assembly and submit shop test record.

C. Owner Inspection:

1. Make completed hoist assembly 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. Verify that field dimensions are as indicated on Shop Drawings.
- B. Verify that items provided by other Sections of Work are ready to receive Work of this Section.

3.2 INSTALLATION

- A. According to manufacturer instructions and as indicated on Drawings.

- B. Comply with ASME B30.11, ASME B30.16, ASME B30.17,, and OSHA 1910.179.

3.3 FIELD QUALITY CONTROL

- A. Inspection: Check hoist and motors for excessive vibration and noise.
- B. Testing:
 - 1. Operate hoist through complete lift and lowering cycle.
 - 2. Verify that hoist, trolley, and controls operate as required.
 - 3. Verify that limit switches operate as required.
 - 4. Verify that pendant cable length is sufficient to permit operation from desired floor levels.
 - 5. Test Load Certification:
 - a. Comply with OSHA 1919.71.
 - b. Test in presence of Engineer.
- C. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than four hours on Site for installation, inspection, startup, field testing, and instructing Owner's personnel in operation and maintenance of equipment.
- D. Equipment Acceptance:
 - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
 - 2. Make final adjustments to equipment under direction of manufacturer's representative.
- E. Repair damaged coatings with material equal to the original coating as specified in Section 099100 "Painting".

3.4 ADJUSTING

- A. Field-calibrate local controls and indicators.

3.5 DEMONSTRATION

- A. Demonstrate hoist operation, routine maintenance, and emergency repair procedures to Owner's personnel.

3.6 ATTACHMENTS

- A. Monorail Hoist Schedule:
 - 1. MH-1:
 - a. Location: Main Pump Station.

- b. Use: To lift pumps and valves for occasional maintenance.
- c. Type: Electric.
- d. Hoist: Chain.
- e. Capacity: 4 tons
- f. Lift Height: 16 feet
- g. Motor Hp: 4.7
- h. Voltage: 460.

END OF SECTION 412223.19

SECTION 431329 - SANITARY SEWERAGE PUMPS

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. Waste Transfer Pumps - Packaged, Direct In-Line, Wastewater-Pump Units.

- B. Related Requirements:

- 1. Section 400519 "Ductile Iron Process Pipe" for piping and connections.
 - 2. Section 400531 "Thermoplastic Process Pipe" for piping and connections.
 - 3. Section 406717 "Industrial Enclosures"
 - 4. Section 406733 "Panel Wiring"
 - 5. Section 407816 "Indicating Lights"
 - 6. Section 407819 "Switches and Push Buttons"
 - 7. Section 407853 "Relays"
 - 8. Section 407856 "Isolators, Intrinsically Safety Barriers and Surge Suppressors"

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

- B. 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. 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.
 - 4. Include diagrams for power, signal, and control wiring.
 - 5. Include control panel layout drawn to scale for exterior and interior components and control panel wiring diagrams.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with manufacturer's written instructions for handling.

1.6 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. 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.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

2.2 PACKAGED WASTEWATER PUMP UNITS

- A. Waste Transfer Pumps - Packaged, Direct In-Line, Wastewater-Pump Units:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Industrial Flow Solutions; Overwatch Model OW 151BC/6VV.
 - b. Or approved equal.
 - 2. Description: Duplex direct in-line pumping system, factory-assembled and -tested, manual-operation, floor-mounted.
 - 3. Pump Type:
 - a. Pumps shall be designed to accommodate design flows with one pump with redundant pump in back up.
 - b. The direct in-line pump shall have a 100% reserve peak pumping capacity (dual pumps). Pump operations shall be set to achieve maximum efficiency as determined by the actual flow rate.
 - c. The power source, voltage, and phasing shall be verified with the engineer and manufacturer prior to construction.

- d. Pumps shall be furnished complete with motor mounting assembly and valves required for installation and operation.
 - e. Direct inline pumps shall be installed in such a way that solids are fed in an upward flow direction to the impeller.
 - f. The pump and controls shall be tested in the factory prior to shipping.
4. Pump Body:
 - a. 304L stainless steel body and cover.
 - b. Stone trap with clean out access integral to unit to collect large solids which cannot be passed through the unit.
 - c. All wetted fasteners shall be made of 304L stainless steel.
 5. Impeller:
 - a. Conical vortex impellers shall be constructed with a detachable pumping face secured to the impeller hub by fasteners to allow for replacement of the hydraulics without removal of the mechanical seal from the shaft.
 - b. Capable of pumping liquids with up to 10% air/gas entrained without air binding.
 - c. Impeller hubs shall be keyed and bolted to the motor shaft with an O-ring for sealing.
 6. Motor:
 - a. Motor and housing shall be designed to be TEFC. Motors shall be sealed, IP67 immersible type. The motors shall be sized so that they will not be overloaded at their rated capacity at any point on the pump performance curve.
 - b. Motors shall be squirrel cage induction type housed in cast iron body. Motors shall be NEMA B-design, insulation shall be minimum Class F for continuous duty in 40 degree C ambient temperature, C-Face, round body, and inverter ready.
 - c. Motor shall have two heavy duty ball bearings to support pump impeller and take radial and thrust loads.
 - d. Pump motor cables shall be shielded and suitable for VFD applications. Cable sizing shall conform to NEC requirements for the full load currents of the motors.
 7. Seal: Mechanical.
 - a. Single mechanical seal lubricated by the pumped liquid.
 - b. The seal shall be independent of the direction of rotation and require no routine maintenance.
 - c. Seal faces shall be Tungsten carbide/Tungsten Carbide or Tungsten Carbide/Silicon Carbide.
 8. Power Cord: Three-conductor, waterproof cable of length required, but not less than 72 inches and with grounding plug and cable-sealing assembly for connection at pump.
 9. Instruments:
 - a. All controls and accessories shall be of the pump manufacturer's model and type specified and shall be included by the manufacturer in accordance with the following requirements:

10. Waste Transfer Control Panel (LCP-1010):
 - a. Control panel enclosure equipment and requirements are specified in Sections noted in paragraph 1.2.B., “Related Requirements”. Control panel to be built in accordance with all of these requirements and spare parts provided as noted.
 - b. Control panel to meet the following general electrical requirements:
 - 1) Comply with NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum)
 - 2) Comply with NEMA ICS 6: Industrial Control and Systems: Enclosures.
 - 3) Comply with NFPA 70.
 - 4) Comply with UL 508A.
 - 5) Control panel shall be equipped with individual motor lock out tag out disconnect switches. Comply with UL 98.
 - 6) Control panel shall operate on a power supply of 480 volts, 3-phase, 60 hertz.
 - 7) Surface-mounted cabinet rated NEMA 4X, Type 316 stainless steel, minimum 14 gauge certified industrial control panel.
 - 8) Control panel shall have a minimum overall short-circuit current rating (SCCR) of 65kA.
 - 9) Control panel shall be equipped with a UL 98, inner door interlocked fused main disconnect switch.
 - 10) Control panel consists of a main circuit breaker, motor circuit protector (MCP) and motor controller for each motor, and a control power transformer 120V secondary (fused on primary and secondary) along with other devices specified. Mount all control components in one common enclosure. Starter control panel sized to match voltage and horsepower of the motor to be controlled.
 - a) Main Breaker: Thermal-magnetic air circuit breaker, Schneider Electric/Square D PowerPact Type or approved equal. Ratings for Continuous and Short Circuit Current: Matching upstream protective device.
 - b) MCP: Molded case motor circuit protector with adjustable magnetic trip only, Schneider Electric/Square D “Mag-Gard” or equal.
 - c) Motor Controller: Full Voltage Motor Starting. Open frame, across-the-line, NEMA-rated magnetic motor starter, Schneider Electric/Square D Class 8536 or equal. Solid state overloads with Class 10/20 selectable tripping. Submersible motors shall use Class 10 trip curve.
 - 11) SPD: The control panel shall be provided with a surge protective device (SPD) rated for 100kA per mode for the incoming power. SPD shall be mounted within the control panel enclosure. Lead lengths shall not be longer than 12 inches from the main circuit breaker.
 - 12) A duplex GFCI utility receptacle (circuit breaker protected) providing 120 volts, 60 Hertz, single phase current shall be mounted on the side of the enclosure.

- c. Provide the following on the front of the control panel
 - 1) Pump On-Off selector switches
 - 2) Status indicating pilot lights for each pump for pump running, pump fault, pump motor high temperature and high waste storage tank level.
 - 3) Alarm horn: weatherproof rated with gasket (Federal Signal Corporation, Cat. #350 or equal) for NEMA 4X applications. Horn shall activate on high tank level only.
 - 4) Alarm beacon: Red lens and solid-state flasher (Ingam Products Inc. LRX-40 or equal) for NEMA 4X applications. Beacon shall activate on high tank level only.
 - 5) Silence and reset pushbuttons shall also be furnished. A common failure/alarm reset pushbutton shall be provided to reset any alarm condition (reset shall occur only if fault condition has been cleared).
 - d. The system shall communicate with plant SCADA system by providing interposing relays for the following digital signals as shown on drawing I-3:
 - 1) Pump “Running” status for each pump
 - 2) Pump “Fault” (common alarm for any pump fault condition) for each pump.
 - 3) Waste Storage Tank High Level
 - e. Interlocks:
 - 1) A Waste Storage Tank High Level signal will be wired to this control panel for use as an interlock. If the tank level remains high for more than 10 seconds (operator adjustable between 0-2 minutes), the transfer pumps will shutdown and horn and beacon are activated.
 - 2) The transfer pumps will not be able to be restarted until all active alarm conditions are cleared and alarm reset pushbutton is pressed.
11. Pump Discharge Piping: Factory or field fabricated, ASTM F714, Schedule 80, HDPE pipe with ASTM D3261 or F2206 fittings.
12. Capacities and Characteristics:
- a. Service: Landfill leachate/wastewater
 - b. Pump Operation: Constant Speed.
 - c. Maximum Anticipated Pumped Fluid Temperature: 90 degrees F.
 - d. Intermediate (Design) Point Flow Rate: 450 gpm.
 - e. Minimum Total Dynamic Head at Intermediate (Design) point Flow Rate: 17.49 feet.
 - f. Maximum Total Dynamic Head at Intermediate (Design) point Flow Rate: 47.49 feet.
 - g. Minimum Overall Efficiency at Intermediate (Design) point Flow Rate: 35%
 - h. Best Efficiency Point (BEP) Flow Rate Acceptable Range (minimum/maximum): 780/840 gpm.
 - i. Minimum Overall Efficiency at BEP: 42.5%
 - j. BEP location Relative to Intermediate Design Point: Right
 - k. Inlet Pipe Size: 12 inches.
 - l. Discharge Pipe Size: 8 inches.
 - m. Speed: 1800 rpm.

- n. Motor Horsepower: 20 hp.
- o. Electrical Characteristics:
 - 1) Volts: 480 V ac.
 - 2) Phases: 3.
 - 3) Hertz: 60.

- 13. Warranty: The manufacturer shall warrant the pump unit against defects in workmanship and material for a period of one year from delivery under normal use, operation and service; or 18 months from shipment, whichever occurs first.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing 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.
- B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for plumbing piping to verify actual locations of sanitary drainage and vent piping connections before sewage pump installation.

3.2 INSTALLATION

- A. Pump Installation Standards:
 - 1. Comply with HI 1.4 for installation of centrifugal pumps.
 - 2. Comply with HI 3.1-3.5 for installation of progressing-cavity sewage pumps.
- B. Wiring Method: Comply with requirements in Division 26.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 CONNECTIONS

- A. Comply with requirements for piping specified in Section 400519 "Ductile Iron Process Pipe" and 400531 "Thermoplastic Process Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test, inspect, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform the following tests and inspections:
 - 1. Perform each visual and mechanical inspection.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 5. Test all signals connected to plant control system to ensure they are functioning properly and perform test with control system programmer.
- C. Pumps and controls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.6 ADJUSTING

- A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust control set points.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 431329

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SECTION 432513 - SUBMERSIBLE SOLIDS HANDLING PUMPS

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. Submersible Solids Handling Pumps: Including their respective motors.
 - a. Main Pump Station Mounting Configuration: Dry pit.
 - b. Filtrate Pump Station Mounting Configuration: Wet Pit
- 2. Pump manufacturer shall have unit responsibility for the pumping system. Manufacturer Supervisory and Support Services shall be provided during installation and field testing of each unit and instruction of the regular operating personnel in the proper care, operation and maintenance of the equipment.

- B. Related Requirements:

- 1. Section 033000 "Cast-in-place Concrete": Concrete Work, except anchor bolts which are as recommended by (pump) Manufacturer furnished by the Contractor.
- 2. Section 055000 "Metal Fabrications" for fasteners, brackets, and other miscellaneous metal fabrications as required by this Section.
- 3. Section 099679 "Atmospheric Protection and Plant Service Areas Coatings" for priming in shop fabrication and field painting.
- 4. Division 26: Electrical Work.
- 5. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for connections and terminations.
- 6. Section 262923 "Variable Frequency Motor Controller": Manufacturer to coordinate their design with the supplier of the variable frequency drives.
- 7. Division 40: Valves, mechanical piping and appurtenances and pipe hangers and supports related to process mechanical work.
- 8. Section 406717 "Industrial Enclosures"
- 9. Section 406733 "Panel Wiring"
- 10. Section 407276 "Level Switches" (Float Switches)
- 11. Section 407816 "Indicating Lights"
- 12. Section 407819 "Switches and Push Buttons"
- 13. Section 407853 "Relays"
- 14. Section 407856 "Isolators, Intrinsically Safety Barriers and Surge Suppressors"

1.3 COORDINATION

- A. Section 013100 “Project Management and Coordination”.
- B. Coordinate installation and startup of Work of this Section with Owner’s operations.

1.4 ACTION SUBMITTALS

- A. Section 013300 “Submittal Procedures”: Requirements for submittals.
- B. Product Data:
 - 1. Total Weight of Equipment: Include weight of single largest item.
 - 2. Materials List: A complete materials table for all equipment establishing compliance with these specifications..
 - 3. Bill of Materials: complete total bill of materials of all equipment.
 - 4. Manufacturer's Recommended Spare Parts List:
 - a. Manufacturer's current price for each item.
 - b. Include gaskets, seals, etc.
 - c. List bearings by bearing manufacturer's numbers only.
- C. Shop Drawings:
 - 1. Certified dimensional drawings showing details of pump construction and auxiliary apparatus.
 - 2. Wiring Diagrams and Schematics: Power and control systems. Wiring requirements between system components, motors, sensors, control panels, and related systems.
 - 3. Motor Data: Including, but not limited to the following.
 - a. Type of enclosure design.
 - b. Rated horsepower.
 - c. Rated voltage.
 - d. FLA.
 - e. Starting current.
 - f. LRA.
 - g. LR KVA.
 - h. NEMA starting code letter and insulation code letter.
 - i. RPM.
 - j. Input power in kW at nameplate rating.
 - k. Starting calculations.
 - l. Cable size.
 - m. Efficiency: At 50, 75, and 100 percent load.
 - n. Power Factor: At 50, 75, and 100 percent load.
 - o. Winding temperature rise.
 - p. Vibration design limits.
 - q. Speed torque curves.
 - r. Trip and Alarm Settings: For temperature protective devices.
 - s. Power and control cable size.
 - t. Materials of construction.

- u. Cable sealing method.
 - v. Description of motor thermal protection and insulation system.
 - w. Service factor.
4. Include control panel layout drawn to scale for exterior and interior components and control panel wiring diagrams.

D. Manufacturer's Certificate:

- 1. Motor Manufacturer Certification: minimum of 8 evenly spaced starts per hour and continuous operation on furnished motor starter or VFD power supply without affecting bearings and windings design life.
- 2. Manufacturer's Installation Certification: Installation is per Manufacturer's installation, operation and maintenance manuals; as specified in PART 3.
- 3. Manufacturer's Field Report: As specified in PART 3.

1.5 DELEGATED DESIGN SUBMITTALS

- A. Pump Supports: Design details, anchor bolt locations, sizing information, and installation requirements. Anchorage design and engineering calculations for pump components signed and sealed by a structural engineer licensed in the State of New York

1.6 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports:

- 1. Proposed Pump Factory Test Plan: Description. Include procedures and equipment.
- 2. Proposed Field Test Plan: Description. Include procedures and equipment.
- 3. Factory and Field Performance Test Data: For Approval. As specified in PART 2 and 3.
- 4. Milestone Schedule: Factory inspection, testing, shipping, and job site delivery.

- B. Manufacturer's Instructions: Detailed instructions on installation, requirements, storage and handling procedures.

- C. Field Quality-Control Submittals: Identify the entity and qualified individual who will inspect the installation in accordance with "Inspection and Testing" Article in Part 3.

- D. Qualifications Statement: Submit qualifications for Manufacturer.

- E. Complete description of surface preparation and shop painting for pumps and motors.

- F. Critical Speed Analyses Report: Include Campbell diagrams, backup documentation, and Statement of Guarantee.

- 1. Statement of Guarantee: Critical speed analyses as required in the "Quality Assurance" Article of this Specification has been completed and the specified limitations/separation margins are met.

- G. Design Data, Characteristics and Performance:

1. Guaranteed performance curves per ANSI/HI 11.6.
 - a. Grade 1U for specified (intermediate) design point.
 - b. Grade 1E for other specified points.
 - c. Actual factory tests results of similar units, showing they met specified requirements for total head (TH), flow rate, overall efficiency, guaranteed maximum net positive suction head required (NPSH3), submergence, and horsepower.
2. Submit curves on 8-1/2 by 11 inch sheets, as large a scale as practical. Plot from zero flow at shut-off head to pump flow rate at minimum specified total head (TH).
3. The POR and AOR per ANSI/HI 9.6.3 shall be clearly shown on the curves.
4. Catalog sheets showing a family of curves are not acceptable.

H. Warranty Information: Demonstrate conformance to “Warranty Article.”

1. Authorized Warranty Center: Within a 3-day shipping radius of job site; fully staffed with factory trained mechanics and equipped with stock of strategic spare parts for each pump model furnished for Project. Document warranty center location prior to delivery of equipment.

1.7 CLOSEOUT SUBMITTALS

- A. Section 017000, “Execution and Closeout Requirements” for closeout procedures requirements.
- B. Project Record Documents: Document actual locations and final orientation of equipment and accessories.
- C. Operation and Maintenance Data Manual: As specified in Section 017823.
 1. Prepare for this project installation. Include cuts, drawings, equipment lists, descriptions, etc. required to instruct operating and maintenance personnel unfamiliar with equipment.
 2. Include trouble shooting data, full preventative maintenance schedules, and complete spare parts lists with ordering information.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Manufacturer to Furnish the Following:
 1. Special tools and test equipment required for proper servicing of equipment as specified. Furnish in a steel tool chest with lock and duplicate keys.
 2. List of recommended spare parts, gaskets, lubricants, and sealants necessary for the first five years operation of each pumping system.
 3. Furnish manufacturer’s recommended spare parts for each size pump:
 - a. Include gaskets, packing, and related materials.
 - b. List all bearings by the bearing manufacturer’s numbers only.
 - c. Include Manufacturer’s current price for each item; pricing to remain in effect for not less than one year after Substantial Completion.

4. Furnish one shelf spare Filtrate Pump Station wet pit submersible pump.

1.9 QUALITY ASSURANCE

A. Manufacturer:

1. Coordination Responsibilities: Pumps, motors, VFDs, guide rails, and other auxiliary equipment.
2. Equipment Furnished: New, unused, and standard. Furnished with accessories required and meeting specified requirements.
3. Service Record: Successful five-year record servicing equipment and systems similar to that specified.
4. Certified to ISO 9001 Standard: For design and manufacture of submersible solids handling pumps.

B. Both Contractor and Manufacturer: Share responsibility for satisfactory installation and operation of entire pumping systems including pumps, motors, VFDs, and accessories.

C. Equipment Specified in this Section:

1. To be standard pumping equipment of proven ability.
2. Manufactured by companies experienced in production of equipment used in system applications as stated in the "System Description," Article in Part 2.
 - a. Manufacture per Hydraulic Institute Standards, unless otherwise specified.
3. Furnish from single manufacturer.
4. Must operate satisfactorily when installed as shown on Drawings, as specified, and as approved by Engineer.

D. Prior to Manufacture: Forward submittal to Engineer indicating the required vibration analyses outlined herein has been performed and specified limitations are met.

1. Dynamic Vibration Analysis:
 - a. Minimum and maximum operating speeds: As specified in "Conditions of Operation" Article.
2. Maximum Vibration Velocity: Inches per Section RMS: Conform to ANSI/HI 11.6 requirements through pump operating range. Include displacement vibration results.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Section 016000, "Product Requirements" for transporting, handling, storing, and protecting products requirements.
- B. Protect equipment and parts against damage during shipment.
- C. Store equipment per Manufacturer's recommendations.

- D. Long Term Storage: Protect and store parts so no damage or deterioration occurs during prolonged delays from time of fabrication to installation; per Manufacturer's requirements.
 - 1. On-Site Long-Term Storage: Follow Manufacturer's detailed long term storage requirements.
- E. Factory Assembled Parts and Components: Do not dismantle for shipment without written permission from Engineer.
- F. Finished Surfaces; Exposed Pump Openings: Protect with blank flanges of rigid wooden or equivalent material. Secure with bolts or other manufacturer approved means.
- G. Unpainted Finished Iron or Steel Surfaces: Protect to prevent rust and corrosion.
- H. After Hydrostatic or Other Tests: Drain entrapped water prior to shipment. Protect to prevent entrance of water and moisture during shipment, storage and handling.
- I. Box or Package Markings: Contents and net weight.
- J. Engineer's Approval: Do not ship until given written approval by Engineer.

1.11 EXISTING CONDITIONS

- A. Special Requirements:
 - 1. Contractor required to make or verify field measurements prior to start of work.
- B. Field Measurements: Verify prior to fabrication. Document on Shop Drawings.

1.12 WARRANTY

- A. Section 017000, "Execution and Closeout" for warranties requirements.
- B. Manufacturer Warranty: Pump and motor for period of five years. Prorated after initial 1.5 years.
 - 1. Warranty Duration: Includes specified warranty period and as outlined in Divisions 01 and 00.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Main Pump Station: Pump raw wastewater from Wet Well to Aeration Tanks Distribution Chamber using dry pit submersible pumps in the Dry Pit.
 - 1. Equipment Specified in this Section: Includes four dry pit submersible wastewater pumps, motors, and accessories.

2. Existing control panels and systems are to be reconnected as shown on the drawings.
 3. Contractor to coordinate and be responsible for proper operation and compatibility between items in this scope of work and items in Division 40 scope.
 4. VFDs are provided in Division 26 by Electrical Contractor.
- B. Filtrate Pump Station: Pump raw wastewater from within Wet Pit to primary screen and grit chamber.
1. Equipment Specified in this Section: Includes one submersible wastewater pump, motor, guide rails, control panels and control systems, and accessories.
 2. Contractor to coordinate and be responsible for proper operation and compatibility between items in this scope of work and items in Division 40 scope.
- C. Pump Motors, Cables, and Appurtenances: Rated for operation in a damp/corrosive environment.
- D. Pumping Units: Totally submersible, solids handling, rotodynamic with submersible close coupled inverter duty motors. Each unit to be aligned and balanced. Designed to pump raw wastewater. All parts shall be so designed and proportioned as to have liberal strength, stability, and stiffness and to be especially adapted for the work to be done. Ample room shall be provided for inspection, repairs, and adjustments.
1. Wet Pit Applications: Pumping units to be automatically connected to discharge piping when lowered into place on discharge connection, providing a water tight seal.
 - a. Pumps: Easily removable from discharge connections and wet well for inspection or service. Lifting pumps from discharge connections and wet well is not to require removal of fasteners or fastenings or require personnel to enter the pump well.
 2. Components: Proportioned to have liberal strength, stability, and stiffness and especially adapted to meet specified requirements.
 3. Provide ample room for inspection, repairs, and adjustments.
- E. Baseplates or Base Elbows for Pumps: Rigidly and accurately anchored in position.
1. Anchor Bolts, Plates, Nuts and Washers: Furnished as specified.
- F. Nameplates: Stainless steel. Permanently attached to each pump and/or motor.
1. Give name of manufacturer, rated flow rate, head, speed, and other pertinent data.
 2. Wet Pit Applications: Contractor to install additional stainless steel nameplates on other above grade locations as instructed by Engineer. Orient and locate so pumps do not need to be moved to gather information.

2.2 CONDITIONS OF OPERATION

- A. Manufacturers and Products: Provide pump units from one of the following:
1. Main Pump Station Dry Pit: Model XFP 405M-CB2, by Sulzer.
 2. Filtrate Pump Station Wet Pit: Model NP 3085 MT 3~Adaptive 462, by Flygt.

3. Or equal substitution product meeting detailed requirements of this specification. Substitution must be submitted to design Engineer two weeks before the bid date for pre-approval.
 4. Pumps Within Each Service Type: Identical in every respect. All parts interchangeable.
- B. Pumps: Designed for conditions of service tabulated as follows and operate within the system head curve envelope as appended.
1. Specific Speed Less Than 4,500 (US units): Continuously rising head performance curve, from runout toward shutoff. For stable pump operation from minimum head operating point to shut-off head.
 2. Specific Speed Greater Than or Equal to 4,500: The intersection of pump head and system head curves to be used to demonstrate stable operation.
 3. Pumps Operation Throughout Operating Range: Within vibration limitations specified in “Dynamic Vibration Analysis” Paragraph in the “Quality Assurance” Article in Part 1.
 4. Pumping Units and Driving Equipment: To withstand maximum turbine run-away speed due to back flow through the pump.
- C. Each pump is to be designed for the conditions of operation tabulated as follows.

Conditions of Operation – Main Pump Station Dry Pit	
Item Description	Design Conditions
Service	Screened Wastewater
Number of Pumps (operating/standby)	4 (3/1)
Maximum Motor Full Load Speed (FLS) (rpm)	890
Maximum Allowable Motor Horsepower (non-overloading throughout operating range) (HP)	85
Drive Type	VFD
Motor Design Voltage/Phase/Frequency	480/3/60
Maximum Anticipated Pumped Fluid Temperature (degrees F.)	90
Minimum Pump Discharge Size (inches)	16
Minimum Pump Suction Size (inches)	16
Minimum Pump Shut-Off Head at Motor FLS Acceptable Range (minimum/maximum) (feet)	15/54
Flow Rate at Secondary Operation Point (gpm)	6000
Minimum TH at Secondary Operation Point (feet)	37.5
Minimum Overall Efficiency at Secondary Operation Point (%)*	80.67
Maximum NPSH Required at Secondary Operation Point (feet)	17.5
Intermediate (Design) Point Flow Rate (gpm)	6806
Minimum TH at Intermediate (Design) Point Flow Rate (feet)	34.7
Minimum Overall Efficiency at Intermediate (Design) Point Flow Rate (%)*	80.50
Maximum NPSH Required at Intermediate (Design) Point Flow (feet)	19.0
Best Efficiency Point (BEP) Flow Rate Acceptable Range (minimum/maximum) (gpm)	6800/7200
Minimum Overall Efficiency at BEP (%)*	81
Primary Operation Point TH (feet)	34.7
Minimum Flow Rate at Primary Operation Point (gpm)	6682
Minimum Overall Efficiency at Primary Operation Point (%)*	80.28

Conditions of Operation – Main Pump Station Dry Pit	
Item Description	Design Conditions
Maximum NPSH Required at Primary Operation Point (feet)	18.5
Minimum Size Solids Passing (inches)	3

* Note that minimum overall efficiencies listed are “wire-to-water” in accordance with ANSI/HI 11.6 – latest edition.

Conditions of Operation – Filtrate Pump Station Wet Pit	
Item Description	Design Conditions
Service	Screened Wastewater
Number of Pumps (operating/standby)	1 (1/0)
Maximum Motor Full Load Speed (FLS) (rpm)	1700
Maximum Allowable Motor Horsepower (non-overloading throughout operating range) (HP)	3
Drive Type	Constant Speed
Motor Design Voltage/Phase/Frequency	460/3/60
Maximum Anticipated Pumped Fluid Temperature (degrees F.)	90
Minimum Pump Discharge Size (inches)	3
Minimum Base Elbow Discharge Size (inches)	4
Minimum Pump Shut-Off Head at Motor FLS Acceptable Range (minimum/maximum) (feet)	9/36.5
Intermediate (Design) Point Flow Rate (gpm)	445
Minimum TH at Intermediate (Design) Point Flow Rate (feet)	15.1
Minimum Overall Efficiency at Intermediate (Design) Point Flow Rate (%)*	60.6
Maximum NPSH Required at Intermediate (Design) Point Flow (feet)	12.5
Minimum Size Solids Passing (inches)	3
Minimum Water Level (inches)	12-3/16

* Note that minimum overall efficiencies listed are “wire-to-water” in accordance with ANSI/HI 11.6 – latest edition.

2.3 PUMP CONSTRUCTION

A. Overall Pump Design: Combine high efficiency and low required NPSH3.

1. Wastewater Applications: Handle high solids concentrations effectively. Impellers/Casings: Must have passage surfaces to which solid or fibrous materials cannot adhere. Capable of passing fibrous and nonwoven materials found in domestic wastewater. Permit low liquid velocities, gradual acceleration, and change of flow direction of pumped media.

B. External Pump and Motor Parts:

1. Dry-Pit Application: Water-tight close grained cast iron, ASTM A48 Class 35B construction, with all parts in contact with wastewater protected by corrosion resistant coatings.

2. Wet-Pit Application: Close grained cast iron, ASTM A48 Class 35B construction, with all parts in contact with wastewater protected by corrosion resistant coatings.
3. External Bolts and Nuts: Type 304 or 316 stainless steel.

C. Impellers:

1. Construction:
 - a. Dry-Pit Application: ASTM A48 Class 30 minimum gray cast iron. Dynamically balance impellers as specified below.
 - b. Wet-Pit Application: ASTM A48 Class 30 minimum gray cast iron. Dynamically balance impellers as specified below.
2. Rotodynamic: Two-plane dynamically balanced per ISO 1940-1 quality grade G2.5 standard to provide smooth, vibration free operation.
 - a. Wastewater Applications with Flushable Fibrous and Non-Woven Material:
 - 1) Semi-open, solids handling type.
 - 2) Capable of passing 3-inch minimum diameter solids due to internal clearances or other features facilitating solids processing including a wear plate with groove.
 - 3) Wear Plate to Impeller Clearance: Easily adjustable without pump disassembly or the need to add or remove shims.
 - 4) Impeller may include pump out vanes on upper shroud reducing axial thrust and minimize clogging due to debris accumulation around the mechanical seal.
 - b. Relatively Clean Wastewater:
 - 1) Enclosed, solids handling type.
 - 2) Capable of passing fibrous material, 4 inch minimum diameter solids.
 - 3) Wear Ring: Type 316 stainless steel, fitted to impeller front shroud.
3. Enclosed or Semi Open Impeller Designs: Stationary wear ring or wear plate to have minimum 50 points Brinnell hardness greater than rotating wear ring or semi-open impeller vane tip hardness.
4. Alternative Materials and Design Approaches: Approved by Engineer.

D. Balanced Tandem Mechanical Shaft Seal System.

1. Upper (Inner) Tandem Seal Set:
 - a. Operate in seal lubricant chamber located just below the stator housing.
 - b. One Stationary Ring: Silicon carbide.
 - c. One Positively Driven Rotating Ring: Tungsten carbide or silicon carbide.
 - d. Function: Independent secondary barrier between pumped liquid and stator housing.
2. Lower (Outer) Tandem Seal Set:

- a. One Stationary Ring: Tungsten carbide or silicon carbide.
- b. One Positively Driven Rotating Ring: Tungsten carbide or silicon carbide.
- c. Function: Primary barrier between pumped liquid and stator housing.
- d. Each Interface: Held in contact by its own Hastelloy-C® or Elgiloy® spring system.
- e. Seal Body: Type 316 stainless steel.
- f. O-Rings: FKM (Viton).
- g. Must require no maintenance and adjustment, but be easily inspected and replaced.
- h. Provide pressure applied to outside diameter of face.
- i. Not Acceptable: Conventional double mechanical shaft seals containing either a common single or double spring, acting between the upper and lower units.

E. Minimum Pump Discharge Size:

1. Wet-Pit Application: Minimum allowable nominal diameter of discharge connection provided for attachment to discharge piping, as shown on Drawings, except as allowed otherwise by this specification.
2. Dry-Pit Application: Minimum allowable nominal diameter of discharge piping, as shown on Drawings, except as allowed otherwise by this specification.
3. Unless Otherwise Noted: Diameter of opening at connection between pump and discharge to be the same as the minimum specified discharge size.

F. Pump Seal Against Discharge Connection:

1. Wet-Pit applications: Pump must tightly seal against discharge connection. Accomplish with simple linear downward motion of pumping unit guided by two guide rails. No portion of the pump is to bear directly on the wet well floor.
 - a. Sliding Guide Bracket: An integral part of or bolted to the pumping unit.
 - b. Pump Casing Machined Connection System: For attachment of the ASTM A48, Class 35, cast iron discharge connection.
 - c. Sealing System: Positive leak proof system providing easy pump removal. Two machined metal-to-metal flanges or flanges with a replaceable rubber seal, form fitted to the machined discharge coupling.
 - d. Discharge Connection:
 - 1) Rigidly and accurately anchored to floor of wet well.
 - 2) Precisely leveled and aligned.
 - 3) Completed Installation: Free from stress or distortion with type 316 stainless steel expansion anchor bolts, monel nuts and accessories.
 - 4) Must receive the pump connection without need of any bolts or nuts.
2. Dry-Pit Applications:
 - a. Pump Casing Flange Connection: To attach to discharge piping. Machined per ASTM B16.1, 125 lb.
 - b. Pump Baseplate and Split Sole Plates: Rigidly and accurately located and anchored to concrete support base piers of dry pit arrangement as shown on Drawings and as specified.
 - c. Precision level and align. Installation to be free from stress or distortion.
 - d. Anchor Bolts: Type 316 stainless steel expansion, monel nuts and accessories.

- 1) Configuration and Installation: Per API RP 686 and ACI 318-08 where not in conflict with specifications.
- 2) Threads: Use Anti-seize compound of molybdenum disulfide base; Molycoat G or approved equal.
- 3) The use of shims or leveling nuts on anchor bolts is specifically prohibited.

e. Baseplate and Associated Accessories:

- 1) Size to support pump/motor assemblies and loads, including dynamic analysis results.
- 2) Pump Unit Handling: Lifting lugs or eye bolts, special slings, strongbacks, or other devices for loading, unloading, erection, installation, and subsequent disassembly and assembly.
- 3) Sole Plates: Under each pump baseplate.
- 4) Jacking Bolts: For leveling pump baseplate sole plate assembly.
- 5) Jacking Bolt Bearing Disks: A 1- inch diameter by 1/4 inch thick stainless steel disk, Disk edges in contact with epoxy grout must be radiused to a 1/2 inch radius to prevent stress risers in epoxy grout.
- 6) Plastic Vent Tubes: Sized recommended by manufacturer.
- 7) Anchor Bolt Layout: To aid in placement of anchor bolts.
- 8) Grout: Five Star DP Epoxy Grout; an expansive, non-shrink, low exothermic epoxy system, or approved equal. For use under sole plates supported by jack bolts.

G. Lifting Cable for Wet-Pit Applications:

1. Lifting Cable and Chain: Type 316 stainless steel cable and short piece of suitably sized Type 316 stainless steel chain between bail and cable.
 - a. Rating: Five times pump weight; minimum.
 - b. Combined Length: Equal to wet well depth; top slab finished grade to wet well bottom, plus six feet to permit raising pump for inspection and removal.
2. Attach lifting cable to a lifting bail on the pump.
3. Eyebolts are not an acceptable alternate to a lifting bail.

2.4 SUBMERSIBLE MOTORS

A. Pump Motors: housed in an air filled, water-tight casing.

1. Insulated Windings: Class F or better, non-hygroscopic and moisture resistant.
2. Motors Greater than 15 HP: Oil filled motor housings are not acceptable.
3. Motors 15 HP or Smaller: Oil filled motor housing is acceptable in dry pit applications.
4. Suitable for use with solid-state starters.
5. Motor Stator: Dipped and baked three times in VPI process and heat shrunk fitted into stator housing.
 - a. Alternative: Trickle impregnation method may be used for motor stator windings.
 - b. No penetrations of stator housing, such as bolts, pins or other fastening devices.

6. NEMA Design B;
 - a. Service Factor: 1.3, acceptable when VFD driven (non-sinusoidal power supply).
 7. Insulation System: Rated at 155 degrees C or better.
 8. Capable of continuous operation at ambient 40 degrees C with Class A temperature rise.
 9. NEMA Starting Code G or H, or better.
 10. Non-overloading. Capable of ten evenly spaced starts per hour.
 11. Minimum Power Factor at Full Load: 0.80.
 - a. Power Factor Correction Capacitors: By manufacturer if motor is below minimum power factor value for constant speed applications.
 12. Motor Efficiency: As noted at the design point in part 2.2 above at full load to meet wire-to-water efficiency specified in "Conditions of Operation".
 - a. The Main Pump Station Pumps shall have inverter duty rated motors and suitable for use with a VFD.
- B. Pump Motor Cooling Characteristics:
1. Permit continuous operation in totally submerged condition.
 2. Three overheat, self-resetting sensing devices: One in each motor winding. Trip at 140 degrees C. Wire devices into controls. If a device activates, pump must shut down.
- C. Closed Loop Cooling Circuit:
1. Integrated Cooling Pump: Rated for continuous duty in completely dry mode and fully submerged condition without damage.
 2. Cooling Jacket: Cast iron ASTM A48 class 30 or steel.
 3. Coolant Pump Impeller: Mounted on motor shaft between tandem mechanical seals to circulate coolant fluid into top inter-space between cooling jacket and motor housing and over motor surface, through ducts in bearing housing and into a casing heat exchanger.
 4. Heat Losses From Motor: Transfer to fluid pumped in casing heat exchanger, which forms a structural unit together with pump discharge cover. After passing through volute-casing heat exchanger, coolant returns to suction side of internal coolant pump (impeller).
 5. Coolant: Environmentally safe glycol or food grade oil rated for use at temperatures of minus 20 degrees C .
 6. Auxiliary Cooling Systems such as Fans or Blowers external of pump motor enclosure is not acceptable.
- D. Non-overloading within range of operation between shutoff and low head run-out conditions shown on pump conditions of operation data table above.
1. Where specific speed is 4,500 or greater, the range from the pump head and system head curves intersection point and low-head run out conditions shall be used to demonstrate non-overloading over the range of operating conditions.
 2. Wet Pit Applications: Capable of running continuously in totally dry condition under full load without damage for a cleaning cycle; 15 minutes maximum.
- E. Pump/motor shaft: Type 420 or 431 stainless steel.

1. Operating at Pump Design Point:
 - a. Shaft Deflection at Lower Seal Face: 0.2 mm maximum
 - b. Shaft Deflection at Wear Ring Area: 0.45 mm maximum.
 2. Permanently lubricated ball bearings sized to withstand axial and radial forces.
 3. Bearing Life: ABMA Minimum L-10: 100,000 hours rated at pump BEP.
- F. Pump motor, its Appurtenances, and Cable: Capable of continuous submergence underwater without loss of watertight integrity to depth of 65feet. Mating surfaces: Machined, fitted with O-rings for watertight sealing.
- G. Power and Control Cable Entry System: Design precluding specific torque requirements ensuring a water tight and submersible seal.
1. Certified by UL or FM to have passed pull-testing requirements.
 2. Chamber and motor: Separated by a stator lead, sealing gland or terminal board, which isolates the motor interior from foreign material gaining access to pump motor top.
 3. Field serviceable.
 4. Entry Into Lead Connection Chamber: Epoxy encapsulated for positive moisture sealing. Cable Grommet: BUNA-N, in addition to epoxy sealed leads.
- H. Power Cables, Conduits and Accessories:
1. Supply pumps with power and sensor conductors.
 2. Pump motor cables: Sized to meet applicable NEC requirements.
 3. Cables: Exceed industry standards for oil, gas and sewage resistance.
 - a. Type SPC or SEOW insulated cables with double jacketed protection system.
 - 1) Outside: Neoprene or chlorinated polyethylene.
 - 2) Inside: Synthetic rubber.
 - b. Individual conductors: Type RUW.
 - c. Sufficient length so cables are continuous between pump and disconnect. No splices allowed.
 - d. If more than one cable is provided per pump: Contractor must furnish and provide for installation of additional conduits, etc. as required for each additional cable.
 - e. One cable per conduit allowed at pump station.
 - f. Conduit: Sized per manufacturers recommendations. Not smaller than 3/4-inch.
 4. Contractor: Furnish required stainless steel conduit hardware and fittings.
 5. Water tight connectors equal to Crouse-Hinds Type "CGB", with neoprene lands to be furnished and installed in control panel enclosure or disconnect to terminate each conduit and seal each cable entry.
 6. Conduit Seals: Equal to Crouse-Hinds Type "EYS".
 7. Coordinate the installation of the above materials with the Manufacturer.

2.5 VARIABLE FREQUENCY DRIVES

- A. Speed Control for Variable Speed Pumps: Variable Frequency Drives, as specified in Section 262923.25, suitable for installation as shown on the Drawings.

2.6 PUMP/MOTOR PROTECTION SYSTEM

- A. Pump/Motor Protection System: To monitor machine temperature, and moisture.
 - 1. Warning and shutdown protection.
 - 2. UL listed.
 - 3. Protective and Monitoring Sensors: Connected to electronic module which provides a signal from the pump/motor sensors to devices located in pump/motor protection equipment.
 - 4. Modules: Manufactured by Benshaw, Sulzer, or equal.
- B. Detailed Operational Data: Accessible via computers using common web browsers. No special software required.
 - 1. Alternatively: Data may be transferred to a higher level distributed control system such as a Supervisory Control and Data Acquisition (SCADA) system.
- C. Pump/Motor Protection System: Monitor each pump/motor's temperature and moisture (leakage).
- D. Protection and Monitoring Sensors:
 - 1. Over Heating Protection:
 - a. Motor Winding Bi-Metallic Thermal Switches or Thermistors: Quantity of three.
 - 1) One installed in each motor stator phase winding. Connect in series to monitor and protect winding from over temperature operation.
 - 2) Upon a High Temperature Event: Thermal switches shall open, activating an alarm and stopping the motor.
 - 2. Temperature Probes: PT-100; Platinum, 100 ohm, 2 or 3-wire.
 - a. Accurate Temperature Monitoring of Bearings:
 - 1) One installed in bearing housing holding the main bearing.
 - b. Direct Stator Temperature Read-Out of Winding:
 - 1) One installed on a motor stator phase winding.
 - 3. Water Intrusion Detection:
 - a. Motor Stator Chamber: Float-type moisture leakage sensor (stator FLS). If activated, FLS to activate an alarm.

- b. Motor Electrical Connection (Cable Junction) Chamber: Float-type moisture leakage sensor (electrical connection FLS). If activated, FLS to activate an alarm.
 - c. Mechanical Seal Lubrication Chamber; Between Inner and Outer Mechanical Seals: Water-in-oil or water-in-air capacitive type moisture sensor. If activated, to activate an alarm.
4. Relays Associated with Monitoring and Protective Devices: Furnished by Manufacturer.

2.7 FILTRATE PUMP STATION CONTROL SYSTEM

A. Level Monitoring System – Float Switches (LSL.LSM & LSH-1040)

1. Provide three float switches, mounting/support hardware and termination box as specified in Section 407276 and as shown on drawing I-3 and I-4. Floats are to be mounted at elevations shown on drawing M-6.
2. A NEMA 4X, 316SS Intrinsic Safety Barrier (ISB) Panel is required for each of the three float switches. ISB's are specified in Section 407856.

B. Local Control Panel (LCP-1040)

- a. Control panel enclosure equipment and requirements are specified in Sections noted in paragraph 1.2.B., "Related Requirements". Control panel to be built in accordance with all of these requirements and spare parts provided as noted.
 - 1) Control panel to meet the general electrical requirements: Comply with NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum)
 - 2) Comply with NEMA ICS 6: Industrial Control and Systems: Enclosures.
 - 3) Comply with NFPA 70.
 - 4) Comply with UL 508A.
 - 5) Control panel shall be equipped with individual motor lock out tag out disconnect switches. Comply with UL 98.
 - 6) Control panel shall operate on a power supply of 480 volts, 3-phase, 60 hertz.
 - 7) Surface-mounted, cabinet rated NEMA 4X, Type 316 stainless steel, minimum 14 gauge certified industrial control panel.
 - 8) Control panel shall have a minimum overall short-circuit current rating (SCCR) of 65kA.
 - 9) Control panel shall be equipped with a UL 98, inner door interlocked fused main disconnect switch.
 - 10) Control panel consists of a main circuit breaker, motor circuit protector (MCP) and motor controller for each motor, and a control power transformer 120V secondary (fused on primary and secondary) along with other devices specified. Mount all control components in one common enclosure. Starter control panel sized to match voltage and horsepower of the motor to be controlled.
 - a) Main Breaker: Thermal-magnetic air circuit breaker, Schneider Electric/Square D PowerPact Type or approved equal. Ratings for Continuous and Short Circuit Current: Matching upstream protective device.

- b) MCP: Molded case motor circuit protector with adjustable magnetic trip only, Schneider Electric/Square D “Mag-Gard” or equal.
 - c) Motor Controller: Full Voltage Motor Starting. Open frame, across-the-line, NEMA-rated magnetic motor starter, Schneider Electric/Square D Class 8536 or equal. Solid state overloads with Class 10/20 selectable tripping. Submersible motors shall use Class 10 trip curve.
- 11) SPD: The control panel shall be provided with a surge protective device (SPD) rated for 100kA per mode for the incoming power. SPD shall be mounted within the control panel enclosure. Lead lengths shall not be longer than 12 inches from the main circuit breaker.
- b. Adhere to requirements for surge protection for all incoming signals entering this panel in accordance with specification Section 407856.
 - c. Provide Hand-Off-Auto selector switch, status indicating pilot lights for running motor fault, motor protection panel and high level alarm, an hour meter, alarm reset pushbutton. All of these items to be located on concealed door behind “dead front” door.
 - d. The system shall communicate with plant SCADA system by providing interposing relays for the following digital signals as shown on drawing I-3:
 - 1) Filtrate Pump “Running” status
 - 2) Filtrate Pump Fault (common alarm for any fault condition in panel including alarms from motor protection panel).
 - 3) Filtrate Pump Station High Level Alarm
 - 4) Filtrate Pump Station Low Level
 - e. Interlocks: When HOA selector switch is in Auto, the filtrate pump will automatically start and stop based on float LSM-1040 (On) and LSL-1040 (off) A high level float (LSH-1040) will trigger a high level alarm if float stays energized for more than 5 seconds (operator adjustable between 0-60 seconds). When HOA selector switch is in Hand, the sump pump will run. The filtrate pump will not be able to be restarted until all active alarm conditions are cleared and corresponding alarm reset pushbutton is pressed (either for Motor Protection alarms or general control panel alarm reset for fault and high level alarm).

2.8 GUIDE RAILS AND PUMP LIFTING DEVICE

- A. Pumping Station: Furnish with necessary, stainless steel upper guide holder and level sensor cable holder.
- B. Lower Guide Holders: Integral with discharge connection.
 - 1. Dual guide rails: Schedule 40, welded 3 inch minimum diameter, Type 316 stainless steel pipe of length as required by Drawings.
 - 2. Single guide rails and guide cables are not acceptable.
- C. Intermediate Guide Brackets: Furnished and installed.

1. Unsupported Guide Rails: No longer than 20 feet, Type 316 stainless steel.
- D. Cable Holders Including Cable Hooks: Fabricated from Type 316 stainless steel plate.
1. No sharp corners or edges that would abrade or cut electrical cable insulation.
 2. Cable Holders: Sufficient length and strength to support each separate cable.
 3. Pump power and lift cables may use the same hook position, provided cables do not foul one another and lift cable is easily accessed from hatch opening.
- E. Chain and Latch Device: To facilitate pump removal from wet well without a series of incremental lifts. Design device to be lowered along guide rails and remotely latch to pump lifting bail without requiring wet well entry.

2.9 SHOP PAINTING

- A. Pump and Associated Equipment: Shop-primed and finished-coated per Manufacturer's standard practice prior to shipment. Color: Manufacturer's standard.
1. Touch-Up Paint: Supplied by Manufacturer.
- B. Interior and Exterior Pump Surfaces, Motor Enclosure and Exterior and Interior of Cooling Jacket: Supplied with Manufacturer's standard epoxy coatings. Cleaned, dry, free of rust, mill scale, grease, dirt, and other foreign matter.
- C. Nameplates: Protect during painting.

2.10 SOURCE QUALITY CONTROL

- A. General:
1. The Engineer has the right to inspect any equipment furnished under this Section prior to shipment from place of manufacture.
 2. Notify Engineer in writing ten working days prior to initial shipment, so arrangements can be made for inspection by the Engineer.
- B. Factory Pump Testing: Performed by Manufacturer.
1. Test pumps as described in ANSI/HI 11.6, American National Standard for Rotodynamic Submersible Pumps for Hydraulic Performance Acceptance Tests, as specified.
 - a. Submit for approval by Engineer the proposed pump factory test plan. Engineer to review in writing prior to testing. Include milestone schedule; factory inspection, testing, shipping, and job site delivery.
 2. Perform hydrostatic test on pressure-containing components per ANSI/HI 11.6 on pumps prior to shipment.
 3. Examine cast surfaces of components by visual inspection per MSS SP-55.
 4. Factory pump tests are the basis of acceptance of hydraulic performance of pumps.
 - a. Factory test pumps prior to shipment per Hydraulic Institute standards.

- b. Test and Record: Flow rate, total head, overall efficiency and input KW for at least five points on pump performance curve.
 - 1) Include the points specified in “Conditions of Operation” Article in Part 2.
 - c. Pumps failing to meet specification requirements are required to be modified to meet specification requirements. If reasonable attempts to correct inefficiencies are unsuccessful, replace pumps with units meeting specified requirements.
5. Certified Pump Performance Curves: Submit test data to Engineer for approval prior to shipment. Include total head, flow rate, overall efficiency and total brake horsepower for each pump supplied.
 6. If Manufacturer does not have historical test records for NPSH3 at specified design pump speed, test one pump to demonstrate NPSH3 versus flow rate. Any alternative testing shall be submitted to Engineer for review.
 7. Meters, Gauges, and Other Test Instruments: Calibrated within manufacturer's established time period prior to scheduled test.
 - a. Provide calibration certification data.
 - b. If Manufacturer has no ISO standard calibration period, Hydraulic Institute Standards governs.
 8. Test pumps at 100 percent of design speed. Determine reduced speed curves using affinity laws.
 9. Test pumps through specified range of flow, and head/flow rate/ efficiency curves plotted at maximum output speed.
 - a. During each test, run pumps at each head condition for sufficient time to accurately determine flow rate, head, power input, and efficiency.
 - b. Determine the overall efficiency at each test point.
 - c. Modify pumps under test until specified conditions are met or replace with pumps meeting specified conditions.

C. Dynamic Vibration Analysis

1. The dynamic vibration analysis required by the following paragraphs shall be performed by:
 - a. Mechanical Solutions Inc. (MSI) of Whippany, NJ.
 - b. DynaTech Engineering, Inc. of Auburn, CA.
 - c. Engineering Dynamics Inc. (EDI) of San Antonio, TX.
 - d. Or equal approved by the Engineer
2. Minimum and maximum operating speeds: As specified in “Conditions of Operation” Article.
3. Wet-pit Mounting: Conduct factory testing to demonstrate compliance with specified vibration characteristics when the wet pit mounted pumping system includes variable speed operation with motors at or above 90 HP or constant speed motors at or above 134 HP (100 kW).

- a. Equip each pump with a vibration sensor and data processor to measure and record the vibration velocity (inches per second RMS) and displacement (mils peak to peak).
 - b. If operating speed range includes operation below 600 rpm over the full range of operating conditions specified. Test with setup that matches actual installation as closely as practicable and in accordance with ANSI/HI 11.6.
 - c. Submit specific test procedure for approval by Engineer a minimum of six weeks prior to the testing.
4. Dry-pit Mounting: Conduct factory testing to demonstrate compliance with specified vibration characteristics when variable speed operation with motors at or above 90 HP or constant speed motors at or above 134 HP (100 kW)
- a. Prior to manufacture, submit required vibration analyses outlined herein verifying that the specified requirements will be met.
 - b. Minimum and maximum operating speeds will be in accordance with the operating speeds required to satisfy the conditions of operation.
5. Dry-pit Mounting: For VFD speed-controlled pumps below 90 HP.
- a. Prior to manufacture, submit a statement certifying that no torsional or lateral critical speeds are in or near the operating speed range based upon historical analysis results for the specified pump model.
 - b. Match to proposed pump/motor confirming that the first torsional and lateral critical speeds are at least 20 percent above the maximum pump speed and blade pass frequency or 20 percent below the minimum pump speed, assumed to be 50 percent of the full load speed.
6. Factory test each pump, including the cables suspended as designed, to demonstrate that no harmful resonance of the system occurs under the following conditions:
- a. 1 times full speed.
 - b. 2 times full speed.
 - c. Number of vanes times running speed.
 - d. Any bending mode natural frequencies within the operating range insert range for speed controlled pumps plus 20 percent separation margin above and below.
 - e. Submit detailed test report with findings.
7. Structural Dynamic Analysis: The combined pump, motor, nearby foundation, and piping out to the first pipe restraint or expansion joint.
- a. Do not assume foundation is rigid.
 - b. Incorporate foundation design shown on Drawings.
 - c. Verify no first or second bending mode frequencies exist within a pump speed and vane pass frequency range from 20 percent below minimum operating speed recommended by manufacturer to 20 percent above maximum operating speed.
8. Lateral Rotodynamic Analysis:
- a. Identify and predict that first lateral critical speed is 20 percent above the maximum pump speed and vane pass frequency or 20 percent below the minimum pump speed.

- b. Any Pump Component Excited Resonant Frequency: No closer than plus or minus 20 percent of natural frequency of any part of installed assembled pumping unit.
 - 1) Any lateral rotordynamic frequencies not satisfying the plus or minus 20 percent margins must not result in a forced damped response allowing contact between shaft and journal bearings.
9. Campbell Diagrams: Submit documenting the following:
 - a. Structural lateral.
 - b. Rotating component lateral.
 - c. Torsional analysis results.
 - d. Graphically demonstrate the separation margins specified above.
10. Maximum Vibration Velocity, Inches per Section RMS: Conform to ANSI/HI 11.6 requirements through pump operating range. Include displacement vibration results.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Take necessary field measurements. Determine exact dimensions for Work and required sizes of equipment under this Contract. Verify all pertinent data and dimensions.

3.2 INSTALLATION

- A. Install equipment per Manufacturer's instructions and recommendations in locations shown on the Drawings.
- B. General: Unless instructed otherwise by Manufacturer's instructions.
 1. Oil and Grease for Initial Operation: Supplied by Contractor.
 2. Baseplates or Base Elbows for Pumps: Installed by Contractor conforming to Manufacturer recommendations and instructions.
 3. Anchor Bolts: Set per Manufacturer's recommendations.
 4. Pump Seal Against Discharge Connection:
 - a. Baseplate and Associated Accessories: Installation requirements.
 - 1) Sole Plates: Install, level and grout per API RP 686, Chapter 5 – Mounting Plate Grouting.
 - 2) Jacking Bolts: Back off after grouting so they do not support any of the load.
 - 3) Jacking Bolt Bearing Disks: Placed under each jack bolt.
 - 4) Plastic Vent Tubes: Spaced as recommended by manufacturer.
 - 5) Grout: Mix and apply according to manufacturer's directions.
 - 6) Manufacturer Representative Presence: Is mandatory during pouring of epoxy grout as well as use of rigid non-absorbing formwork and a head box.
 - 7) Surface of formwork in contact with epoxy grout must be covered with a layer of paste wax to facilitate removal.

- 8) Clearance between the concrete surface and bottom surfaces of sole plates to be per Manufacturer's recommendation.
- 9) Concrete surface in contact with epoxy grout:
 - a) Chipped to present a slightly rough surface and remove the laitance.
 - b) The surface must then be cleaned of all dust, moisture and oil.
 - c) Place thin layer of leveling grout under jacking bolt bearing discs.
 - d) Place Plastic Vent Tubes: Sized and spaced per manufacturer's recommendation, under sole plates to vent air during grouting and prevent voids in epoxy grout.
- 10) Annular Space Between Anchor Bolts and Anchor Bolt Sleeve: Filled with expanding urethane foam.
 - a) Threads of anchor and jack bolts in contact with grout to be covered with paste wax and a layer of duct tape.
 - b) After alignment tolerances are met: Tighten anchor bolts snug to prevent movement during the pour.
 - c) Epoxy grout is not to extend above the top edge of the sole plates.
 - d) After the epoxy grout has fully cured, within 24 to 48 hours after pouring, remove jack bolts and tighten anchor bolts tightened to torque levels recommended by Manufacturer.
- 11) Threaded Jack Bolt Holes: Coat with grease. Clean jack bolts of paste wax and duct tape then reinsert and secure in position with a lock nut to within 1/4 inch of bottom of hole.
- 12) After grouting, chip and patch edges to present a smooth finish.

C. Upon Completion of Each Pump Application: Manufacturer shall inspect installation.

1. Satisfactory Inspection: Submit certificate stating equipment installation is satisfactory and meets Manufacturer's installation, operation and maintenance manuals. State equipment is ready for operation, and operating personnel have been suitably instructed in operation, lubrication and maintenance of each unit.

D. Ensure Proper Installation: If Contractor does not provide qualified installation staff during installations, the Engineer may require Contractor to provide services of Manufacturer's factory representative to give necessary instruction and supervision.

3.3 INSPECTION AND TESTING

A. General:

1. Prior to Shipment from Place of Manufacture: Engineer reserves right to inspect furnished equipment meeting this Section's specified requirements.
 - a. Manufacturer to notify Engineer in writing 30 business days prior to initial shipment, so arrangements may be made for inspection by Engineer.

2. Field Tests: Not be conducted until pumping system, including controls, is complete and ready for testing.

B. Field Pump Test:

1. Manufacturer to furnish services of a representative having complete knowledge of proper operation and maintenance to inspect final installation and supervise test run of equipment.
 - a. Pump Pricing: Include minimum eight hours of representative's time for field pump testing.
2. Written Test Procedures: Submit to Engineer for approval 30 days prior to testing.
3. Contractor to furnish water, power, facilities, labor, materials, supplies and test instruments required to conduct field testing.
4. Final Acceptance Tests: Demonstrate these Specification requirements have been met by equipment as installed.
 - a. Contractor to, at a minimum, verify the following:
 - 1) Pumping units are properly installed and in correct alignment.
 - 2) Correct lubrication per manufacturer's instructions.
 - 3) Correct direction of rotation of motors and reverse connections, if necessary.
 - 4) Pump units operate without overheating or overloading and without objectionable vibration.
 - 5) No mechanical defects in any of the parts.
 - 6) Pump units deliver specified total head and flow rate to demonstrate units generally meet requirements specified. Factory performance test is basis of pump acceptance.
 - 7) Sensors and controls perform satisfactorily as to sequence control, correct start and stop elevations, and proper level alarm functions.
 - 8) Signals connected to plant control system are functioning properly and tested with control system programmer.
5. If pump unit performance does not meet specifications, take corrective measures or remove and replace with pumps which satisfy conditions specified.
6. Continuous Operating Period: A five-day period of pump units' operation is required before acceptance. Pump units failing during this period shall be repaired or replaced. Continuous operating period shall then be restarted; resetting run time to zero.

C. Field Vibration Testing: In presence of Engineer.

1. Small or Constant Speed Pump Units: Test per ANSI/HI 11.6 at full speed operation, by a minimum level III qualified vibration technician as defined by Vibration Institute or equivalent.
 - a. Verify the Following:
 - 1) Compliance with specified limitations

- 2) There are no field installed resonant conditions due to misalignment, the foundation, or connecting piping and its supports, when operating at any speed within the specified operating range.
2. Pumping Systems Variable Frequency Drives or Motors 100 HP or Larger: After installation, and as soon as conditions permit full speed operation.
 - a. Contractor to retain services of fully qualified independent mechanical vibration testing and analysis firm.
 - 1) Acceptable Firms:
 - a) Mechanical Solutions Inc. (MSI) Whippany, NJ
 - b) Engineering Dynamics Inc. (EDI) San Antonio, TX
 - c) Other organization pre-approved by Engineer.
 - b. Perform detailed vibration signature analysis of units per ANSI/ISO 11.6, including "Bump Tests" and X-Y vibration profiles.
 - 1) Verify the following:
 - a) Compliance with the specified vibration limitations and
 - b) There are no field installed resonant conditions due to misalignment, the foundation, or the connecting piping and its supports, when operating at any speed within the specified operating range.
 - c. Testing Speeds:
 - 1) Design full speed.
 - 2) Design minimum speed.
 - 3) A maximum of 3 Hz increments between minimum and full speed.
 - d. Written Report: Submit. Include detailed schematic drawings of pump units.
 - 1) Indicating on schematics where and in which direction vibration readings were taken and recorded. Document the following on schematics.
 - a) Peak-to-peak displacement, in mils.
 - b) Frequency spectrum
 - c) Peak velocity level, in inches per second,
 - d) Velocity level, in inches per second RMS.
 - 2) Report must contain a complete analysis of findings. Describe any problem encountered; probable cause, and specific recommendations for required corrective action.
 - e. When System is Furnished with Vibration and Temperature Monitoring System:
 - 1) Motor vibration sensor may be used for acceptance testing.
 - 2) Temporary surface mounted sensors mounted in vicinity of installed sensor is preferred to establish accuracy of permanently installed system.

- f. Take Corrective Action if Required: Retest units to ensure full compliance with this Specification.
 - g. Costs for Field Testing and Required Corrective Actions: Borne by Contractor.
 - h. Follow Up Testing: Repeat vibration testing and analysis specified, six months after initial vibration signature testing.
 - 1) Prepare report comparing six month and signature test results.
 - 2) Significant worsening of vibration, as determined by Engineer, during six month tests shall require corrective action and retesting.
3. Take corrective action if required. Have units retested to ensure full compliance with the specified requirements. All costs associated with field tests or any required corrective action to be borne by the Contractor.

3.4 MANUFACTURER SERVICES INCLUDING OPERATING INSTRUCTIONS

A. Installation Inspection and Startup:

1. Contractor to include in bid price, providing services of Manufacturer's factory representative having complete knowledge of proper operation and maintenance.
 - a. Representative to instruct Owner representatives and Engineer on operation and maintenance.
 - b. Instruction may be conducted in conjunction with inspection, installation and start-up of pump units.
 - c. If there are difficulties in equipment operation due to design or fabrication, additional service to be provided until performance is as specified.
 - d. Listed Service Requirements: To be exclusive of travel time, and will not limit or relieve Contractor of obligation to provide sufficient service necessary to place equipment in satisfactory and functioning condition.
2. Installation Inspection: Complete review of installation per Section 014000 Quality Requirements.
 - a. Written Installation Certification: Installation is complete and operable in all respects, per Manufacturer's information and instructions and no conditions exist which may affect warranty.
 - b. Qualified supervisory services, including Manufacturers' Factory representatives, to be provided to ensure installation is done in a manner approved by Manufacturer.
 - c. Manufacturer's factory representative to supervise and approve:
 - 1) Installation and alignment of pumps with motors.
 - 2) Grouting.
 - 3) Alignment of connecting piping and installation of field installed packing or mechanical seal.
 - d. Start-Up or Operation Difficulties due to Manufacturer's Design or Fabrication:
 - 1) Manufacturer to provide additional service until performance is as specified.

- e. Services of Manufacturer's factory representative and training to be provided when first pump unit is started, with follow-up visits upon start-up of each subsequent pump unit.
 - f. Minimum Time On-Site: One 8 hour day per pump.
3. Start-Up:
- a. Written Field Report. Summarize test procedures and results. Include tested and measured variables. Show installation meets performance requirements of this specification and project.
 - b. Tested and Measured Variables: Including but not limited to the following.
 - 1) Flow rates.
 - 2) Total heads.
 - 3) Shaft-speed.
 - 4) Vibration measurements.
 - c. Minimum Time On-Site: One 8 hour day per pump.
- B. Training:
- 1. Field and classroom instruction on operation and maintenance of the equipment.
 - a. Include start-up, shut-down troubleshooting, lubrication, maintenance, and safety.
 - 2. Manufacturer to provide detailed manuals to supplement training courses.
 - a. Include specific details of equipment supplied and operations specific to project.
 - b. If required, make use of teaching aids, slide/video presentations, etc.
 - 3. After Completing Training Services: Deliver training materials used by Manufacturer to Owner.
 - 4. Minimum Time On-Site: One 8 hour day.
- C. Contractor is solely responsible for the following:
- 1. Requesting inspection and training services
 - 2. Coordinating requests with other relevant trades.
 - 3. Ensuring effectiveness of Manufacturers' service.
 - 4. If lack of coordination by Contractor results in need to recall Manufacturer's factory representative, time lost will not be counted against above days.

END OF SECTION 432513

SECTION 434111 - GLASS-COATED BOLTED STEEL STORAGE TANKS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and design, fabricate and erect a glass-coated, bolted steel storage tank including foundations, tank structures, and tank appurtenances as shown on the Drawings, the appended figures and as specified herein. Painted or galvanized bolt together tank are not acceptable.
- B. Tank shall be designed and produced by a manufacturer specializing in the production of glass-coated, bolt-together steel tank systems.
- C. A site and project specific foundation designed by the tank manufacturer with a New York State PE stamp must be submitted with the tank submittals

1.2 RELATED WORK

- A. Earthwork is included in Section 312000.
- B. Granular materials are included in Section 310515.
- C. Ductile iron pipe and fittings is included in Section 400519
- D. Thermoplastic pipe and fittings is included in Section 400531.
- E. Concrete is included in Division 3.
- F. Instrumentation work is included in Division 40.

1.3 SUBMITTALS

- A. Submit, in accordance with Section 013300, shop drawings showing details of construction and erection as follows:
 - 1. A list of ten tanks installed by the tank manufacturer that are in use by Northern U.S. climate customers for waste water storage service. These tanks shall be of the same size or larger capacity and material of construction as specified herein, and the tanks shall have been operating to the satisfaction of the owners for a minimum of 5 years. Include in this list the names and telephone numbers of the owners and design engineers.
 - 2. Complete fabrication, assembly, support, and structural drawings together with design criteria, specifications, and data covering the materials and appurtenances to be furnished and the design of the tank and piping, the concrete foundation and service platforms. Drawings shall be signed and sealed by a licensed professional structural engineer registered in the State of New York. At a minimum, details for the following items shall be provided:

- a. Storage tank
 - b. Manway
 - c. Roof hatch and step-off platform
 - d. Roof vent
 - e. All piping connections
 - f. Fittings
 - g. Overflows with pipe support bracket clamps
 - h. Cathodic protection system
 - i. Ladders, including cage and locked gate for exterior ladder.
3. Design and detail drawings of the foundation slab and tank anchorage signed and sealed by a licensed professional structural engineer registered in the State of New York.
 4. Upon completion of construction of the tank, submit structural design calculations of the "as-built" tank signed and sealed by a structural engineer registered in the State of New York. Calculation shall be submitted for record purposes only and will not be reviewed by the Engineer. Calculations shall include, but shall not be limited to a description of the structural design loading conditions used for the design of the entire tank, including the foundation and a description of the structural design method and codes used in establishing the allowable stresses and safety factors applied in the design. Identify all forces transferred into the foundation and methods of transfer of forces to the foundation subgrade.
 5. Instructions for the erection and maintenance of the tank. Instructions shall include, but shall not be limited to bolt installation, gasket and/or sealant application, coating report, foundation work and cleanup.
 6. Manufacturer's certification that the tank has been manufactured in accordance with AWWA D103.
 7. Manufacturer's quality assurance/quality control document describing procedures to be followed during fabrication.
 8. Submit for selection manufacturer's standard colors and non-standard options along with any any additional costs from the manufacturer.
 9. Submit representative sample of "Edge coating" utilized on the proposed tank system.
 10. Submit representative sample of glass coating utilized both inside and outside of the tank.

B. Copies of the following test reports shall be furnished to the Engineer:

1. Manufacturer's mill test reports for plate and roof framing materials.
2. Mil thickness test and holiday detection test for glass coating.
3. At the conclusion of the work, a written report prepared by the tank manufacturer, certifying that the work was inspected in accordance with Section 11 of AWWA D103. This report shall meet the requirements of Section 11 and also cover the hydrostatic test.

1.4 REFERENCE STANDARDS

A. International Conference of Building Officials (ICBO)

1. Uniform Building Code (UBC)

B. New York State Department of State, Division of Code Enforcement and Administration

1. Building Code of New York State

- C. American Concrete Institute (ACI)
 - 1. ACI 350R - Environmental Engineering Concrete Structures
- D. American Society for Testing Materials (ASTM) International
 - 1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Conditions (Nonextruding and Resilient Bituminous Types)
- E. American National Standards Institute (ANSI)
 - 1. ANSI A10.4 - Requirements for Personal Hoists, Safety.
 - 2. ANSI A14.3 - Ladders - Fixed - Safety Requirements.
- F. American Water Works Association (AWWA)
 - 1. AWWA D103 - Factory-Coated Bolted Steel Tanks for Water Storage.
- G. Society for Protective Coatings (SSPC)
 - 1. SSPC SP-10 – Surface Preparation Specification No. 10 Near-White Blast Cleaning.
- H. Occupational Safety and Health Administration (OSHA)
- I. The New York State Building Code.
- J. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. The tank manufacturer shall have a minimum of ten installed tanks that are in use by Northern U.S. climate customers for waste water storage service. These tanks shall be of the same size or larger capacity and material of construction as specified herein, and the tanks shall have been operating to the satisfaction of the owners for a minimum of 5 years. Manufacturers lacking the experience requirement shall provide a satisfactory 100 percent cash bond for the length of the coating warranty period, which is 5 years with cathodic protection.
- B. The tank manufacturers authorized dealer shall be the erector of the tank and shall be specialists in the construction of bolted, glass-fused-to-steel tank.
- C. The tank manufacturer shall certify that it has a Factory Mutual inspection of its manufacturing facilities annually to establish and review quality control procedures.
- D. All shell, floor and roof penetrations shall be adequately reinforced to transfer vertical, tangential and horizontal stresses; seismic load; and incidental differential settlement
- E. The tank manufacturer shall provide a site specific design for the storage tank. The design shall be signed and sealed by a professional engineer licensed to practice in the State of New York.

- F. The tank is subject to review by the New York State Department of Environmental Conservation.
- G. The tank shall be an Aquastore Tank as manufactured by CST Storage, or equal.

1.6 TANK DESCRIPTION

- A. The primary liquid anticipated to be stored in the tank is landfill leachate (S.G-1.05) with a pH of about 8.0 and a temperature of 32 degrees F to 80 degrees F.
- B. The tank shall be bolted glass-fused-to-steel tank meeting the following size(s):
- C. New Waste Handling Tank
- D. Nominal capacity: 128,510 gallons
- E. Useable capacity: 108,000 gallons
- F. Nominal diameter: 25.18 ft
- G. Nominal sidewall height: 31.07 ft
- H. Max. liquid depth: 29.07 ft
- I. Freeboard: 24 inches
- J. The following accessories shall be provided for each tank. They shall be located as indicated on the Drawings.
 - 1. One 30-in by 30-in roof access hatch per tank. The hatch shall have a minimum 4” raised curb with hinged cover and downward overlap of at least 2-in with hasp for lock.
 - 2. One tank inlet and one outlet connection, at the sizes shown on the Drawings, shall be provided through the tank floor. Pipe connections shall be located in accordance with the manufacturer's recommendation. Suitable reinforcement shall be provided around each pipe connection.
 - 3. One hot dip galvanized steel flanged manway with a diameter of 30-in shall be provided in the sidewall of each tank. The manways shall be placed with the centerline approximately 3’-0” above the tank floor. Manways shall have a watertight seal and the openings shall be suitably reinforced. Manways shall be bolted using Type 316 stainless steel hardware and utilize a davit arm assembly for easier access.
 - 4. One properly sized air vent assembled in accordance with AWWA D103 shall be provided. The vent shall be sized by the tank manufacturer and installed above the maximum water level. The vent shall be sized so that at the maximum rate of water fill (450 gpm) and withdrawal 450 gpm. The vent shall be constructed of aluminum and shall include a 24 mesh non-corrodible screen to prevent the entrance of birds or other animals.
 - 5. The overflow weir boxes at an elevation of 18 inches below the top of the tank sidewall. Each weir box shall have an overflow pipe located on the exterior of the tank that extends underground to connect to the effluent line. Each weir box shall be a minimum of 18 inches in length, 23-1/2 inches wide, and shall be fabricated of 6061-T6, 5086-H34 or 5052-H36 aluminum, with 0.25-in minimum thickness. The overflow box shall have a

design capacity of 450-gpm. The use of multiple weir boxes on each tank is acceptable to meet these flow rates. Each overflow shall include a 24-mesh non-corrodible screen to prevent the entrance of birds or other animals, installed within the overflow at a location least susceptible to damage by vandals.

6. Ladders, manway, roof hatch and vent shall be as shown on the Drawings. All components shall conform to AWWA D103, with the ladders and cage meeting all OSHA requirements.
7. Ladders
 - a. The aluminum ladders shall be at locations shown on the Drawings. Ladders, ladder accessories and ladder clearances shall conform to the requirements of OSHA and EM 385-1-1. The more stringent requirements shall apply.
 - b. Exterior ladders shall be provided with walk-through rail extension, and shall extend no less than 42-in above the landing. Rail extensions shall conform to the requirements of OSHA and EM 385-1-1. The more stringent requirements shall apply. Rail extensions shall provide not less than 18-in of walk through space between the rail and a fall prevention device.
 - c. The ladders shall be fitted with a fall prevention device conforming to the requirements of OSHA and EM 385-1-1. The more stringent requirements shall apply. The interior ladder shall be fitted with a removable fall prevention device extension. Two climbing belts shall be provided to the Owner. Provide stainless steel hardware and fasteners, accessories, and all other materials required for the complete installation.
 - d. The ladder must not have a fall cage.
 - e. The ladder is to have a 3M DBI Lad-Saf X2 (rated for two people).
 - f. Must be a cable lifeline system with safety cable grab.
 - g. There is to be a step-off platform.
 - h. The vertical cable must end ABOVE the step-off platform. There is to be no below-platform disconnect.
 - i. Secondary fall protection lanyard must be able to transfer to the horizontal railings or another horizontal lifeline system at the step-off platform. This has to be able to accommodate 5,000 lbs per employee attached.
 - j. The ladder is to be retractable and not accessible from ground level.
8. Cathodic Protection System
 - a. A cathodic protection system especially designed for a glass-fused-to-steel tank.
 - b. The system shall be a passive type utilizing a specially designed system of magnesium or zinc anodes with steel cores mounted on the floor of the tank.
 - c. Anodes shall be externally connected to the tank utilizing specially calibrated resistance lead wires such that the electrical current output from each anode or assembly can be conveniently measured.
 - d. The system shall protect and control corrosion of the submerged portion of the tank wall and floor.
 - e. The design life of the cathodic protection system must be a minimum of 10 years. Electrical continuity shall be provided between all tank sidewall.
9. Tank Mixer
 - a. Tank mixer shall be installed through the 24" roof ventilator.
 - b. Tank mixer shall meet the following requirements:

- 1) Height: 22 inches
 - 2) Material, housing: 316 Stainless Steel
 - 3) Material, air distribution housing: Glass filled polypropylene and EPDM.
 - 4) Retrieval Chain: at least 50 feet of 316 stainless steel chain.
 - 5) Wiring: UL-listed submersible pump cable 14 AWG
 - 6) Enclosure: Manufacturer supplied weather resistant enclosure
- c. Mixer to be GridBee AP Series AP2000 by Ixom Watercare Inc. or approved equal.
- d. The air compressor unit shall meet the following requirements:
- 1) Motor Type: 120VAC, 60 Hz, 20A, 1 HP, continuous duty-cycle
 - 2) Airflow: 4.3 cfm
 - 3) Material, skid: stainless steel
 - 4) Pressure gauge range: 0-60 psi with pressure relief
 - 5) Max. pressure: 40 psi
- e. Air compressor unit to be AC655 by Ixom Watercare Inc. or approved equal.

K. Design Requirements

1. Dimensions, elevations and locations of penetrations and appurtenances shall be as shown on the Drawings and/or as specified herein.
2. Design Loads
 - a. Dead load of the tank and its accessories, and live load of the contained liquid, shall be as specified in AWWA D103.
 - b. Roof Live Load: in accordance with the Building Codes, but minimum of 15-psf uniform. Concentrated roof live loads shall consist of a single vertical load of 500 lb applied to any 10-ft² area of the tank roof. This load need not be combined with the uniform roof live load specified. The roof plating may temporarily deflect between structural supports when live loads are applied, however, no permanent deflection will be permitted after the load is removed.
 - c. The tank shall be designed for snow, wind and seismic loads in accordance with the Building Codes and AWWA D103. Tank discontinuities shall be designed for localized pressures calculated in accordance with Chapter 23 of the UBC.
 - d. Platform and ladder loads shall be in accordance with AWWA D103.
 - e. Allowable design stress of steel for the tank shall be in accordance with AWWA D103.
 - f. When multiple vertical bolt line sheets and plates of ASTM A1011 Grade 50 are used the effective net suction area shall not be taken as greater than 85% of the gross area.
 - g. When rolled structural shapes are used, the material shall conform to minimum standards of ASTM A36 or A992.
 - h. Stiffeners shall be of the “web truss” design, with extended tail to create multiple layers of stiffener, fabricated of steel with hot dipped galvanized coating. Rolled angle stiffeners shall not be permitted for intermediate horizontal win stiffeners.
 - i. Center post supports are not permitted. Both dead and live loads of the roof shall be carried by the tank walls, without additional support. Walkway and handrail shall be constructed of aluminum.

- j. The tank design shall conform to the New York State Building Code and AWWA standards.

3. Foundation

- a. The foundation shall be designed to support the structure, its live loads and seismic forces. The foundation shall be designed for a maximum allowable soil bearing pressure of 2,000-psf where the least lateral dimension (width) is at least 3.0-ft. Footings with a width less than 3.0-ft shall be designed to bear at pressures no greater than 0.67 times the width as measured in feet. The minimum footing width shall be 18-in.
- b. The tank manufacturer shall provide the foundation and anchorage design for the storage tank in accordance with AWWA D103 and the New York State Building Code. Minimum reinforcement shall be as recommended in ACI 318.
- c. At a minimum, concrete and reinforcing steel shall conform to the requirements of Division 3.

1.7 DELIVERY, STORAGE AND HANDLING

- A. All plates, members and miscellaneous parts shall be packaged for shipment in a manner that prevents abrasion or scratching of the finished coating system. Heavy paper or plastic foam sheets shall be placed between each panel to eliminate sheet-to-sheet abrasion.
- B. Materials shall be delivered to the job site, marked for proper installation, as close to the time of erection as possible.
- C. Individual stacks of panels shall be wrapped in heavy black plastic and shall be steel banded to special wood pallets built to the roll radius of the tank panels. The tank components shall be shipped from the factory to the job site by truck, and the truck that carries the tank components shall haul the tank components exclusively. The tank manufacturer shall be responsible for unloading all tank materials at the job site.
- D. Handle and store all materials carefully to prevent distortions or other damage that could affect structural, mechanical, or electrical integrity. Store all materials that are subject to deterioration by exposure to the elements off the ground in a well-drained location and protected from the weather. All materials shall be accessible for inspection and handling.
- E. Materials furnished for the tank that are determined to be defective by the Engineer shall be rejected and replaced with acceptable sheets. All materials rejected must be removed from the project site immediately and replaced with material of a quality acceptable to the Engineer. Failure to reject any material or to require removal of any such rejected material shall not relieve the Contractor from responsibility for the quality and character of material used.

1.8 WARRANTY

- A. Submit manufacturer's written warranty to cover any defects on the tank materials and coatings. At a minimum, the warranty shall provide assurance against defects in material or workmanship, under normal and proper use, maintenance and operation, for a period of one

year. The tank manufacturer shall also provide a 3-year Extended Performance Warranty against corrosion of the glass-coated surfaces in contact with the stored water.

- B. If within a period of one (1) year from the date of completion (or 14 months after delivery) the tank structure or any part thereof shall prove to be defective in material or workmanship upon examination by the manufacturer, the manufacturer will supply a replacement part, will repair, or allow a credit for same.
- C. The warranty shall be further extended with the use of Manufacturer supplied cathodic protection system as follows: the glass coated product zone surfaces, that portion of the tank interior below the normal high elevation of the contained liquid will not corrode under normal and proper use, maintenance and operation during the period expiring 60 months after liquid is first introduced into the tank.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. The selection of factory applied glass-fused-to-steel and bolt-together tank construction for this facility is based on the design criteria, construction methods specified and optimum coating for resistance to internal and external surface corrosion. Deviations from the specified design, construction, or coating details will not be permitted.
- B. The bolted, glass-fused-to-steel tank shall conform to AWWA D103 and the additional requirements specified herein. The exterior sidewall color of the tank shall be as selected by the Owner from the manufacturer's standard color options.
- C. Tank shall have a glass-coated bolted steel floor on top of a reinforced concrete floor and ringwall. The floor panels shall be the same material as the tank sidewalls. Concrete work shall be in accordance with Division 3.
- D. Ladders, manways, roof hatches and vents shall be as shown on the Drawings. All components shall conform to AWWA D103, with the ladders and platforms meeting all OSHA requirements.
- E. Pipe straps shall be of Type 316 stainless steel for interior straps and hot-dipped galvanized for exterior straps. Straps shall be placed at appropriate intervals as recommended by the tank manufacturer and shall be of sufficient size for the pipe that they support.
- F. A manufacturer's nameplate shall list each tank's serial number, diameter and height, maximum design capacity, intended storage use, and date of installation. The nameplate shall be affixed to the tank exterior sidewall at a location approximately 5-ft above finished grade elevation in a position of unobstructed view.
- G. Following the decoiling and shearing process, steel sheets shall be steel grit blasted on both sides to the equivalent of SSPC SP-10. Sand blasting and chemical pickling of steel sheets shall not be considered an acceptable method. The sheets shall be evenly oiled on both sides to protect them from corrosion during fabrication.

- H. After initial sheet preparation, all full height vertical wall sheets shall be machined and a thermal spray coating of a corrosion resistant stainless steel alloy shall be applied to all sheet edges that are to be exposed to the tank contents (interior) or the weather (exterior). The same glass coating as applied to the sheet surfaces shall be applied to the exposed edges.
- I. After fabrication and before application of the coating system, all sheets shall be thoroughly cleaned using a caustic wash and hot rinse process followed immediately by hot air drying. The tank coating system shall conform solely to Section 12.4 of AWWA D103. All sheets shall be inspected for traces of foreign matter or rust. Any sheets found with defects shall be cleaned again or grit blasted to an acceptable level of quality.
- J. All sheets shall receive one coat of a glass precoat on both sides and shall then be air dried. A second coat to both sides of the sheets of cobalt blue glass frit shall be made.
- K. The sheets shall be fired at a minimum temperature of 1500 degrees F for a sufficient period of time to ensure complete fusion of glass frit and steel sheets.
- L. A final cover coat of milled glass shall then be applied to the inside of the sheet. This milled glass shall be formulated with titanium dioxide to produce a finished interior surface with optimum toughness and resistance to conditions normally found in potable water storage tank.
- M. The sheets shall then be fired a second time at a minimum temperature of 1500°F in strict accordance with the manufacturer's ISO 9001 quality process control procedures, including firing time, furnace humidity, temperature control, etc.
- N. Minimum drying coating thickness shall be 7.0 mils. The finished inside color shall be white.
- O. All coated sheets shall be inspected for mil thickness (Mikrotest or equal). All sheets shall be checked for color uniformity by an electronic colorimeter.
- P. An electrical leak detection test shall be performed on the inside surface of each panel after fabrication. Inside wet sheet surfaces shall be inspected using a low voltage wet sponge holiday testing in accordance with ASTM D5162-91 Method A. The tester shall be used at a voltage of 67.5 volts (10%) and set so the alarm is sounded if the electrical resistance of the glass coating falls below 125,000. Test tester shall have a valid calibration record. The testing solution used to wet the sponge shall contain a low sudsing wetting agent added at a ratio of not more than 1.2 fluid oz. per gallon of water. Every sheet shall be 100% tested for holidays and any sheet with a discontinuity shall be rejected.
- Q. Alternate outside tank sidewall colors shall be separately fired over the standard cobalt blue based during milled glass application.
- R. Finished outside colors shall not vary noticeably among tank panels. Off color panels will be rejected; replacement panels of matching color shall be supplied by the tank manufacturer.
- S. Aluminum Geodesic Dome Roof
 - 1. The tank roof shall be furnished and manufactured by CST Industries, the tank manufacturer. Roofs shall be designed to AWWA D108 and ADM – 2010 and be constructed of triangular aluminum panels as shown on contract drawings. Roofs shall be clear span and self-supporting. Center post supports are not permitted. Materials shall be

- AA6005A-T61, AA6061-T6 or AA3003-H16. All metal components of the aluminum dome structure shall be aluminum or 300 series stainless steel. Alternate aluminum dome manufacturers wishing to be considered must pre-qualify with the Engineer in order to register as an acceptable alternate.
2. Connection forces shall be transferred through gusset plates connected to the top and bottom flanges of the beam struts. The connections shall be designed as moment connections; a minimum of four bolts shall be used to connect the gusset plate to each strut flange. The structural analysis shall be performed using non-linear, second order, stiffness analysis models in accordance with ADM 2010 Chapter C. Stability shall be provided for the structure as a whole and for each of its components. The available strengths of members and connections determined in accordance with Section C.3 shall equal or exceed the required strengths determined in accordance with Section C.2.
 3. No galvanized, aluminized, painted, or plated steel shall be used anywhere in the dome above the mounting bracket base plates. Dissimilar materials in the supporting structure shall be isolated from the aluminum dome by means of a composite elastomeric gasket. Designs that incorporate raised battens, overlapping panels and/or designs that incorporate fasteners which penetrate panels and attach to structural members are expressly prohibited.
 4. Roof live loads and dead loads shall be carried by tank sidewalls, without additional support. A roof hatch, with a hinged gasket cover and locking hasp, shall be provided near the outside tank ladder.
 5. Roofs are aluminum in color and shall be constructed of non-corrugated, triangular geodesic aluminum panels, which are sealed and firmly clamped in an interlocking manner within a fully triangulated aluminum space truss system of wide flange extrusions, thus forming a dome structure. Fabric type flashing is not allowed.
 6. The dome shall be self-supporting from the periphery structure with horizontal thrust contained by an integral tension ring. The entire structure shall be designed as a watertight system under all design loads and temperature conditions. The design shall include sealant to be completely encapsulated by applying it to the gusset covers inner circumference, beneath the gusset covers top closure plates.
 7. The top surface of the batten bars must be completely flush with the triangular panel surfaces so that no ponding of water occurs at cover joints. Raised batten bars, overlapping panels, and/or panel attachment fasteners that penetrate panels are expressly prohibited.
 8. The walkway and handrail, if supplied with the roof, shall be constructed of aluminum.
 9. The roof manway opening shall be at least 30" square. The opening shall have a curb of at least 4" in height, and the cover shall have a downward overlap of at least 2". The manway shall be aluminum.
 10. Dome Materials
 - a. Triangulated dome frame struts: 6061-T6 aluminum or 6005A-T61.
 - b. Structural frame gussets: 6061-T6 aluminum, 0.3125 inch nominal thickness.
 - c. Triangular closure panels: .050 inch nominal thickness, 3003-H16 aluminum Sheet.
 - d. Perimeter tension/compression ring: 6061-T6 aluminum or 6005A-T61.
 - e. Fasteners: Fasteners shall be designed with a factor of safety of 2.34 on ultimate strength and 1.65 on yield strength. Threaded fasteners shall be 304 stainless steel. Lockbolts shall be 7075-T73 aluminum, 304 or 305 stainless steel. Screws shall be aluminum or 300 series stainless steel.
 - f. Sealant: Silicone by Pecora, General Electric Silpruf or equal and shall be resistant to ozone and UV. Sealer shall conform to Federal Specification TT-S-00230.

- g. Gaskets: Silicone, General Electric SE-44/88 or equal. Gaskets shall conform to ZZ-R-765, Class 2, Grade 50 or equal. Neoprene may be substituted but only if shielded from UV light. Gaskets must be 1/8" thickness minimum.
 - h. Anchor Fasteners: Series 300 stainless steel.
 - i. Dormers, doors, and hatches: 6061-T6, 5086-H34 or 5052-H36 or 5052-H32 aluminum, 0.090inch nominal thickness.
 - j. The tank supplier shall perform all manufacturing work described herein with mechanics skilled and experienced in the fabrication of aluminum dome roof structures. Fabrication shall be done in an ISO 9001 certified facility.
 - k. All field work shall be completed by the MATD qualified erection crew. Sub-contracting of the roof manufacturing or erection is not allowed.
 - l. Field re-fabrication of structural components or panels will not be accepted. Forcing of the structure to achieve fit-up during construction is expressly forbidden and not acceptable. Any indication of improper fit-up of parts shall be immediately reported to the fabricator.
 - m. All sealant joints shall be tooled slightly concave after sealant is installed. Care shall be taken to keep sealant confined to the joint in a neat manner. Any sealant applied outside of the joint shall be removed so that the panels will be free from misplaced sealant. All gasket materials shall be continuous, splices will not be allowed.
- T. All shell, floor and roof penetrations shall be adequately reinforced to transfer vertical, tangential and horizontal stresses, seismic load, and incidental differential settlement.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install tank in accordance with AWWA D103 and in strict accordance with manufacturer's recommendations.
- B. Foundation preparation shall be in accordance with Section 312000 and concrete work shall be in accordance with Section 033000.
- C. Anchor bolts shall not be driven but shall be set when the concrete is placed and in the locations indicated on the approved shop drawings. This is required to limit corrosion impacts to the concrete reinforcement. Place butyl rubber elastomer waterstop seal on the inside surface of the starter ring below the floor line. Place one bentonite impregnated water seal below the butyl rubber seal. Install materials in accordance with tank manufacturer's instructions.
- D. Field erection of the glass-coated, bolted steel tank shall be in strict accordance with the manufacturer's recommendations and shall be performed by a factory-trained representative. Care shall be taken to avoid damage of the coating system.
- E. No backfill shall be placed against the tank side wall without prior written approval and design review of the tank manufacturer. In no case shall the backfill elevation vary more than on (1) foot around the periphery of the tank shell.

- F. An electrical leak test shall be performed during erection using a 9 Volt leak detection device. All electrical leak points found on the inside surface shall be repaired in accordance with the manufacturer's recommendations.
- G. Bolts used in tank lap joints shall be zinc plated and of sufficient strength and length to provide the required structural strength. The bolt fasteners shall be designed by the manufacturer in accordance with AWWA D103.
- H. All bolt heads up to the splines on the shank shall be encapsulated with a high impact polypropylene stabilized with an ultraviolet light resistant material.
- I. All bolts shall be installed so that the head portion is inside the tank and the washer and nut are on the exterior. All lap joint bolts shall be selected so that threaded portions will not be exposed in the shear plane between tank sheets.
- J. Bolt lengths shall be sized to achieve a neat and uniform appearance. Excessive threads extending beyond the nut after torquing will not be permitted.
- K. All lap joint bolts shall include a minimum of four splines on the underside of the bolt head at the shank in order to resist rotation during torquing.
- L. High-density polyethylene co-polymer caps and sealant shall be used to cover bolts, nuts and washers exposed on the tank exterior sidewall.
- M. The lap joints, bolt connections and sheet edges shall be sealed with high-density polyethylene material. The sealant shall be compatible with the stored liquid and shall meet applicable NSF Additives Standard 6.
- N. The sealant shall cure to a rubber-like consistency, shall have excellent adhesion to the glass coating, shall have low shrinkage and shall be suitable for interior and exterior exposure. The sealant shall be Sika TS Plus, or equal. Neoprene gaskets and tape type sealer will not be permitted.

3.2 GLASS COATING TEST

- A. During erection of the tank, the manufacturer shall perform mil thickness test (Mikrotest or equal) and a holiday detection test (Tinker Razor or equivalent) of glass coating. A report shall be submitted to the Engineer summarizing the results of the tests.

3.3 TESTING

- A. Tank testing shall be in accordance with AWWA D103.
- B. The tank shall be tested for liquid tightness by filling the tank to its maximum capacity. Any leaks detected by this test shall be corrected by the manufacturer at no additional cost to the Owner. The Contractor shall bear all costs associated with hydrostatic testing of the erected tank that includes, but is not limited to labor, equipment, filling the tank with water and emptying the water from the tank.

3.4 INSPECTION

- A. The manufacturer shall make a visual inspection of the tank interior coating and appurtenances, tank exterior coating and appurtenances, and the immediate area surrounding the tank. A written report prepared by the tank manufacturer, certifying that the work was inspected in accordance with Section 11 of AWWA D103 shall be submitted to the Engineer. This report shall meet the requirements of Section 11 and also cover the hydrostatic test. It shall also indicate that the tank have been installed in accordance with the manufacturer's instructions and that they meet all the requirements of this specification.

3.5 PERIODIC INSPECTION

- A. On or near the one year anniversary date of initial tank use, the manufacturer shall make a visual or ROV inspection of the tank interior coating and appurtenances, tank exterior coating and appurtenances, and the immediate area surrounding the tank. A written summary of this inspection shall be submitted to the Owner. The tank manufacturer shall make arrangements with the Owner to have the tank available for inspection. The cost of this inspection, including all labor, materials, expenses, etc. shall be included in the bid price.

END OF SECTION 434111

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SECTION 460553 - IDENTIFICATION FOR WATER AND WASTEWATER 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. Nameplates.
- 2. Tags.
- 3. Stencils.
- 4. Labels.
- 5. Lockout devices.

- B. Related Requirements:

- 1. Section 099679 - "Atmospheric Protection and Plant Service Area Coatings": Execution requirements for painting specified by this Section.

1.3 PREINSTALLATION MEETINGS

- A. Section 013100 "Project Management and Coordination": Requirements for preinstallation meeting.
- B. Convene minimum one week prior to commencing Work of this Section.

1.4 SUBMITTALS

- A. Section 013300 "Submittal Procedures": Requirements for submittals.
- B. Product Data: Submit manufacturers catalog literature for each product required.
- C. Shop Drawings: Submit list of wording, symbols, letter size, spacing of labels, and color coding for equipment identification and schedule, including equipment number, location, function, and manufacturer's name and model number.
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

F. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 017700 “Closeout Procedures”: Requirements for maintenance materials.
- B. Extra Stock Materials: Furnish two containers of spray-on adhesive.
- C. Tools: Furnish special crimpers and other devices required for Owner to reinstall tags.

1.6 QUALITY ASSURANCE

- A. Maintain a copy of each standard affecting the Work of this Section on-Site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Manufacturers:
 1. Craftmark Pipe Markers,
 2. Kolbi Pipe Marker Co.,
 3. Pipemarket.com (Brimar Industries, inc.),
 4. Seton Identification Products
- B. Description: Laminated three-layer plastic with engraved black letters on light, contrasting background color.

2.2 TAGS

- A. Plastic Tags:
 1. Manufacturers:
 - a. Brady ID,
 - b. Craftmark Pipe Markers,
 - c. Kolbi Pipe Marker Co.,
 - d. Marking Services, Inc.,
 - e. R&R Identification Co.

- f. Seton Identification Products
- g. Description:
- h. Laminated three-layer plastic with engraved black letters on light, contrasting background color.
- i. Minimum Tag Size and Configuration: 1-1/2-inch square.
- j. Provide with brass hooks suitable for attaching the tag.
- k. Stamp or etch tags with identifying information on schedule coded in a system provided by the Owner.

B. Metal Tags:

1. Manufacturers:

- a. Brady ID,
- b. Craftmark Pipe Markers,
- c. Kolbi Pipe Marker Co,
- d. Marking Services, Inc.,
- e. Pipemarket.com (Brimar Industries, Inc.),
- f. R&R Identification Co.
- g. Seton Identification Products

2. Description:

- a. Stainless steel construction; stamped letters.
- b. Minimum Tag Size and Configuration: 1-1/2-inch square with finished edges.
- c. Stamp or etch tags with identifying information on schedule coded in a system provided by the Owner.

C. Information Tags:

1. Manufacturers:

- a. Brady ID,
- b. Seton Identification Products
- c. Description:
- d. Clear plastic with printed CAUTION and message.
- e. Minimum Tag Size: 3-1/4 by 5-5/8 inch.
- f. Furnish grommet and self-locking nylon ties.

1. Tag Chart: Typewritten, letter-size list of applied tags and location, plastic laminated.

2.3 STENCILS

A. Manufacturers:

- 1. Kolbi Pipe Marker Co,
- 2. Marking Services, Inc.,
- 3. Pipemarket.com (Brimar Industries, Inc.),
- 4. R&R Identification Co.
- 5. Seton Identification Products

6. Furnish materials according to _____ standards.

B. Description:

1. Clean-cut symbols.
2. Letter Height: 1-3/4 inch.

C. Stencil Paint: As specified in Section 099000 "Painting and Coating"; semi-gloss enamel.

2.4 LABELS

A. Manufacturers:

1. Brady ID,
2. Seton Identification Products

B. Description:

1. Laminated Mylar construction.
2. Minimum Size: 1.9 by 0.75 inch.
3. Adhesive backed, with printed identification.

2.5 LOCKOUT DEVICES

A. Lockout Hasps:

1. Manufacturers:
 - a. Brady ID,
 - b. Master Lock Company, LLC
2. Description:
 - a. Anodized aluminum construction.
 - b. Furnish hasp with erasable label surface.
 - c. Minimum Size: 7-1/4 by 3 inches.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Section 017300 "Execution": Requirements for installation preparation.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Prepare surfaces as specified in Section 099000 "Painting and Coating" for stencil painting.

3.2 INSTALLATION

- A. Identify equipment with stencil painting.
- B. Identify inline pumps and other small devices with tags.
- C. Identify control panels and major control components outside panels with plastic nameplates.
- D. Apply stencil painting as specified in Section 099000 "Painting and Coating".
- E. Install identifying devices after completion of coverings and painting.
- F. Install plastic nameplates with corrosion-resistant mechanical fasteners or adhesive.
- G. Labels:
 - 1. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer.
 - 2. For unfinished covering, apply paint primer before applying labels.
- H. Install tags using corrosion-resistant chain.

END OF SECTION 460553

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Appendix A

Geotechnical Subsurface Explorations and Engineering Recommendations

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Memorandum

To: Mr. Butch Conover, Commissioner of Public Works, City of Rome, New York

*From: Greg Bold, P.E., PMP
Gregory F. Dellinger*

Reviewed: Douglas J. Aghjayan, P.E.

Date: August 13, 2024

*Subject: Geotechnical Subsurface Explorations and Engineering Recommendations
Water Resource Recovery Facility Improvements
Rome, New York*

Introduction

This memorandum presents the results of our subsurface explorations program and provides geotechnical engineering recommendations for the design and construction of the proposed leachate storage tank as part of the proposed facility improvements at the Water Resource Recovery Facility (WRRF) in Rome, New York.

Elevations noted herein are in feet and referenced to the North American Vertical Datum of 1988 (NAVD 88).

Purpose and Scope

The purpose of this study was to investigate the subsurface conditions at the location of the proposed structure and to provide geotechnical engineering recommendations for design and construction of the project.

CDM Smith performed the following scope of work for this project:

- Conducted a subsurface explorations program consisting of four borings to evaluate subsurface conditions and obtain soil samples for geotechnical laboratory testing.
- Conducted geotechnical laboratory tests on select soil samples to assist with soil classification and determination of engineering properties.
- Developed geotechnical engineering recommendations for design and construction of the project.
- Prepared this memorandum.

Site and Project Descriptions

The City of Rome WRRF is located at 7180 East Dominick Street in Rome, New York (**Figure 1**). The WRRF is bounded by a vacant trailer park to the west, NY Route 49 to the north, Wright Drive to the east, and the Mohawk River to the south. Access to the WRRF is controlled by a gate at the east end of the service road from East Dominick Street.

The proposed construction consists of a 25-foot-diameter by 30-foot-high, 100,000 gallon above-ground storage tank, an approximately 13-foot by 16-foot waste transfer station, and a 6-foot by 5-foot pressure level/indicator vault.

The proposed waste transfer station will consist of a fiberglass shed with an estimated bearing pressure of 800 pounds per square foot (psf). The foundation is proposed to be an 8-inch-thick concrete pad at the ground surface with 16-inch-thick haunch around the slab perimeter.

The proposed finished floor elevation (FFE) of the storage tank and waste transfer station are El. 428.5 and El. 430.0, respectively. The proposed bottom of the pressure level/indicator vault is about 8 feet below existing grade, which is approximately El. 419.

The proposed construction will be located in a landscaped area on the south side of the WRRF property, near the gravity thickeners and welding shop. The ground surface in the area ranges from approximately El. 430 at the east side to approximately El. 427 at the west side. An existing underground electric line is located approximately 3 feet west of the proposed storage tank.

The existing conditions and proposed construction are shown on **Figure 2**.

Subsurface Exploration Program

CDM Smith subcontracted CME Associates, Inc. (CME) of Syracuse, New York to advance four borings (CDM-101 through CDM-104) at the site December 13 and 14, 2023. The boring locations are shown on **Figure 2** and were determined by tape measurements from existing site features. The ground surface elevations at the boring locations were interpolated between the existing elevation contours and rounded to the nearest 0.5 foot. A CDM Smith geologist was on site full-time to coordinate the subsurface explorations, log the borings, and collect soil samples.

CME advanced the borings to a depth of about 40 feet below ground surface (bgs) with a truck-mounted Diedrich D-120 drill rig using the hollow-stem auger drilling method. Standard Penetration Tests (SPTs) with split-spoon sampling were conducted in all borings continuously to 10 or 12 feet bgs and then at 5-foot intervals thereafter. The SPTs were conducted in general accordance with ASTM D1586 using a 2-inch outside diameter sampler, driven 24 inches by blows from a 140-pound hammer falling freely for 30 inches. The number of blows required to drive the sampler each 6-inch increment was recorded and the SPT resistance (N-value) was calculated as the sum of the blows to drive the sampler from 6 to 18 inches of penetration, measured in blows per foot (bl/ft).

Samples collected from the borings were visually classified by the CDM Smith geologist at the time of drilling. Pocket penetrometer and torvane readings were typically performed on split-spoon samples of fine-grain cohesive soils and are noted on the boring logs. Representative soil samples from each split-spoon were collected and stored in jars for subsequent review and laboratory testing.

When possible, groundwater levels at the boring locations were estimated from the moisture condition of the samples obtained and by the observed water levels within the boreholes at the time of drilling. However, groundwater levels observed at the time of drilling may not represent stabilized levels.

The boreholes were backfilled with soil cuttings upon termination. The boring logs are included in [Attachment A](#).

Geotechnical Laboratory Tests

All geotechnical laboratory tests were performed on selected samples collected from the borings at CDM Smith's Geotechnical Testing Laboratory in Chelmsford, Massachusetts. Grain size analyses were performed on two samples by mechanical sieving in accordance with ASTM D6913 and on two samples by combined mechanical sieving with hydrometer in accordance with ASTM D6913 and D7928. Moisture content determinations were performed on six soil samples in accordance with ASTM D2216. Atterberg (liquid and plastic) limits determinations were performed on two samples in accordance with ASTM D4318. All samples tested were classified in accordance with ASTM D2487, which is based on the Unified Soil Classification System (USCS).

Geotechnical laboratory test results are summarized in [Table 1](#). The geotechnical laboratory test reports are contained in [Attachment B](#).

Subsurface Conditions

The generalized descriptions of the major soil layers encountered in the borings are described below, beginning at the ground surface and proceeding downward. The subsurface conditions are known only at the sampling locations and may vary significantly from the descriptions given below at other locations. These variations may not become evident until construction. A summary of the subsurface conditions encountered in the borings is presented in [Table 2](#).

Topsoil

An approximately 2- to 3-inch-thick layer of Topsoil was encountered at all boring locations.

Fill

Fill was encountered underlying the topsoil at all boring locations. The Fill extended to depths ranging from about 4.5 to 6 feet bgs (El. 422 to El. 423) and consisted mostly of a mixture of SILT, Clayey SILT, and CLAY and SILT with varying amounts of sand and gravel. The SPT N-values in the layer ranged from 4 to 20 bl/ft.

Peat

A 0.7- to 2-foot-thick layer of Peat was encountered beneath the Fill in borings CDM-101, CDM-103, and CDM-104. The layer extended to depths ranging from 5.3 to 8 feet bgs (El. 421 to El. 422.2). The SPT N-values of the samples containing peat ranged from 5 to 10 bl/ft.

Clay, Silt, Sand

Layers of naturally deposited Clay and Silt and of Silt and Sand were encountered underlying the Peat and Fill. The Clay and Silt was encountered between approximate depths of 8 and 40 feet bgs and ranged from about 1.5 to 34 feet thick. The layer primarily consisted of Silt and Clay, Clay and Silt, Clayey Silt, and Silty Clay with trace to little fine sand. The SPT N-values in the layers ranged from 8 to 37 bl/ft. Borings CDM-103 and CDM-104 were terminated in a Clay and Silt layer at a depth of 40 feet bgs (El. 387.5 and El. 387, respectively).

The Silt and Sand layers were encountered between approximate depths of 5 and 40 feet bgs and ranged from about 5.5 to 20 feet thick. The layer primarily consisted of a mixture of SILT and fine SAND. At a depth of approximately 5 feet bgs, an approximately 6-foot-thick layer of the Silt and Sand was encountered in CDM-102 with SPT N-values of 0 to 4 bl/ft, indicating a very loose to loose relative density. The SPT N-values at other locations within the Sand and Silt layer ranged from 10 to 49 bl/ft. Borings CDM-101 and CDM-102 were terminated in Silt and Sand layers at a depth of 40 feet bgs (El. 388 and El. 387, respectively).

Groundwater Conditions

Groundwater levels at the boring locations were estimated from the moisture condition of the samples obtained and by the observed water levels within the boreholes at the time of drilling at depths between 4 and 8 feet bgs (El. 419.5 and El. 424). Water levels measured during drilling may not represent stabilized groundwater levels.

Expected Variation in Subsurface Conditions

Our interpretation of the subsurface conditions presented herein is based on soil and groundwater conditions observed at discrete locations in the borings at the time of drilling. The subsurface conditions may vary from those described herein at other locations and times. These variations may not become evident until construction. If subsurface conditions are found to be different than described herein, the recommendations contained in this memorandum should be re-evaluated by CDM Smith and confirmed in writing.

Water levels measured in the borings may not represent stabilized levels. Groundwater levels can fluctuate with rainfall, time, season, temperature, climate, construction activities in the area, and other factors. Therefore, groundwater levels at the time of construction may be different from those observed at the time of the explorations.

Geotechnical Design Recommendations

General

Geotechnical engineering evaluations have been made to the current understanding of the proposed construction as described herein. These evaluations have been based on the results of our subsurface explorations, laboratory test results, published correlations with soil properties, and the minimum requirements of the 2020 Building Code of New York State, which is referenced to the 2018 International Building Code (Code). In addition, recommended design criteria are based on performance tolerances, such as allowable settlement, as understood to relate to similar structures.

Storage Tank Foundation Design

The existing fill, peat, and very loose to loose silt and sand are considered unsuitable for foundation and slab support of the storage tank. Two foundation options are proposed to support the proposed structure. The first option consists of over-excavating the unsuitable soils down to about El. 417 (approximately 10 to 11 feet bgs), replacing the unsuitable soils with compacted Structural Fill, and supporting the proposed structure on conventional spread footings. Based on the estimated groundwater levels, this option may result in excavating into the groundwater table and produce a significant amount of excess excavated material that will likely require offsite disposal. The second option consists of using ground improvement to “stiffen” the underlying unsuitable layers so that the structure can be supported on shallow footings with a slab-on-grade.

Conventional Spread Footings

The proposed storage tank may be supported on conventional spread footings provided the unsuitable soils beneath the tank are removed and replaced with compacted Structural Fill. We estimate that the excavation of unsuitable soil will extend to approximately El. 417. All over-excavation and removal of unsuitable materials should be performed in the foundation bearing zone, which is defined by a 1-horizontal to 1-vertical slope extending downward and outward from 2 feet beyond the outside edges of the footings to firm naturally deposited soils.

The footings should be at least 3 feet wide and designed for a net allowable bearing pressure of 2,000 psf. A friction coefficient of 0.25 may be used to compute resistance to sliding, which assumes that the concrete for the footings is placed directly on a granular soil subgrade.

The estimated settlement of the proposed structure founded on conventional spread footings, with the recommended allowable bearing pressure, is expected to be less than 2 inches with no more than 1 inch of differential settlement under static loads.

The excavated soils are unlikely to be suitable for reuse during construction. Thus, any material that is over-excavated to construct the conventional footings described above will likely require testing and off-site disposal.

Ground Improvement with Shallow Footings and Slab-on-Grade

Spread footings with ground improvement (i.e., rigid inclusions) may be used where removal and replacement of the fill is impractical or costly. Ground improvement is typically designed and

installed by specialty geotechnical contractors using proprietary methods under a performance specification that sets criteria for allowable bearing pressure and settlement. Typical rigid inclusion ground improvement methods that are considered suitable for this project include rammed or grouted aggregate piers (RAPs or GAPS), controlled modulus columns (CMCs), and vibro-concrete columns.

Ground improvement for this project would consist of installing rigid vertical ground reinforcement elements consisting of columns of crushed/grouted stone, concrete, or grout that extend through the unsuitable soils and terminate in a medium dense Silt and Sand or Clay and Silt layer. The tops of the reinforcement elements would be embedded in an approximately 2-foot-thick layer of high-quality compacted granular soil (referred to as the "load transfer platform") that distributes the bearing loads from the footings down to the reinforced ground. A load test and modulus tests are performed on a reinforcing element(s) to confirm the design capacity and stiffness. For this site, appropriate criteria for footings on improved ground would be an allowable bearing capacity of 4,000 psf, a maximum allowable total settlement of 1 inch, and a maximum allowable differential settlement of $\frac{3}{4}$ inch.

This option should require less over-excavation and replacement of unsuitable soil compared to the conventional footing option described above.

Waste Transfer Station & Pressure Level/Indicator Vault Foundation Design

The waste transfer station and pressure level/indicator vault may be supported as proposed provided a 12-inch-thick layer of compacted crushed stone is placed directly below the foundations.

The crushed stone should be compacted with at least four complete coverages using a vibratory plate compactor and the subgrades should be prepared as described in the following sections. Filter fabric should be placed between the crushed stone and surrounding soils. Due to the underlying fill, peat, and naturally deposited soils, the estimated settlement of the proposed waste transfer station is expected to be up to 2 inches with no more than 1 inch of differential settlement under static loads. The estimated settlement of the proposed pressure level/indicator vault is expected to be less than 1 inch.

Foundation Depth

In accordance with the Code, all foundations supported on soil should bear at least 5 feet below any adjacent ground surface exposed to freezing. Interior footings within heated portions of the structures should bear at least 18 inches below the respective top of slab elevations.

Design Groundwater Level and Hydrostatic Pressure

Groundwater levels at the boring locations were estimated at the time of drilling between El. 419.5 and El. 424. For design purposes, we recommend a design groundwater level of El. 426 for computing hydrostatic pressure.

Resistance to Buoyancy

Any portion of a structure that extends below the design groundwater elevation should be appropriately waterproofed and designed to resist buoyancy from hydrostatic pressure based on the design groundwater level. The dead weight of the structure and the weight of any backfill directly above the foundation may be used to resist buoyancy. Soil used as backfill may be assumed to have a total unit weight of 125 pounds per cubic foot (pcf) if above the design groundwater level, and an effective unit weight of 65 pcf if below the design groundwater level.

Lateral Pressures on Below-Grade Structures

Below-grade walls that are restrained from movement should be designed for lateral pressures from soil and groundwater. For below-grade walls above the design groundwater elevation we recommend using an equivalent fluid unit weight of 65 pounds per cubic foot (pcf) for computing the lateral soil pressure. For below-grade walls below the design groundwater elevation we recommend using an equivalent fluid unit weight of 95 pcf for computing the combined lateral soil and hydrostatic pressure against foundation walls.

For surcharge loads adjacent to the walls, a uniform lateral pressure equal to 0.5 times surcharge pressure should be applied over the full height of the walls. To eliminate the surcharge loading from adjacent structure foundations on walls, the structures should be separated such that a line extending 2 feet beyond the edge of the foundation, then outward and downward at a slope of 1 horizontal to 1 vertical (1H:1V) does not intersect the adjacent structure.

Seismic forces against buried structures should be determined in accordance with the Code.

Resistance to Unbalanced Lateral Forces

Unbalanced loads should be designed to be resisted by friction on the bottom of the foundation. For purposes of design, a coefficient of friction of 0.25 should be used. A passive lateral earth pressure resistance of up to a maximum equivalent fluid pressure of 150 pcf may be used, provided the foundations are backfilled with structural fill that is compacted to a density of at least 95 percent of the maximum dry density as determined by laboratory test ASTM D1557. The top 2 feet of passive resistance should be neglected due to surface effects and potential for disturbance from frost action and other factors. Frictional resistance should be assumed to be mobilized first to its full capacity before any passive pressure is developed.

Seismic Design and Liquefaction

It is our opinion that the site should be classified as Site Class D for seismic design purposes. Spectral accelerations should be modified for Site Class D when determining the design earthquake response accelerations and seismic design category for the seismic analysis at the site.

The underlying soils at the site are not considered susceptible to liquefaction.

Construction Considerations

Excavations and Excavation Support

All excavations should be made in accordance with Occupational Safety and Health Administration (OSHA) regulations.

We estimate that excavations up to approximately 11 feet deep will be required for construction of the proposed storage tank. We anticipate that excavations can be made using conventional earthmoving equipment and that the excavated materials will consist mostly of fill, peat, silt, sand, and clay and silt.

Depending on the available space, it may be possible to perform the portions of the excavation as an open cut with temporary sides slopes no steeper than 1.5 horizontal to 1 vertical. The existing metal shop and an existing fence (southern property line) are located approximately 10 feet of the proposed tank location. Therefore, it is anticipated that the excavation for the conventional spread footings will need temporary excavation support in these areas. We anticipate that soldier piles and lagging or steel sheet piling will be suitable for bracing excavations. The excavation support system should be designed by a Professional Engineer registered in New York who is engaged by the Contractor. CDM Smith should review the design of the excavation support system.

Care should be taken during excavations to avoid undermining adjacent structures, pipelines, and utilities. Excavations that extend into the zone of influence of these structures should be braced. The zone of influence is defined as extending 2 feet beyond the bottom exterior edge of the foundation or springline of pipe then out and away at an angle of 45 degrees.

An underground electric line is located approximately 3 feet from the proposed tank location. Due to the proximity to the proposed tank footprint and the required excavation for foundation construction, it is recommended that this utility line be relocated prior to beginning the foundation construction.

Dewatering

The depth to groundwater encountered in the borings during drilling ranged from about 4 to 8 feet bgs. Therefore, excavations may encounter groundwater.

The Contractor should be prepared to manage groundwater, perched water, or surface runoff that enters excavations. We expect that dewatering can be accomplished with sumps and conventional submersible pumps that discharge into on-site recharge pits. Sumps must be adequately filtered to avoid loss of fines and clogging of pumps. The site should be graded to direct surface water runoff away from the excavations.

All dewatering, handling and disposal of effluent, and any special testing should be conducted in accordance with local regulations, permits and specified requirements. If wet weather is encountered during construction, the Contractor should consider scheduling excavations to limit the duration of open cuts, slope the bottoms of excavations to facilitate drainage, and provide berms to limit runoff into the excavations. Additionally, any excavated material that is to be reused

as fill should be stockpiled in such a manner that promotes runoff and limits saturation of the material.

Preparation and Protection of Subgrades

The groundwater level should be lowered at least two feet below the bottom of the excavation before final excavations for foundations are made. The final excavation to subgrade should be made using a smooth-edged bucket where possible. Granular soil foundation subgrades should be proof-compacted with a minimum of 4 passes using a vibratory plate compactor. Care should be taken to avoid excess traffic on the prepared subgrades prior to backfilling and foundation construction.

Boulders, cobbles, debris, and any other obstructions should be removed, and the resulting area replaced with compacted Structural Fill. Any unsuitable material present at the subgrade level including fill, organic soils, or any other soft, loose, or disturbed soil present at subgrade level should be removed and replaced with compacted Structural Fill.

Concrete for foundations may be placed directly on the soil subgrade. The final foundation subgrade should be free of standing water, frost, and frozen or loose soil. Areas of the subgrade disturbed by traffic or surface water should be repaired. We recommend that a CDM Smith engineer observe the final preparation of foundation subgrades.

Backfilling and Reuse of On-Site Materials

Backfill placed for the support of footings and slabs-on grade, and within three feet of buried walls and structures should meet the gradation and compaction requirements for Structural Fill. Backfill placed outside the building limits should meet the requirements for Common Fill or Select Common fill. Common Fill and Select Common Fill may be susceptible to frost heave. The potential for frost heave can be reduced by grading outside areas for proper drainage, installing sub-drains, and by using Structural Fill or Crushed Stone rather than Common Fill within 1 to 2 feet of the ground surface.

Any material containing organic matter or debris is unsuitable for reuse beneath paved surfaces but may be reused in landscaped areas.

The moisture content of any material proposed as backfill generally should be within 3 percent of its optimum moisture content at the time of placement and compaction.

Based on our review of soil samples collected from the borings and the results of laboratory gradation tests on selected samples, the Fill and Silt and Sand are considered unsuitable for reuse as Structural Fill or Common Fill.

Structural Fill

Structural Fill placed below foundations and against foundation walls should consist of a mineral soil free of organic material, loam, debris, frozen soil, clay lumps, or other deleterious material which may be compressible, or which cannot be properly compacted. Structural Fill should conform to the following gradation requirements:

U.S. Standard Sieve Size	Percent Passing by Weight
3 inches	100
½ inch	50 - 100
No. 4	20 - 70
No. 40	5 – 35
No. 200	0 – 10

Structural Fill should be placed in loose layers no thicker than 8 inches and compacted with suitable compaction equipment to at least 95 percent of maximum dry density as determined by ASTM D1557. Lift thickness should be reduced to 4 inches in confined areas accessible only to hand guided compaction equipment.

Common Fill

Common Fill used as backfill to restore the site grades, around structures where passive pressure is not relied on, and in landscaped areas should consist of granular soil free from organic material, loam, debris, frozen soil, or other deleterious material that may be compressible or which cannot be compacted properly. It should contain stones no larger than 6 inches and have no more than 20 percent of material passing the No. 200 sieve. The material passing the No. 200 sieve shall be non-plastic. Common Fill should conform to the following gradation:

U.S. Standard Sieve Size	Percent Passing by Weight
6 inches	100
3 inches	80 - 100
No. 4	20 - 100
No. 200	0 - 20

Common Fill should be placed in loose lifts not to exceed 12 inches and compacted with suitable compaction equipment to at least 92 percent of maximum dry density as determined by ASTM D1557. Lift thickness should be reduced to 6 inches in confined areas accessible only to hand-guided compaction equipment.

Select Common Fill

Select Common Fill used for trench backfilling or grading below pavement subbase should be the same as Common Fill except that it should not contain stone larger than 2 inches.

Select Common Fill should be placed in loose lifts no thicker than 12 inches and compacted with suitable compaction equipment to at least 95 percent of maximum dry density as determined by ASTM D1557. Lift thicknesses should be reduced to 6 inches in confined areas accessible only to hand guided compaction equipment.

Crushed Stone

Crushed stone used below foundations should consist of durable crushed rock or durable crushed gravel stone conforming to New York State Department of Transportation size 3A crushed stone 703-0201.

Filter Fabric

Filter fabric, when used as a separation barrier between soil and crushed stone, should be non-woven geotextile such as Mirafi 140N or an approved equivalent.

Freezing Conditions

Freezing of the soil beneath the foundations during construction may result in subsequent settlement of the structure. Therefore, special precautions should be taken to prevent the subgrade soils from freezing if construction is performed during freezing weather.

All subgrades should be free of frost before placement of concrete. Frost-susceptible soils that have frozen should be removed and replaced with compacted Structural Fill. The footings and the soil adjacent to the footings should be insulated until they are backfilled. Soil placed as fill should be free of frost, as should the ground on which it is placed.

If slabs-on-grade or footings are built and left exposed during the winter, precautions should be taken to prevent freezing of the underlying soil.

Monitoring and Protection of Existing Structures

Pre- and Post-Construction Surveys

Prior to the start of construction, a pre-construction survey that includes descriptions of interior and exterior conditions of existing structures and site conditions within 100 feet of the work should be performed. Descriptions shall include cracks, damage, or other existing defects and should include information to make it possible to determine the effect, if any, of the construction operations on the defect. Where significant cracks or damage exists, or for defects too complicated to describe in words, photographs should be taken and made part of the record. The Contractor's record of the pre-construction survey should consist of written documentation, video, and photographs of the conditions identified.

Vibration Monitoring

Construction vibrations from excavation activities such as installing excavation support systems, demolition of existing infrastructure, or other activities can cause damage to adjacent structures, utilities, and other facilities. To avoid or mitigate this potential damage, limits on ground vibrations in the form of ground displacement, velocity, or acceleration at given frequencies are typically established. The U.S. Bureau of Mines has established criteria to limit ground vibrations using the peak particle velocity (PPV) and frequency parameters. These limits have been established using the cracking of plaster walls in a residential house as a model.

The maximum peak particle velocities associated with impact or vibratory methods at the ground surface at existing adjacent structures and utilities should be as follows:

Maximum Frequency (Hz)	Peak Particle Velocity (inch per. Sec.)
Over 40	2.0
30 to 40	1.5
20 to 30	1.0
Less than 20	0.5

In no case should the maximum peak particle velocities caused by construction activities exceed 2.0 inches per second at the closest facility (structure or utility) to the work.

Settlement/Deformation Monitoring

Settlement/deformation monitoring points should be established on adjacent existing structures, roadways, and utilities located within 50 feet from an excavation. The monitoring points should be established on the exterior corners and along the perimeter existing structures at a spacing of not more than 25 feet. Where excavation support is used, the lateral movement of the system should be monitored at the top of the support system at points not more than 25 feet on center along the length of the system. In addition, we recommend surface monitoring of existing manhole rims and the pavement or ground surface overlying sensitive utilities located within 50 feet from an excavation.

Monitoring should be performed during the installation of any excavation support system, dewatering, excavations, and backfilling associated with the work. The monitoring points should be installed and baseline locations taken prior to the start of construction. The survey of the monitoring points should be performed daily during the installation of any excavation support system, excavation, and dewatering, and then twice weekly thereafter until all backfilling is complete.

The Contractor should be prepared to alter the excavation methods if settlements/deformations measured exceed any of the below threshold values. If settlement/deformation exceeds any of the limiting values, the Contractor should stop all construction activities, stabilize the excavation, and revise excavation methods to prevent additional settlement/deformation. These criteria may need to be altered by the Engineer as necessary on a case-by-case basis.

The Contractor should be prepared to alter the excavation methods if settlement exceeding 1/4 inch is measured at the existing structures. If settlement exceeding 1/2 inch is measured at the existing structures, the Contractor should stop all construction activities, stabilize the excavation, and revise excavation methods to prevent additional settlement.

Foundation Installation, Monitoring, and Testing

In accordance with Section 1705 of the Code, full-time observation and documentation by a registered design professional or their representative is required during foundation construction. To satisfy these requirements, a CDM Smith representative should be present on site full-time during construction to observe and document foundation construction.

Future Work

We recommend that CDM Smith be engaged during construction to:

- Review contract drawings and specifications related to the geotechnical aspects of the project to confirm that our recommendations have been properly interpreted and incorporated into the documents.
- Review contractor submittals and respond to Request for Information (RFIs) related to the geotechnical aspects of the project.
- Review installation and monitoring of geotechnical instrumentation.
- Confirm conditions encountered are suitable for support of the proposed structures and that the foundation subgrades are prepared.
- Observe, test and document placement and compaction of backfill material where appropriate.

In addition, CDM Smith would be present to identify and provide response should conditions encountered differ from those assumed during preparation of this report.

Closing

This memorandum was prepared exclusively for the City of Rome for the proposed leachate storage tank as part of the proposed facility improvements at the Water Resource Recovery Facility (WRRF) in Rome, New York. Our recommendations are based on our understanding of the project at this time, which has been described in this memorandum. These recommendations have been prepared in accordance with generally accepted engineering practices. No other warranty, express or implied, is made. In the event that changes in the design or scope of the upgrades occur, the conclusions and recommendations contained herein should not be considered valid unless verified in writing by CDM Smith.

Butch Conover, Commissioner of Public Works, City of Rome, New York

August 13, 2024

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Figures

Figure 1 – Site Location Map

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IMAGE OBTAINED FROM GOOGLE EARTH PRO FEBRUARY 2024

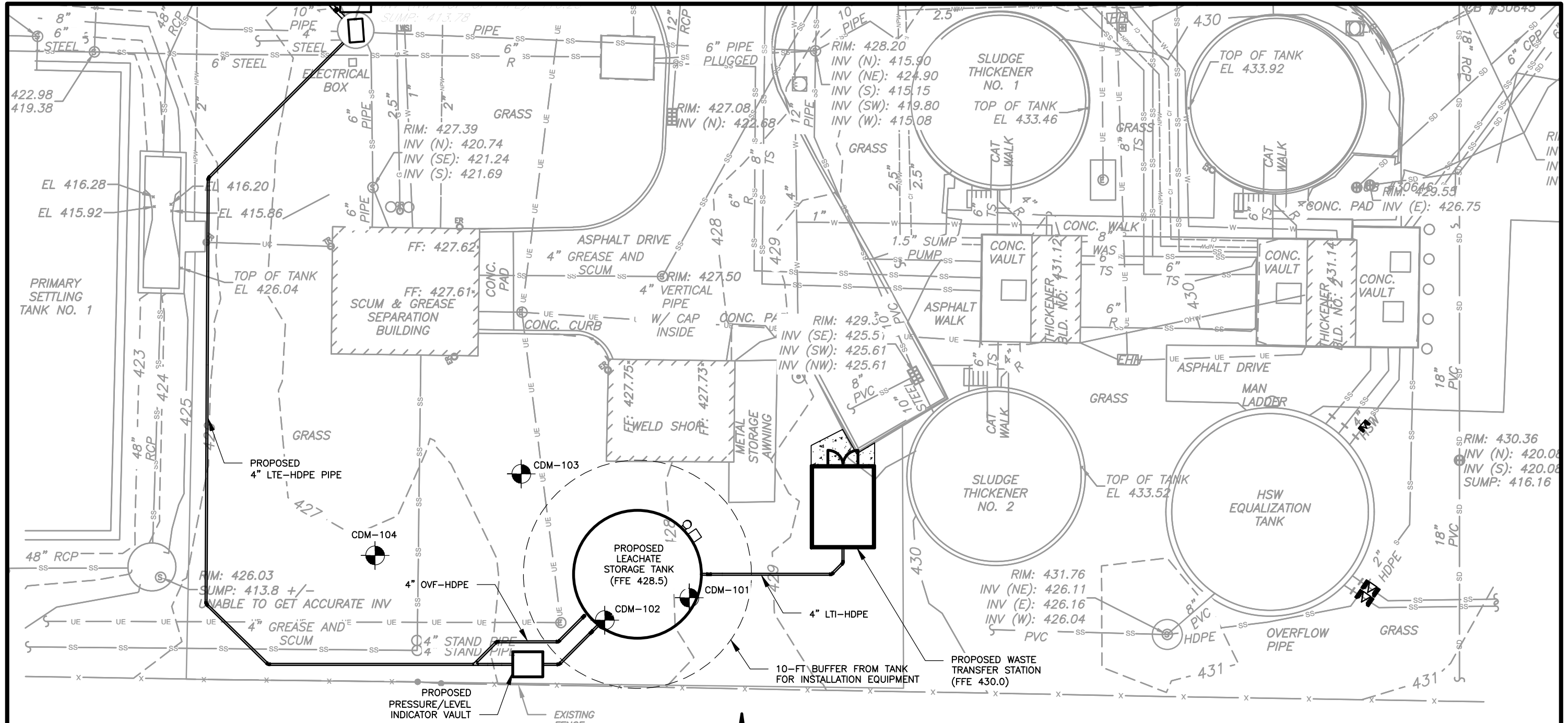
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CITY OF ROME
 ONEIDA COUNTY, NEW YORK
 WATER RESOURCE RECOVERY FACILITY IMPROVEMENTS

SITE LOCATION MAP
 FIGURE 1

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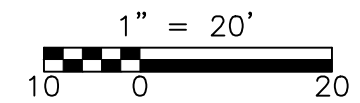


NOTES:

1. THE BASE MAP WAS DEVELOPED FROM A SURVEY PERFORMED BY BRYANT ASSOCIATES, P.C. IN DECEMBER 2023. HORIZONTAL DATUM IS NAD 83 CENTRAL ZONE. BENCHMARK ELEVATIONS SHOULD BE VERIFIED PRIOR TO CONSTRUCTION.
2. ELEVATIONS ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88)
3. THE TEST BORINGS WERE OBSERVED AND LOGGED ON A FULL-TIME BASIS BY A CDM SMITH REPRESENTATIVE.

LEGEND

- CDM-101 DESIGNATION AND APPROXIMATE LOCATION OF TEST BORINGS DRILLED BY CME ASSOCIATES, INC. OF EAST SYRACUSE, NEW YORK ON DECEMBER 13, 2023 AND DECEMBER 14, 2023.



CITY OF ROME
ONEIDA COUNTY, NEW YORK
WATER RESOURCE RECOVERY FACILITY IMPROVEMENTS

EXPLORATION LOCATION PLAN
FIGURE 2

Tables

City of Rome
Water Resource Recovery Facility Improvements
Oneida County, New York

Table 1: Summary of Geotechnical Laboratory Results

Exploration No.	Sample No.	Sample Depth (ft) ⁽⁵⁾	Stratum	USCS Classification ⁽¹⁾	Grain Size Analysis ⁽²⁾							Atterberg Limits ⁽³⁾			Moisture Content (%) ⁽⁴⁾
					Gravel (%)		Sand (%)			Fines (%)		LL	PL	PI	
					Coarse	Fine	Coarse	Medium	Fine	Silt	Clay				
CDM-101	S-5	8-10	Clay and Silt	CL-ML	--	--	--	--	--	--	--	25	20	5	20.1
CDM-102	S-2	2-4	Fill	CL-ML	0.0	0.0	0.0	0.9	7.9	64.4	26.8	--	--	--	20.3
CDM-102	S-6	10-12	Silt and Sand	ML	0.0	1.3	0.8	1.4	16.7	79.8		--	--	--	23.0
CDM-103	S-5	8-10	Clay and Silt	CL-ML	--	--	--	--	--	--		27	21	6	23.9
CDM-104	S-2	2-4	Fill	ML	12.6	1.9	1.0	2.5	6.8	75.2		--	--	--	14.5
CDM-104	S-5	8-10	Clay and Silt	CL	0.0	0.0	0.0	0.6	2.4	69.0	28.0	30	21	9	23.7

Notes:

1. USCS classifications were performed in accordance with ASTM D2487.
2. Grain size analysis tests were performed in accordance with ASTM D7928 & D6913.
3. Atterberg limit tests were performed in accordance with ASTM D4318.
4. Moisture content analysis were performed in accordance with ASTM D2216.
5. Indicated depths are depths below ground surface at the time of drilling.

Abbreviations:

- : No test
- CL: Lean Clay
- CL-ML: Low Plasticity Clay
- ML: Silt
- ft: Feet
- %: Percentage
- No.: Number
- LL: Liquid Limit
- PL: Plastic Limit
- PI: Plasticity Index

City of Rome
Water Resource Recovery Facility Improvements
Oneida County, New York

Table 2: Summary of Subsurface Conditions

Exploration No.	Approximate Coordinates ⁽¹⁾		Approximate Ground Surface Elevation (ft) ⁽²⁾	Approximate Exploration Depth (ft) ⁽³⁾	Approximate Depth to Top of Stratum (ft) ⁽³⁾					Approximate Depth to Groundwater (ft) ⁽³⁾⁽⁴⁾	Approximate Groundwater Elevation (ft) ⁽²⁾⁽⁴⁾
	Northing	Easting			Topsoil	Fill	Peat	Clay & Silt	Silt & Sand		
CDM-101	1168678.72	1132316.15	428.0	40.0	0.0	0.2	6.0	8.0/31.5	18.7/34.5	4.0	424.0
CDM-102	1168674.24	1132299.30	427.5	40.0	0.0	0.2	N.O.	12.5/21.5	5.0/14.0/24.0	6.0	421.5
CDM-103	1168703.40	1132282.64	427.5	40.0	0.0	0.2	4.6	5.3/31.5	11.5	8.0	419.5
CDM-104	1168687.15	1132253.48	427.0	40.0	0.0	0.2	5.0	6.0	N.O.	4.0	423.0

Notes:

1. Northings and Eastings are in feet and reference the New York State Plane Coordinate System Central Zone, North American Datum of 1983 (NAD 83).
2. Elevations are referenced to the North American Vertical Datum of 1988 (NAVD 88).
3. Indicated depths are depths below ground surface at the time of drilling.
4. Groundwater levels were estimated from the moisture condition of the samples obtained at the time of drilling and may not represent stabilized groundwater levels.

Abbreviations:

N.O.: Not Observed
ft: Feet
No.: Number

Attachment A

Boring Logs



Boring Number: CDM-101

Client: City of Rome

Project Name: Water Resource Recovery Facility Improvements

Project Location: Rome, New York

Project Number: 276880

Drilling Contractor/Driller: CME Associates, Inc./Gary Richards

Surface Elevation (ft): 428.0

Drilling Method/Bore Hole Diameter: HSA/4 in.

Total Depth (ft): 40.0

Hammer Style/Weight/Drop Height/Spoon Size: Automatic/140 lb/30 in./2 in.

Depth to Initial Water Level (ft):

Bore Hole Location:

Depth	Date	Time
4.0	12/14/2023	15:19

N: 1168678.72

E: 1132316.15

Abandonment Method: Backfilled with soil cuttings.

Drilling Date: Start: 12/14/2023

End: 12/14/2023

Logged By: Hong Cai

Elev. (ft)	Depth (ft)	Sample Type	Sample Number	Sample Length (in)	Blows per 6 inches	Sample Recovery (in)	N-Value	Pocket Pen (tsf)	Torvane (tsf)	Graphic Log	Strata	Material Description	Remarks
428.0	0											Top 2": Dry, brown, TOPSOIL. Bottom 14": Dry, stiff, gray to dark gray, CLAY & SILT and fine to coarse SAND, little fine gravel (CL).	The groundwater level was estimated from the moisture condition of the samples obtained
		SS	S-1	24	2 3 6 4	16	9				FILL	Dry, medium stiff, brown to dark brown, SILT & CLAY, some fine to coarse Gravel, little fine to medium sand, trace wood (CL).	
		SS	S-2	24	4 4 4 4	8	8					Moist, stiff, dark brown, Clayey SILT, trace fine sand, trace wood (CL-ML).	
423.0	5	SS	S-3	24	5 7 7 4	4	14	3.5	0.35			Moist, medium stiff, brown, PEAT (Pt).	
		SS	S-4	24	4 3 2 3	16	5				PEAT	Moist, medium stiff, brown, SILT & CLAY, trace fine sand, trace roots (CL).	
418.0	10	SS	S-5	24	4 4 4 6	18	8	1	0.2			CLAY AND SILT	
		SS	S-6	24	6 8 9 15	24	17	2.5	0.4				

Sample Types		Consistency vs Blowcount/Foot				Burmister Classification	
AS - Auger/Grab Sample	HP - Hydro Punch	Granular (Sand):		Fine Grained (Clay):		and	50 - 35%
CS - California Sampler	SS - Split Spoon	V. Loose: 0-4	Dense: 30-50	V. Soft: <2	Stiff: 8-15	some	35 - 20%
NQ - 1.9" Rock Core	ST - Shelby Tube	Loose: 4-10	V. Dense: >50	Soft: 2-4	V. Stiff: 15-30	little	20 - 10%
NX - 2.2" Rock Core	WS - Wash Sample	M. Dense: 10-30		M. Stiff: 4-8	Hard: >30	trace	< 10%
	GP - Geoprobe					moisture, density, color	

Reviewed by: G. Dellinger

Date: 2/9/2024

Boring Number: CDM-101



Boring Number: CDM-101

Client: City of Rome

Project Name: Water Resource Recovery Facility Improvements

Project Location: Rome, New York

Project Number: 276880

Elev. (ft)	Depth (ft)	Sample Type	Sample Number	Sample Length (in)	Blows per 6 inches	Sample Recovery (in)	N-Value	Pocket Pen (tsf)	Torvane (tsf)	Graphic Log	Strata	Material Description	Remarks
413.0	15											Moist, very stiff, brown, SILT & CLAY (CL).	
											CLAY AND SILT	Top 6": Moist, olive gray, SILT & CLAY, trace fine sand (CL). Bottom 12": Moist, gray-brown, fine SAND and SILT (SM).	
		SS	S-7	24	5 9 13 22	18	22						
408.0	20												
		SS	S-8	24	6 8 9 21	18	17					Moist, medium dense, gray-brown, fine SAND and SILT (SM).	
403.0	25												
		SS	S-9	24	8 14 19 16	24	33					Moist, dense, gray-brown, SILT and fine SAND (ML).	
398.0	30												
		SS	S-10	24	11 13 21 27	24	34	1.75	0.25			CLAY AND SILT	Top 18": Moist to wet, hard, gray-brown, CLAY & SILT, little fine sand (CL). Bottom 6": Moist, brown-gray, SILT and fine SAND (ML).

Boring Number: CDM-101



Boring Number: CDM-101

Client: City of Rome

Project Name: Water Resource Recovery Facility Improvements

Project Location: Rome, New York

Project Number: 276880

Elev. (ft)	Depth (ft)	Sample Type	Sample Number	Sample Length (in)	Blows per 6 inches	Sample Recovery (in)	N-Value	Pocket Pen (tsf)	Torvane (tsf)	Graphic Log	Strata	Material Description	Remarks
393.0	35											Bottom 6": Moist, brown-gray, SILT and fine SAND (ML).	
		SS	S-11	24	3 9 13 17	24	22	0.75	0.15		SILT AND SAND	Moist to wet, medium dense, gray-brown, Clayey SILT, little fine sand (ML).	
388.0	40											Test boring terminated at 40.0 feet bgs.	
383.0	45												
378.0	50												



Boring Number: CDM-102

Client: City of Rome

Project Name: Water Resource Recovery Facility Improvements

Project Location: Rome, New York

Project Number: 276880

Drilling Contractor/Driller: CME Associates, Inc./Gary Richards

Surface Elevation (ft): 427.5

Drilling Method/Bore Hole Diameter: HSA/4 in.

Total Depth (ft): 40.0

Hammer Style/Weight/Drop Height/Spoon Size: Automatic/140 lb/30 in./2 in.

Depth to Initial Water Level (ft):

Bore Hole Location:

Depth	Date	Time
6.0	12/14/2023	12:20

N: 1168674.24

E: 1132299.30

Abandonment Method: Backfilled with soil cuttings.

Drilling Date: Start: 12/14/2023

End: 12/14/2023

Logged By: Hong Cai

Elev. (ft)	Depth (ft)	Sample Type	Sample Number	Sample Length (in)	Blows per 6 inches	Sample Recovery (in)	N-Value	Pocket Pen (tsf)	Torvane (tsf)	Graphic Log	Strata	Material Description	Remarks
0												Top 2": Dry, brown, TOPSOIL.	The groundwater level was estimated from the moisture condition of the samples obtained
		SS	S-1	24	1 5 5 7	14	10					Bottom 12": Dry, loose, gray, SILT, some fine to medium sand, some fine to coarse gravel (ML).	
		SS	S-2	24	7 7 8 7	19	15	0.5	0.1		FILL	Dry, medium dense, brown, Clayey SILT, trace fine sand (CL-ML).	
423.0												Top 8": Dry, brown, SILT & CLAY, trace fine gravel, trace fine to coarse sand, trace roots (CL-ML).	
	5	SS	S-3	24	4 2 2 2	16	4					Bottom 8": Dry, brown, SILT, some fine sand (ML).	
		SS	S-4	24	WOH WOH WOH 1	12	0	0.5	0.1		SILT AND SAND	Moist to wet, very loose, brown, SILT and fine SAND (ML).	
		SS	S-5	24	WOH 1 1 1	12	2	0.75	0.1			Moist to wet, very loose, brown, SILT and fine SAND (ML).	
418.0												Wet, loose, brown, SILT, some fine sand (ML).	
	10	SS	S-6	24	2 5 5 5	24	10	0.25	0.15				
												Top 12": Wet, very stiff, brown, SILT & CLAY, trace fine sand (CL-ML).	
413.0		SS	S-7	24	4 8 10 11	24	18				CLAY AND SILT	Bottom 12": Wet, olive gray, fine SAND, some silt (SM).	

Sample Types		Consistency vs Blowcount/Foot				Burmister Classification	
AS - Auger/Grab Sample	HP - Hydro Punch	Granular (Sand):		Fine Grained (Clay):		and	50 - 35%
CS - California Sampler	SS - Split Spoon	V. Loose: 0-4	Dense: 30-50	V. Soft: <2	Stiff: 8-15	some	35 - 20%
NQ - 1.9" Rock Core	ST - Shelby Tube	Loose: 4-10	V. Dense: >50	Soft: 2-4	V. Stiff: 15-30	little	20 - 10%
NX - 2.2" Rock Core	WS - Wash Sample	M. Dense: 10-30		M. Stiff: 4-8	Hard: >30	trace	< 10%
	GP - Geoprobe					moisture, density, color	

Reviewed by: G. Dellinger

Date: 2/9/2024

Boring Number: CDM-102



Boring Number: CDM-102

Client: City of Rome

Project Name: Water Resource Recovery Facility Improvements

Project Location: Rome, New York

Project Number: 276880

Elev. (ft)	Depth (ft)	Sample Type	Sample Number	Sample Length (in)	Blows per 6 inches	Sample Recovery (in)	N-Value	Pocket Pen (tsf)	Torvane (tsf)	Graphic Log	Strata	Material Description	Remarks
	15											Bottom 12": Wet, olive gray, fine SAND, some silt (SM).	
408.0	20	SS	S-8	24	6 7 7 10	24	14	3.75	0.45		SILT AND SAND	Moist to wet, grayish brown, fine SAND and SILT, trace fine gravel (SM).	
403.0	25	SS	S-9	24	8 12 18 32	24	30				CLAY AND SILT	Top 12": Moist, grayish brown, CLAY & SILT, little fine sand (CL).	
398.0	30	SS	S-10	24	14 18 31 35	24	49				SILT AND SAND	Bottom 12": Moist, grayish brown, SILT, some fine sand, (ML). Top 8": Moist, grayish brown, SILT, some fine sand (ML). Middle 8": Moist, grayish brown, Clayey SILT, trace fine sand (ML). Bottom 8": Moist, grayish brown, SILT and fine SAND (ML).	
393.0		SS	S-11	24	8 12 8 11	24	20	1.5	0.35			Moist, medium dense, grayish brown, Clayey SILT, little fine sand (ML).	



Boring Number: CDM-102

Client: City of Rome

Project Name: Water Resource Recovery Facility Improvements

Project Location: Rome, New York

Project Number: 276880

Elev. (ft)	Depth (ft)	Sample Type	Sample Number	Sample Length (in)	Blows per 6 inches	Sample Recovery (in)	N-Value	Pocket Pen (tsf)	Torvane (tsf)	Graphic Log	Strata	Material Description	Remarks
	35											Moist, medium dense, grayish brown, Clayey SILT, little fine sand (ML).	
388.0	40	SS	S-12	24	7 8 15 20	24	23	0.75	0.25		SILT AND SAND	Moist, medium dense, olive gray, Clayey SILT, little fine sand (ML).	
383.0	45											Test boring terminated at 40.0 feet bgs.	
378.0	50												
373.0													



Boring Number: CDM-103

Client: City of Rome

Project Name: Water Resource Recovery Facility Improvements

Project Location: Rome, New York

Project Number: 276880

Drilling Contractor/Driller: CME Associates, Inc./Beau Fletcher

Surface Elevation (ft): 427.5

Drilling Method/Bore Hole Diameter: HSA/4 in.

Total Depth (ft): 40.0

Hammer Style/Weight/Drop Height/Spoon Size: Automatic/140 lb/30 in./2 in.

Depth to Initial Water Level (ft):

Bore Hole Location:

Depth	Date	Time
8.0	12/13/2023	14:16

N: 1168703.40

E: 1132282.64

Abandonment Method: Backfilled with soil cuttings.

Drilling Date: Start: 12/13/2023

End: 12/13/2023

Logged By: Hong Cai

Elev. (ft)	Depth (ft)	Sample Type	Sample Number	Sample Length (in)	Blows per 6 inches	Sample Recovery (in)	N-Value	Pocket Pen (tsf)	Torvane (tsf)	Graphic Log	Strata	Material Description	Remarks
0												Top 2": Dry, brown, TOPSOIL.	The groundwater level was estimated from the moisture condition of the samples obtained
		SS	S-1	24	2 5 6 9	16	11					Bottom 14": Dry, medium dense, dark brown, SILT, some fine to medium sand, trace fine gravel (ML).	
		SS	S-2	24	5 8 12 12	18	20	1.5	0.15		FILL	Dry, very stiff, brown, SILT & CLAY, some fine sand, trace roots (CL-ML).	
423.0												Top 5": Dry, light brown, SILT, little fine sand, trace fine gravel (ML).	
	5	SS	S-3	24	11 5 5 6	15	10				PEAT	Middle 5": Dry, dark brown, PEAT (Pt).	
		SS	S-4	24	7 8 9 6	18	17	> 4.5	NA		CLAY AND SILT	Bottom 5": Dry, olive gray, CLAY & SILT, trace fine sand (CL). Dry, medium dense, brown, Clayey SILT, little fine sand (ML).	
418.0												Moist to wet, stiff, brown, SILT & CLAY, little fine sand (CL-ML).	
	10	SS	S-5	24	3 4 5 4	24	9	1.5	0.4				
413.0		SS	S-6	24	7 11 5 16	18	16	3	0.3		SILT AND SAND	Moist, medium dense, olive gray, fine SAND and SILT (SM).	

Sample Types	Consistency vs Blowcount/Foot	Burmister Classification
AS - Auger/Grab Sample CS - California Sampler NQ - 1.9" Rock Core NX - 2.2" Rock Core	Granular (Sand): V. Loose: 0-4 Loose: 4-10 M. Dense: 10-30	and 50 - 35% some 35 - 20% little 20 - 10% trace < 10% moisture, density, color
HP - Hydro Punch SS - Split Spoon ST - Shelby Tube WS - Wash Sample GP - Geoprobe	Dense: 30-50 V. Dense: >50	
	Fine Grained (Clay): V. Soft: <2 Soft: 2-4 M. Stiff: 4-8	
	Stiff: 8-15 V. Stiff: 15-30 Hard: >30	

Reviewed by: G. Dellinger

Date: 2/9/2024

Boring Number: CDM-103



Boring Number: CDM-103

Client: City of Rome

Project Name: Water Resource Recovery Facility Improvements

Project Location: Rome, New York

Project Number: 276880

Elev. (ft)	Depth (ft)	Sample Type	Sample Number	Sample Length (in)	Blows per 6 inches	Sample Recovery (in)	N-Value	Pocket Pen (tsf)	Torvane (tsf)	Graphic Log	Strata	Material Description	Remarks
	15											Moist, medium dense, olive gray, fine SAND and SILT (SM).	
408.0	20	SS	S-7	24	7 11 12 8	23	23	1.75	0.2			Moist, medium dense, olive gray, SILT and fine SAND (ML).	
403.0	25	SS	S-8	24	4 10 19 25	23	29	3.5	0.2		SILT AND SAND	Moist to wet, medium dense, olive gray, Clayey SILT, little fine sand (ML).	
398.0	30	SS	S-9	24	5 15 18 18	24	33					Top 12": Moist, olive gray, SILT and fine SAND (ML). Bottom 12": Moist to wet, olive gray, Clayey SILT, little fine sand (ML).	
393.0		SS	S-10	24	11 20 17 21	24	37	2.5	0.2		CLAY AND SILT	Moist to wet, hard, olive gray, CLAY & SILT, little fine sand (CL).	



Boring Number: CDM-103

Client: City of Rome

Project Name: Water Resource Recovery Facility Improvements

Project Location: Rome, New York

Project Number: 276880

Elev. (ft)	Depth (ft)	Sample Type	Sample Number	Sample Length (in)	Blows per 6 inches	Sample Recovery (in)	N-Value	Pocket Pen (tsf)	Torvane (tsf)	Graphic Log	Strata	Material Description	Remarks
	35											Moist to wet, hard, olive gray, CLAY & SILT, little fine sand (CL).	
388.0	40	SS	S-11	24	6 7 13 20	24	20	2	0.2		CLAY AND SILT	Moist, very stiff, olive gray, CLAY & SILT (CL).	
383.0	45											Test boring terminated at 40.0 feet bgs.	
378.0	50												
373.0													



Boring Number: CDM-104

Client: City of Rome

Project Name: Water Resource Recovery Facility Improvements

Project Location: Rome, New York

Project Number: 276880

Drilling Contractor/Driller: CME Associates, Inc./Beau Fletcher

Surface Elevation (ft): 427.0

Drilling Method/Bore Hole Diameter: HSA/4 in.

Total Depth (ft): 40.0

Hammer Style/Weight/Drop Height/Spoon Size: Automatic/140 lb/30 in./2 in.

Depth to Initial Water Level (ft):

Bore Hole Location:

Depth	Date	Time
4.0	12/13/2023	11:20

N: 1168687.15

E: 1132253.48

Abandonment Method: Backfilled with soil cuttings.

Drilling Date: Start: 12/13/2023

End: 12/13/2023

Logged By: Hong Cai

Elev. (ft)	Depth (ft)	Sample Type	Sample Number	Sample Length (in)	Blows per 6 inches	Sample Recovery (in)	N-Value	Pocket Pen (tsf)	Torvane (tsf)	Graphic Log	Strata	Material Description	Remarks
427.0	0	SS	S-1	24	2 4 7 10	18	11	1.5	NA	[Cross-hatched pattern]	FILL	Top 2": Dry, dark brown, TOPSOIL. Bottom 16": Dry, medium dense, brown, Clayey SILT, some fine to medium sand, little fine to coarse gravel (ML).	The groundwater level was estimated from the moisture condition of the samples obtained
		SS	S-2	24	12 8 8 8	18	16						
422.0	5	SS	S-3	24	3 3 3 5	16	6	NA	NA	[Wavy pattern]	PEAT	Top 8": Moist, brown, CLAY & SILT, trace fine sand (CL). Bottom 8": Moist, dark brown, PEAT (Pt).	
		SS	S-4	24	5 8 10 9	18	18	NA	NA				
		SS	S-5	24	3 3 7 10	24	10	2.5	0.5	[Vertical lines pattern]	CLAY AND SILT	Moist to wet, stiff, brown, SILT & CLAY, trace fine sand (CL).	
417.0	10												
		SS	S-6	24	6 12 11 10	24	23	2	0.4			Moist to wet, very stiff, olive gray, SILT & CLAY, trace fine sand (CL).	

Sample Types	Consistency vs Blowcount/Foot	Burmister Classification
AS - Auger/Grab Sample CS - California Sampler NQ - 1.9" Rock Core NX - 2.2" Rock Core	Granular (Sand): V. Loose: 0-4 Dense: 30-50 Loose: 4-10 V. Dense: >50 M. Dense: 10-30	and 50 - 35% some 35 - 20% little 20 - 10% trace < 10% moisture, density, color
HP - Hydro Punch SS - Split Spoon ST - Shelby Tube WS - Wash Sample GP - Geoprobe	Fine Grained (Clay): V. Soft: <2 Stiff: 8-15 Soft: 2-4 V. Stiff: 15-30 M. Stiff: 4-8 Hard: >30	

Reviewed by: G. Dellinger

Date: 2/9/2024

Boring Number: CDM-104



Boring Number: CDM-104

Client: City of Rome

Project Name: Water Resource Recovery Facility Improvements

Project Location: Rome, New York

Project Number: 276880

Elev. (ft)	Depth (ft)	Sample Type	Sample Number	Sample Length (in)	Blows per 6 inches	Sample Recovery (in)	N-Value	Pocket Pen (tsf)	Torvane (tsf)	Graphic Log	Strata	Material Description	Remarks
412.0	15											Moist to wet, very stiff, olive gray, SILT & CLAY, trace fine sand (CL).	
		SS	S-7	24	6 9 9 3	24	18	1.5	0.25			Moist to wet, very stiff, olive gray, SILT & CLAY, little fine sand (CL).	
407.0	20												
		SS	S-8	24	6 11 11 20	24	22	1.5	0.3		CLAY AND SILT	Moist to wet, very stiff, olive gray, SILT & CLAY, trace fine gravel, trace fine sand (CL).	
402.0	25												
		SS	S-9	24	10 15 20 22	24	35	1.5	NA			Wet, hard, olive gray, Silty CLAY, trace fine sand (CL).	
397.0	30												
		SS	S-10	24	5 5 7 10	24	12	3	0.4			Moist, stiff, olive gray, Silty CLAY (CL).	



Boring Number: CDM-104

Client: City of Rome

Project Name: Water Resource Recovery Facility Improvements

Project Location: Rome, New York

Project Number: 276880

Elev. (ft)	Depth (ft)	Sample Type	Sample Number	Sample Length (in)	Blows per 6 inches	Sample Recovery (in)	N-Value	Pocket Pen (tsf)	Torvane (tsf)	Graphic Log	Strata	Material Description	Remarks
392.0	35											Moist, stiff, olive gray, Silty CLAY (CL).	
		SS	S-11	24	8 11 15 27	24	26	3	0.25		CLAY AND SILT	Moist, very stiff, olive gray, CLAY & SILT, little fine sand (CL).	
387.0	40											Test boring terminated at 40.0 feet bgs.	
382.0	45												
377.0	50												

Attachment B

Geotechnical Laboratory Test Results



CDM Smith Geotechnical Laboratory Testing Summary Sheet

Client: City of Rome

Project Number: 21984-276880

Reviewed By: M. Polsky - Lab Manager

Project Water Pollution Control Facility –
Name: Main Pumping Station Improvements

Task: LT.GEO-Geotechnical

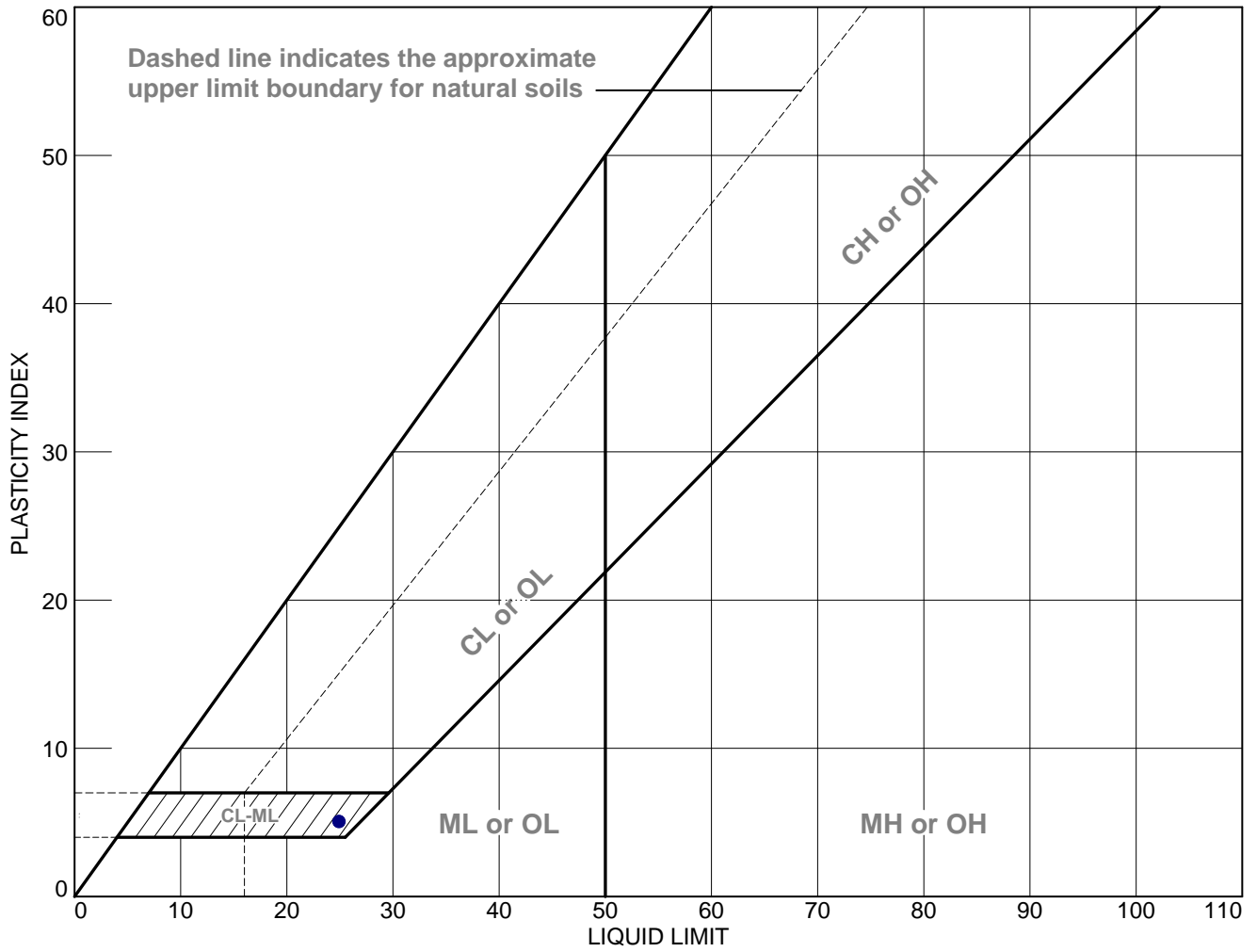
Assigned By: G. Dellinger

Date Reviewed: 1/12/2024

Project Location: Rome, NY

Sample Date	Boring Number	Sample	Depth (ft)	Identification Tests								Strength Tests			Soil Description		
				Water Content %	LL %	PL %	Gravel %	Sand %	Fines %	Org. %	Dry unit wt. pcf	σ_c psi	Failure Criteria (CIU)	$\sigma_1 - \sigma_3$ or τ psi		Strain %	
12/14/23	CDM-101	S-5	8-10	20.1	25	20											Brown silty clay
12/14/23	CDM-102	S-2	2-4	20.3			0.0	8.8	91.2								Brown interbedded silty and clay
12/14/23	CDM-102	S-6	10-12	23.0			0.0	20.2	79.8								Brown silt with sand
12/13/23	CDM-103	S-5	8-10	23.9	27	21											Gray-brown silty clay
12/13/23	CDM-104	S-2	2-4	14.5			14.5	10.3	75.2								Brown silt with gravel
12/13/23	CDM-104	S-5	8-10	23.7	30	21	0.0	3.0	97.0								Brown lean clay

LIQUID AND PLASTIC LIMITS TEST REPORT



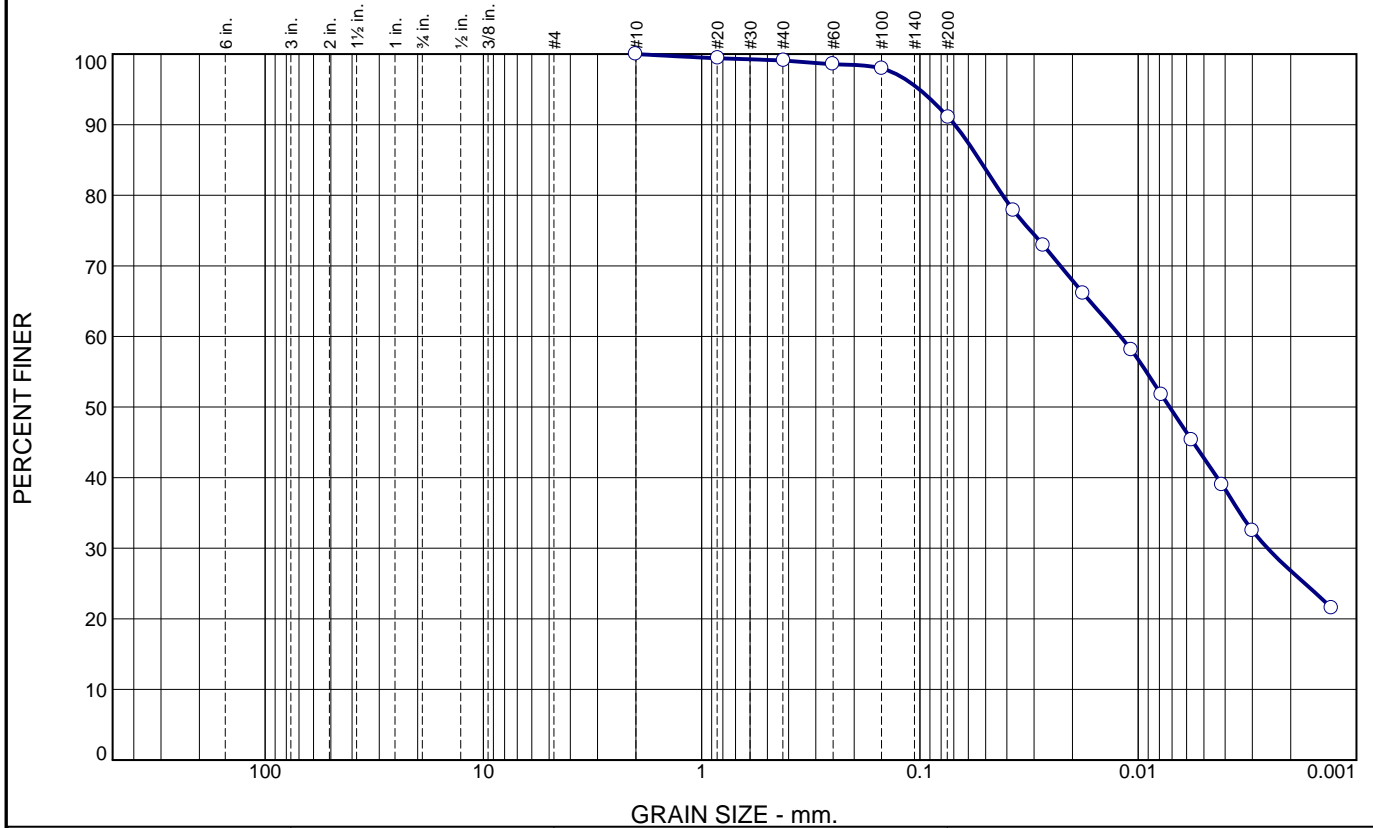
SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	CDM-101	S-5	8-10'	20.1	20	25	5	CL-ML

<p style="text-align: center; font-size: 1.2em;">CDM Smith</p> <p style="text-align: center; font-size: 1.2em;">Boston, Massachusetts</p>	<p>Client: City of Rome</p> <p>Project: WPCF-Main Pumping Station Improvements Rome, NY</p> <p>Project No.: 21984.276880</p>
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Tested By: MJP

Checked By: MBP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.9	7.9	64.4	26.8

SIEVE SIZE OR DIAMETER	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.4		
#40	99.1		
#60	98.6		
#100	97.9		
#200	91.0		
0.0372 mm.	77.9		
0.0272 mm.	72.9		
0.0179 mm.	66.1		
0.0108 mm.	58.1		
0.0078 mm.	51.8		
0.0057 mm.	45.3		
0.0041 mm.	39.0		
0.0030 mm.	32.5		
0.0013 mm.	21.5		

* (no specification provided)

Soil Description

Brown interbedded silty and clay

Atterberg Limits

PL= LL= PI=

Coefficients

D₉₀= 0.0692 D₈₅= 0.0533 D₆₀= 0.0120
D₅₀= 0.0072 D₃₀= 0.0026 D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= CL-ML AASHTO= A-4(3)

Remarks

As received moisture content = 20.3%

Source of Sample: CDM-102 Depth: 2-4'
Sample Number: S-2

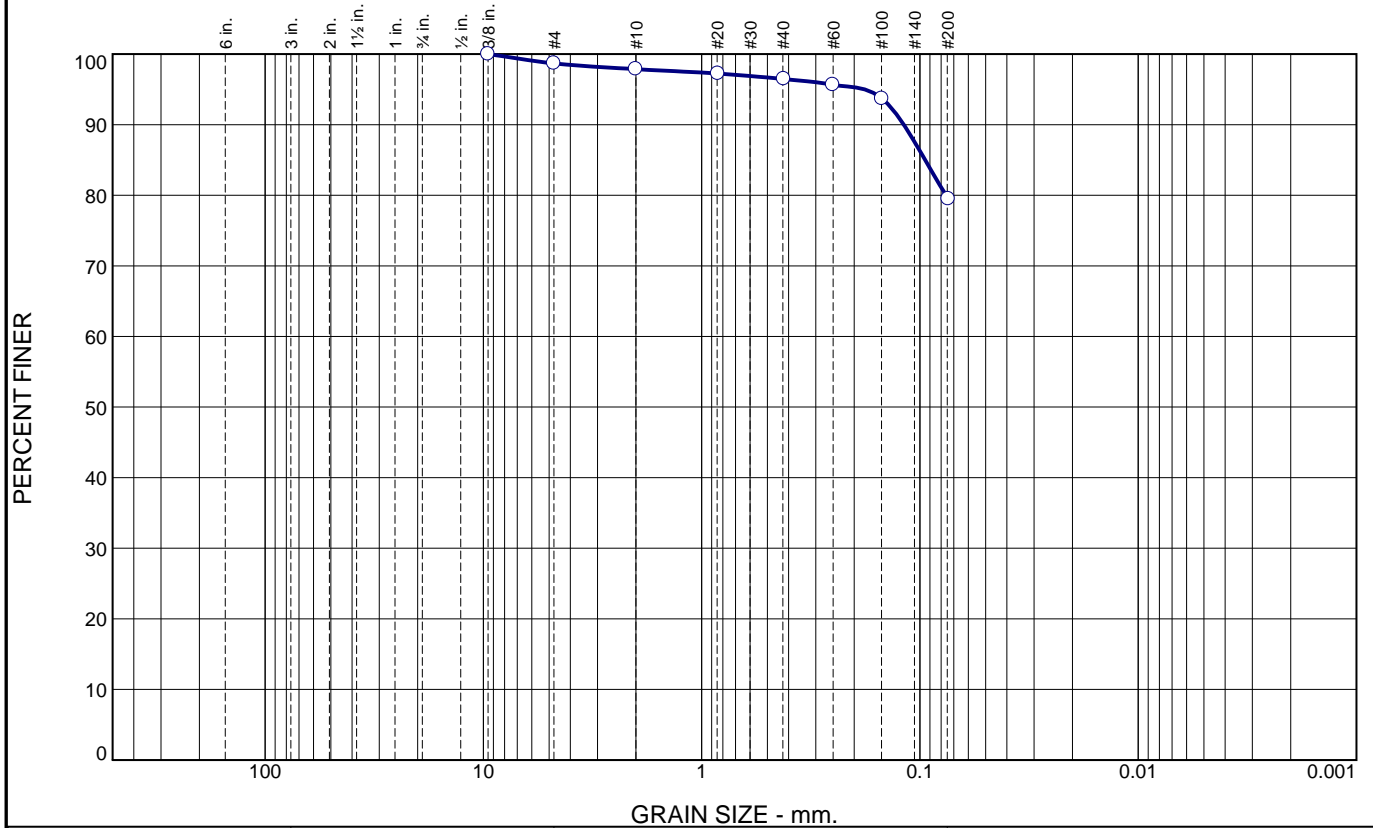
Date: 12/14/23

CDM Smith Boston, Massachusetts	Client: City of Rome Project: WPCF-Main Pumping Station Improvements Rome, NY Project No: 21984.276880
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Tested By: MFB/MJP

Checked By: MBP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.3	0.8	1.4	16.7	79.8	

SIEVE SIZE OR DIAMETER	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.375	100.0		
#4	98.7		
#10	97.9		
#20	97.2		
#40	96.5		
#60	95.7		
#100	93.7		
#200	79.5		

Soil Description

Brown silt with sand

Atterberg Limits

PL= LL= NP PI=

Coefficients

D₉₀= 0.1185 D₈₅= 0.0947 D₆₀=
D₅₀= D₃₀= D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Remarks

As Received Moisture Content = 23.0%

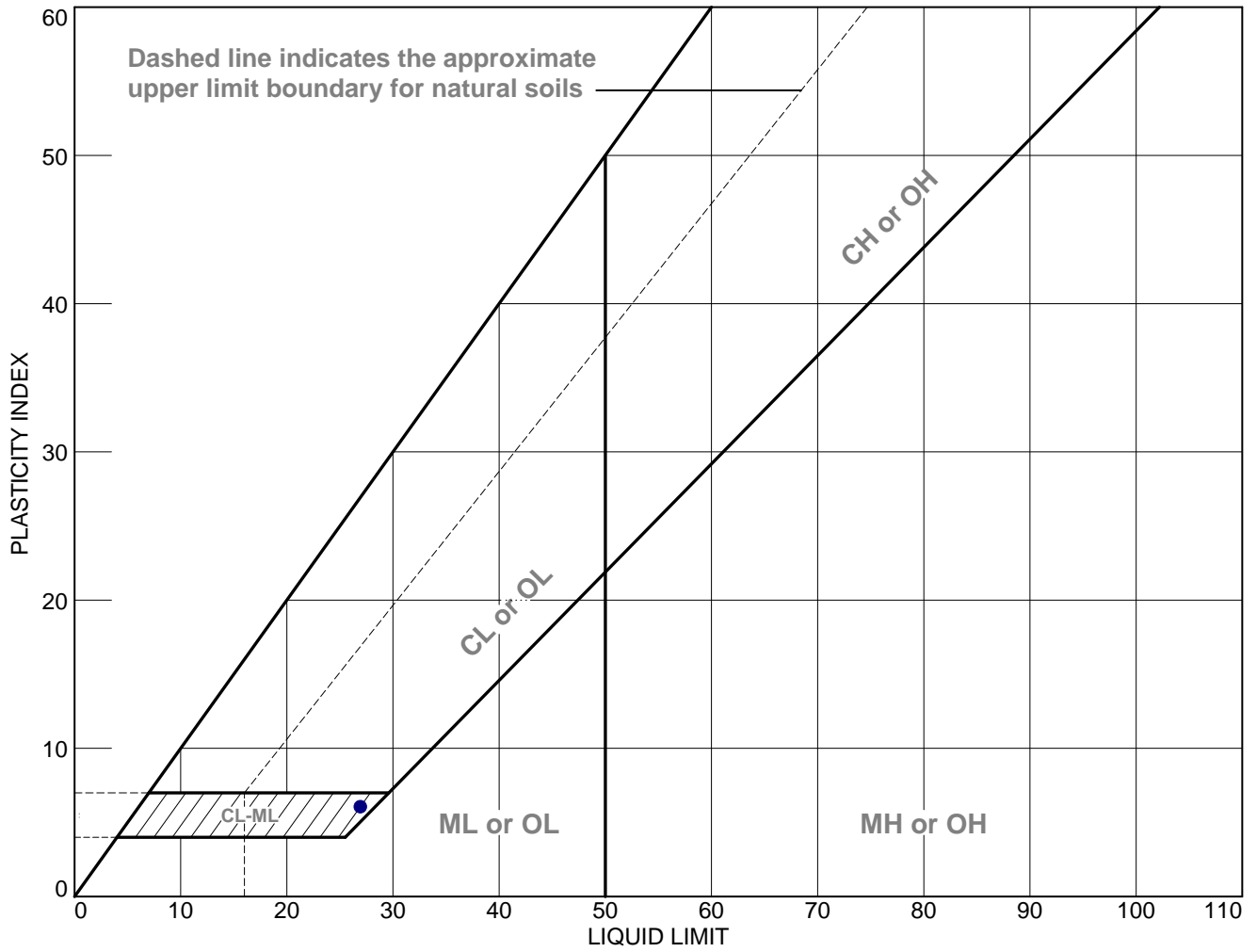
* (no specification provided)

Source of Sample: CDM-102 Depth: 10-12' Date: 12/14/23
Sample Number: S-6

<p>CDM Smith</p> <p>Boston, Massachusetts</p>	<p>Client: City of Rome</p> <p>Project: WPCF-Main Pumping Station Improvements Rome, NY</p> <p>Project No: 21984.276880</p>
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Tested By: MFB/MJP Checked By: MBP

LIQUID AND PLASTIC LIMITS TEST REPORT



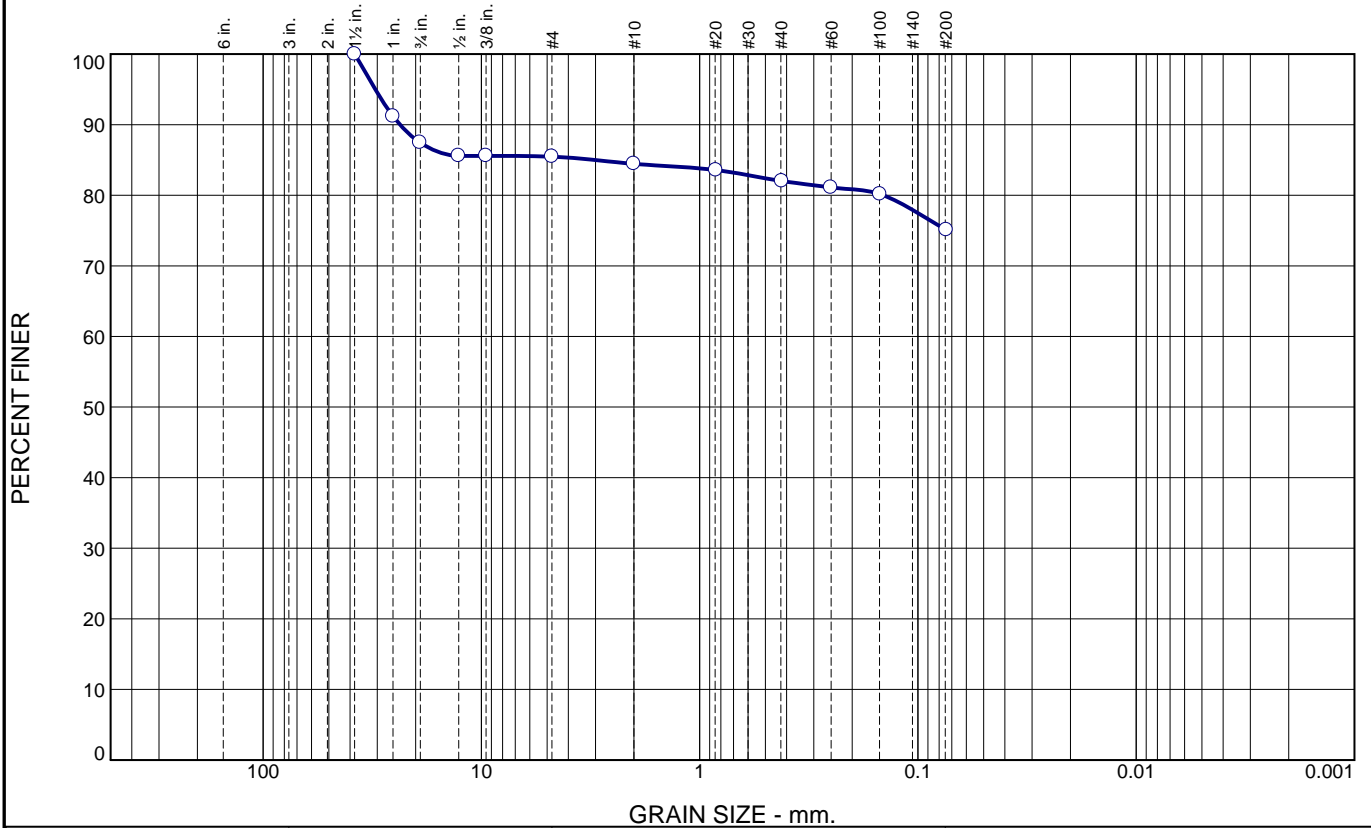
SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	CDM-103	S-5	8-10'	23.9	21	27	6	CL-ML

<p>CDM Smith</p> <p>Boston, Massachusetts</p>	<p>Client: City of Rome</p> <p>Project: WPCF-Main Pumping Station Improvements Rome, NY</p> <p>Project No.: 21984.276880</p>
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Tested By: MFB

Checked By: MBP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.6	1.9	1.0	2.5	6.8	75.2	

SIEVE SIZE OR DIAMETER	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	91.2		
.75	87.5		
0.5	85.6		
.375	85.6		
#4	85.5		
#10	84.5		
#20	83.6		
#40	82.0		
#60	81.1		
#100	80.2		
#200	75.1		

Soil Description

Brown silt with gravel

Atterberg Limits

PL= LL= NP PI=

Coefficients

D₉₀= 23.6209 D₈₅= 3.0223 D₆₀=

D₅₀= D₃₀= D₁₅=

D₁₀= C_u= C_c=

Classification

USCS= ML AASHTO= A-4(0)

Remarks

* (no specification provided)

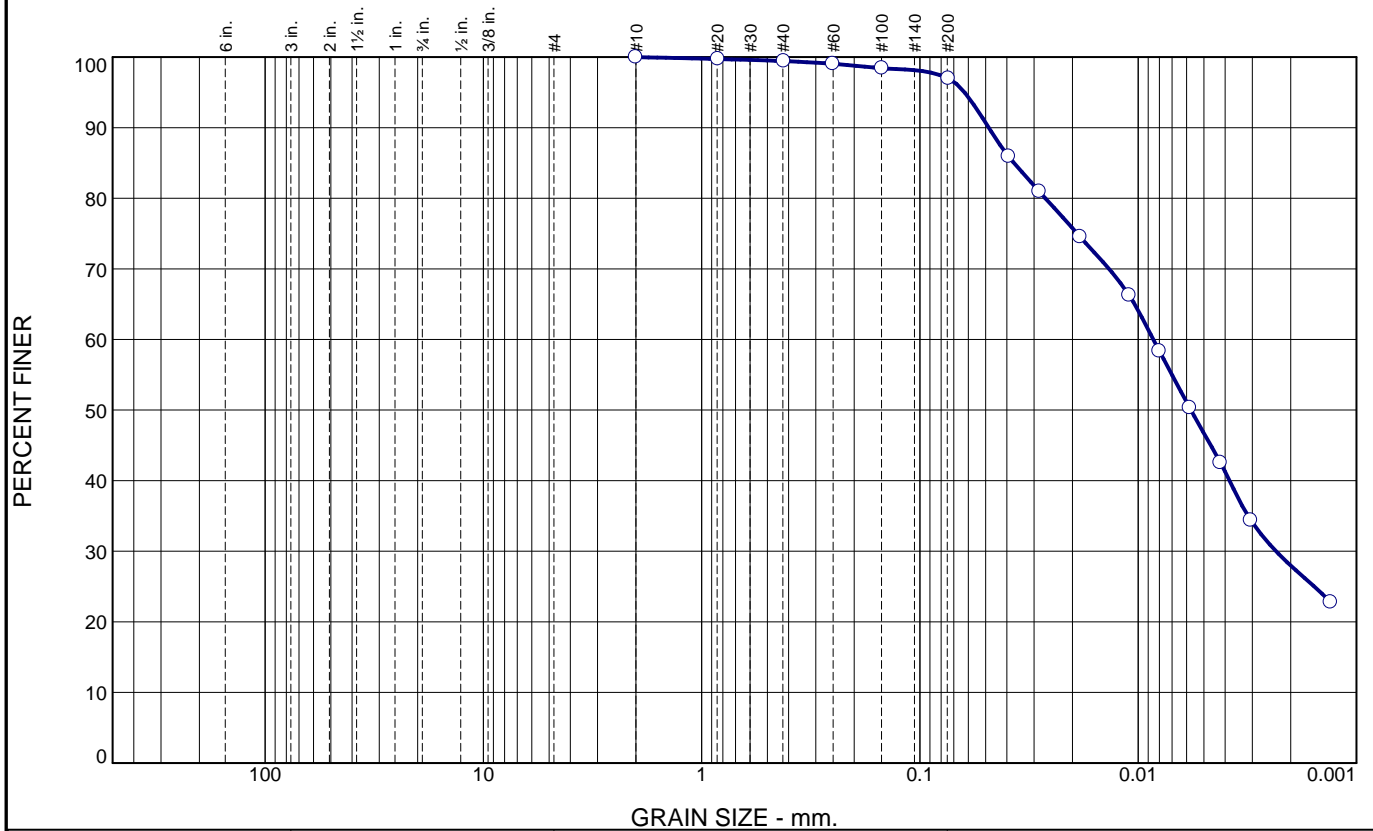
Source of Sample: CDM-104 Depth: 2-4'
 Sample Number: S-2

Date: 12/13/23

<p style="text-align: center; font-size: 1.2em;">CDM Smith</p> <p style="text-align: center; font-size: 1.2em;">Boston, Massachusetts</p>	<p>Client: City of Rome</p> <p>Project: WPCF-Main Pumping Station Improvements Rome, NY</p> <p>Project No: 21984.276880</p>
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Checked By: MBP

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.6	2.4	69.0	28.0

SIEVE SIZE OR DIAMETER	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.7		
#40	99.4		
#60	99.1		
#100	98.4		
#200	97.0		
0.0392 mm.	85.9		
0.0284 mm.	80.9		
0.0184 mm.	74.5		
0.0110 mm.	66.2		
0.0080 mm.	58.3		
0.0058 mm.	50.3		
0.0042 mm.	42.5		
0.0030 mm.	34.4		
0.0013 mm.	22.8		

* (no specification provided)

Soil Description

Brown lean clay

Atterberg Limits

PL= 21 LL= 30 PI= 9

Coefficients

D₉₀= 0.0484 D₈₅= 0.0371 D₆₀= 0.0085
D₅₀= 0.0057 D₃₀= 0.0023 D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= CL AASHTO= A-4(8)

Remarks

As received moisture content = 23.7%

Source of Sample: CDM-104
Sample Number: S-5

Depth: 8-10'

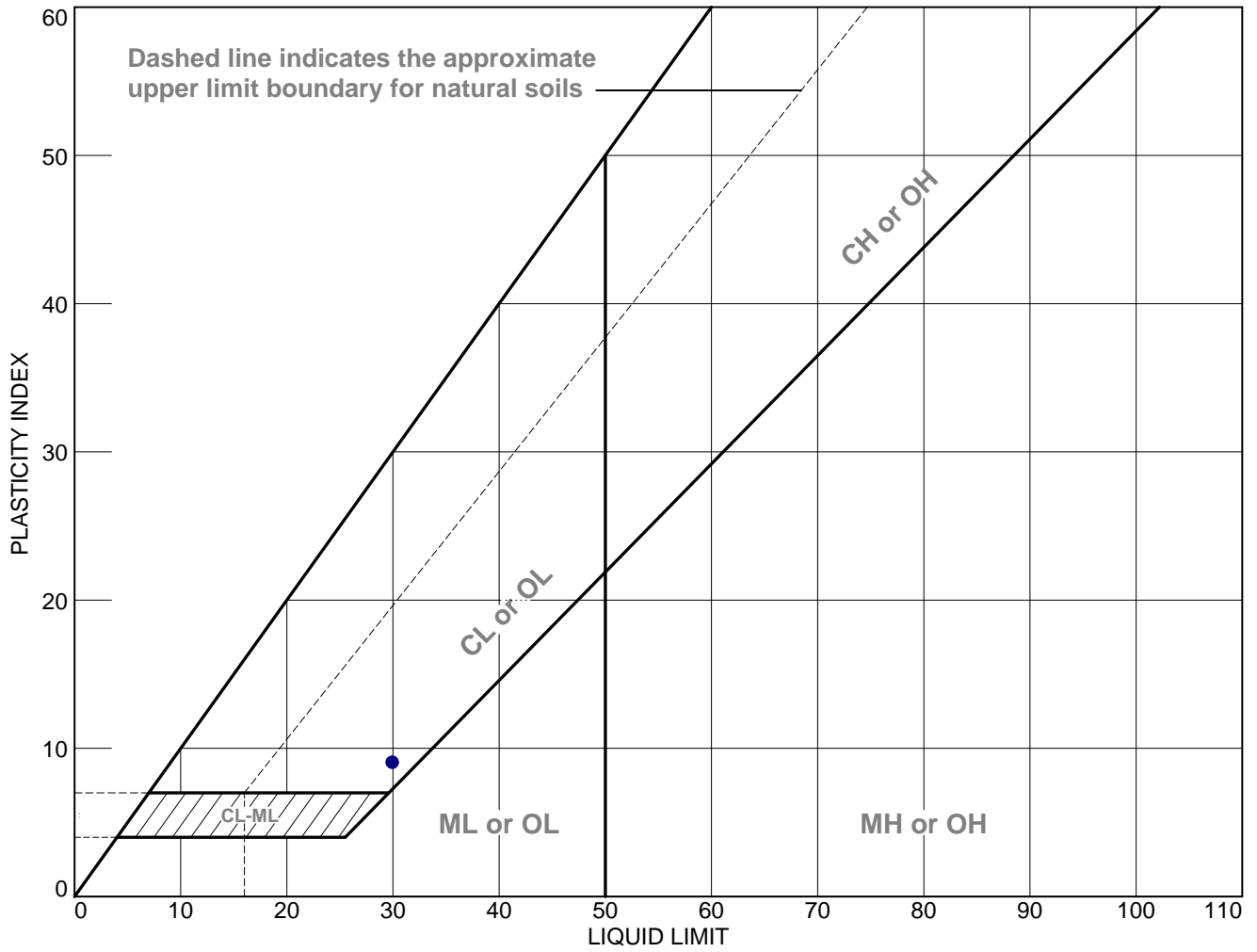
Date: 12/13/23

<p style="text-align: center; font-size: 1.2em;">CDM Smith</p> <p style="text-align: center; font-size: 1.2em;">Boston, Massachusetts</p>	<p>Client: City of Rome</p> <p>Project: WPCF-Main Pumping Station Improvements Rome, NY</p> <p>Project No: 21984.276880</p>
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Tested By: MFB/MJP

Checked By: MBP

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	CDM-104	S-5	8-10'	23.7	21	30	9	CL

<p>CDM Smith</p> <p>Boston, Massachusetts</p>	<p>Client: City of Rome</p> <p>Project: WPCF-Main Pumping Station Improvements Rome, NY</p> <p>Project No.: 21984.276880</p>
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Tested By: MFB

Checked By: MBP



Appendix B

AquaLogics Quote

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5 Dwight Park Drive
Syracuse, NY 13209
Phone: (315) 413-0400
Fax: (315) 413-0404

Proposal # Q1-24-123-B
October 23, 2024

CDM Smith
75 State Street, Suite 701
Boston, MA 02109

Attention: Eric J. Silverman, PE, PMP, CDT

Reference: City of Rome, Water Resource Recovery Facility Improvements

Applicable Sections: 406100 - Process Control and Enterprise Management System General Provisions
406121.20 - Process Control System Testing
406126 - Process Control System Training
406196 - Process Control Descriptions
406733 - Panel Wiring
406863 - Configuration of HMI Software
407000 - Instrumentation for Process Systems
407113 - Magnetic Flow Meters
407276 - Level Switches
407313 - Pressure and Differential Pressure Gauges
407326 - Gauge-Pressure Switches
407336 - Pressure and Differential Pressure Switches
407363 - Diaphragm Seals
408000 - Commissioning of Process Systems

AquaLogics Systems, Inc. is pleased to offer the following proposal for your consideration.

Existing Thickener Building SCADA Panel Modifications:

Qty.1- Lot material to be provided and installed by AquaLogics in the existing Thickener Building SCADA Panel.

- (1) Allen-Bradley 1756-IB16, 24VDC Discrete Input (DI) module, 16 point.
- (4) CITEL DLA-24D3 plug in analog I/O surge protectors.
- (26) Phoenix Contact 2794903, varistor type discrete I/O surge protectors.
- All required wire, terminal blocks, fuses and misc. control panel hardware.

Qty.1- Lot services associated with modifying the existing Thickener Building SCADA Panel.

- Twenty-four (24) hours drafting services to provide mechanical and electrical schematic drawings reflecting all modifications to the existing Thickener Building Control Panel. Services include all drawing revisions from submittals to “as installed” drawing sets.
- Forty (40) hours engineering services to modify the existing Thickener Building Control Panel PLC and OIU programming as required to integrate the following equipment as shown on the I-drawings. All

monitoring, control, trending, data logging, and alarming functions will be consistent with that of the existing system.

1. Waste Transfer Pump Control Panel (LCP-1010)
 - Pump No.1 Running
 - Pump No.1 Fault
 - Pump No.2 Running
 - Pump No.2 Fault
 2. PSH/PSL/PIT/PI-1032
 - High Level Alarm
 - Low Level Alarm
 - Level
 3. PCHV-1035
 - Open/Closed status
 - In Remote
 - Position Control/Command
 - Position Feedback
 4. FIT/FE-1032
 - Flow Instantaneous/Total
 5. Filtrate Pump Control Panel (LCP-1040)
 - Pump Running
 - Pump Fault
 - High Level
 - Low Level
 6. FIT/FE-XXX (Filtrate flow)
 - Flow Instantaneous/Total
- Sixteen (16) hours shop services to factory wire the discrete input module and ancillary devices in preparation for field installation within the existing Thickener Building Control Panel.
 - Ten (10) hours field services to install and wire the discrete input module and ancillary devices in the existing Thickener Building Control Panel.
 - Twelve (12) hours field services to load modified PLC and OIU programs, start-up and test all control panel modifications.

Instrumentation:

- Qty.2- Main Pump Station Magnetic Flow Meters (FIT/FE-XXX, FIT/FE-XXX); Rosemount 8750WD, 16” magnetic flow meter with 316LSS bulletnose electrodes, 316L SS grounding electrode, polyurethane liner, remote wall mount flow transmitter with Local Operator Interface (LOI) and display, two discrete channels (DI/DO), calibration certificate and 30’ transmitter to flow tube interconnecting cable.
- Qty.1- Filtrate Magnetic Flow Meter (FIT/FE-XXX); Rosemount 8750WD, 8” magnetic flow meter with 316LSS bulletnose electrodes, 316L SS grounding electrode, polyurethane liner, integrally mounted flow transmitter with Local Operator Interface (LOI) and display, two discrete channels (DI/DO) and calibration certificate.
- Qty.1- Waste Handling Magnetic Flow Meter (FIT/FE-1032); Rosemount 8750WD, 4” magnetic flow meter with 316LSS bulletnose electrodes, 316L SS grounding electrode, polyurethane liner, integrally mounted flow transmitter with Local Operator Interface (LOI) and display, two discrete channels (DI/DO) and calibration certificate.

Qty.1- Waste Handling Tank Level/Pressure Assembly; (1) Ashcroft 4.5” Duragauge pressure gauge (PI-1030), (2) Ashcroft B-series pressure switches (PSL-1030/PSH-1030) and (1) Rosemount 2051 pressure transmitter with local display (PIT-1030). Factory assembled/piped and filled to Ashcroft diaphragm seal with flushing connection.

SCADA Integration Services:

Qty.1- Lot SCADA Integration services to incorporate instrumentation and controls as shown on I-drawings.

- Thirty (30) hours engineering services to modify the existing SCADA System as required to integrate the following equipment as shown on the I-drawings. All monitoring, control, trending, data logging, reporting and alarming functions will be consistent with that of the existing system.

Waste Transfer Pump Control Panel (LCP-1010)

- Pump No.1 Running
- Pump No.1 Fault
- Pump No.2 Running
- Pump No.2 Fault

PSH/PSL/PIT/PI-1032

- High Level Alarm
- Low Level Alarm
- Level

PCHV-1035

- Open/Closed status
- In Remote
- Position Control/Command
- Position Feedback

FIT/FE/1032

- Flow Instantaneous/Total

Filtrate Pump Control Panel (LCP-1040)

- Pump Running
- Pump Fault
- High Level
- Low Level

FIT/FE-XXX (Filtrate flow)

- Flow Instantaneous/Total

Field Services:

Qty.16- Hours field service to provide instrumentation configuration, calibration and commissioning services for all provided instrumentation. A field service report will be provided, documenting all instrument configurations, calibration and testing results.

Qty.16- Hours field service to provide I/O testing of all data points as shown on the I-drawings and as listed above. Testing will be from field instrument to PLC, HMI and SCADA to ensure a fully operational system. A field service report will be provided, documenting all I/O testing results.

Qty.8- Hours field service to provide operator training to plant personnel. Training sessions will be provided hands-on, in the field utilizing the actual instrument, control panel and/or SCADA workstation in which training is being provided for.

Documentation:

Submittals will be provided electronically in PDF format and emailed to the engineer, owner and/or contractor as required. The submittal package will include the following:

- Table of contents.
- List of project personnel with contact information.
- Parts and labor warranty documentation.
- Scope of Supply indicated all products and services being proposed by AquaLogics.
- I/O list indicating quantity and type of I/O, programming related functions and design notes.
- Thickener Building Control Panel Drawings, existing control panel drawings edited to identify all project related panel modifications.
- Thickener Building Control Panel Bill of Materials (BOM), existing control panel BOM edited to identify all project related panel modifications.
- Instrumentation Bill of Materials. Itemizing all project related instrumentation being proposed by AquaLogics.
- Vendor Literature/Product Datasheets edited to clearly identify what is being proposed for each panel component and field instrument, part numbers, options, and accessories will be clearly marked to easily identify what is being proposed.

Operation & Maintenance Manuals will be provided electronically in PDF format and emailed to the engineer, owner and/or contractor as required. Three (3) hard copies will be provided in 3-ring binders, additional copies can be provided if needed. The O&M manuals will include the following:

- Table of contents.
- List of project personnel with contact information.
- Parts and labor warranty documentation.
- Scope of Supply indicated all products and services provided by AquaLogics.
- I/O list indicating quantity and type of I/O, programming related functions and “as installed” notes.
- Thickener Building Control Panel drawings, “as installed”.
- Thickener Building Control Panel Bill of Materials (BOM), “as installed”.
- Instrumentation Bill of Materials.
- Vendor Literature/Product Datasheets edited to reflect “as provided” panel components and instrumentation.
- Panel Component and Instrumentation O&M documentation as provided by the Original Equipment Manufacturer (OEM).

Pricing:

Existing Thickener Building SCADA Panel Modifications.....	\$14,000.00
Instrumentation.....	\$34,825.00
SCADA Integration Services.....	\$3,900.00
Field Services.....	\$5,200.00
Total Net Price.....	\$57,925.00

Taxes:

Sales or Use Taxes are not included.

Warranty:

All proposed equipment is warranted against system failure due to defects in workmanship and/or materials for a period of twelve (12) months from equipment start-up, not to exceed eighteen (18) months from date of shipment from our factory. This warranty does not cover failures due to human negligence and/or acts of nature.

Not Included:

Equipment installation, field wiring, conduits or piping unless specifically stated above.

Freight:

Prepaid and included to Rome, NY.

Delivery:

Submittals: 4-6 weeks after receipt of order.

Equipment: 12-16 weeks after drawing approvals.

Terms:

95% Net 30 days, 5% retainage allowed, not to exceed 90 days from shipment.

Thank you for the opportunity to provide you with our quotation. Should you have any questions or desire additional information please don't hesitate to contact our office.

Best regards,
AquaLogics Systems, Inc.

A handwritten signature in black ink that reads "Donald W. Ballway". The signature is written in a cursive style with a large, looping 'D' and 'W'.

Donald W. Ballway

